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Blue Economy Financing Solutions for the Fisheries and Aquaculture Sectors of Caribbean Island States

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Abstract: This study reviews various financing solutions available for fisheries and aquaculture development in Caribbean small island developing states (SIDS) and Barbados, Grenada, and St. Vincent and the Grenadines. Previously identified financing needs within the fisheries and aquaculture sectors have been matched with the most suitable financing mechanisms. However, the use of blue levies is recommended and applicable in almost every scenario, as they allow these sectors to drive their own development in financing research and conservation projects to their own benefit. The use of "blue tokens" with sufficiently low repayment coupons allows development projects to gather public support for fisheries, thereby increasing the likelihood of the project being successful through community buy-in. The possibility of natural capital being traded as public equities as "Natural Asset Companies" provides the opportunity for development projects to fund themselves. The review concludes that natural capital can be leveraged as the base through which public-private partnerships (PPPs) can facilitate optimal delivery of ecosystem services, benefit multiple stakeholders, and provide numerous development opportunities. An enabling environment for debt and lending with low-interest loan repayments is also applicable to almost every scenario, as it facilitates access to capital finance for infrastructure development and the acquisition of increasingly sustainable fishing equipment. Steps towards generating an enabling environment for financing fisheries and aquaculture in the Caribbean region are also discussed. The establishment of dedicated financing institutions, PPPs, and sufficient data reporting infrastructure for the fisheries and aquaculture industry are essential for driving development in these sectors. Likely, the largest limiting factor in financing Caribbean fisheries and aquaculture industries is a lack of awareness of the range of finance and financing mechanisms available to stakeholders, as well as an enabling environment for financing blue Economy sectors. This review is thus intended to aid financing institutions, Blue Economy developers, and specifically Caribbean fisheries and aquaculture stakeholders and Caribbean governments by raising awareness of the financing mechanisms available, encourage the incorporation of their use in the fisheries and aquaculture industries in the Caribbean, and encourage policymakers to create an enabling environment for financing development in these crucial sectors.

Keywords: Caribbean Blue Economy; fisheries and aquaculture; natural assets; SIDS financing; sustainable finance

Key Contribution: Review and matching of the most suitable finance and financing solutions to previously identified development needs for the fisheries and aquaculture sectors of Caribbean Island States. Their associated implementation and necessary structures for incentivizing their use through an enabling environment are also discussed.

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1. Introduction

In recovering from the restrictions placed on countries due to the COVID-19 pandemic, the development of the Blue Economy, and by extension, fisheries and aquaculture, has been heralded as an option for the greatest sustainable development [1]. The rise of the

Blue Economy is seen as an avenue through which countries can coordinate and develop their aquatic resources for sustainable economic, environmental, and social development, especially small island developing states (SIDS) such as those in the Caribbean [1] and in particular Barbados, St. Vincent and the Grenadines, and Grenada.

Currently, fisheries in Barbados, Grenada, and St. Vincent and the Grenadines land approximately 6000 tonnes of fish per annum and are not able to satisfy local consumption needs [2]. Fish imports have increased over the last decade due to high demand, with fish consumption at a high international level in Barbados (around 40 kg/capita/year) and mid-level in Grenada and St. Vincent and the Grenadines (27 and 20 kg/capita/year respectively; Ref. [2]). Population forecasts show a slight increase in the population of these 3 countries by 2030 and then a decrease to reach their 2015 levels [2]. This indicates that the pressure on fish resources as a result of demand is not likely to increase. Moreover, the economic and social importance of aquaculture and inland fisheries is currently low in these countries [3]. Marine capture fisheries are of greater importance as they employ a significant fraction of each country's labour force (23,500 people in total), which generates significant national revenue [4]. However, the failure to integrate fishery data into economic value (especially from artisanal, subsistence and small-boat fishing) [3] risks a potential underestimation of the contribution these fisheries sub-sectors have in contributing to the national Blue Economy.

Coastal and marine habitats provide multiple important ecosystem services which contribute to the Blue Economy sectors in the three countries [5]. In terms of fisheries and aquaculture in the Caribbean region, marine and coastal habitats (namely mangroves, seagrass beds and coral reefs) provide noteworthy functions to capture fisheries, specifically as breeding grounds, nurseries and feeding grounds that contribute to productivity. Activities or phenomena that degrade or reduce these habitats (i.e., a reduction in either area or health) will likely diminish the provisioning of these services, as a healthy environment underpins the economic activities dependent on it [5]. Moreover, a single ecosystem concurrently contributes to several ecosystem services [5], emphasising the potential significance of these systems to a country's well-being and national Blue Economy development. The economic price of replacing these ecosystem functions and services when a degraded ecosystem can no longer deliver them will be extremely high [4]. A rough estimate of the total contribution of mangroves, coral reefs and seagrass beds is USD 800 million annually for all three of the countries [6]. Moreover, the natural capital (living natural resources such as plants, animals, and ecosystems) in Grenada, Barbados, and St. Vincent and the Grenadines is being depleted, owing to anthropogenic drivers, specifically coastal development, overfishing, introduction of invasive species, pollution, and the impacts of climate change [3,7–9].

Currently, there is insufficient infrastructure in place for the economic-value development of the fishery sector, nor for the expansion of the aquaculture sector, particularly where sector-specific policies are not aligned to the Blue Economy concept nor integrated into national or regional development planning [4]. The Blue Economy in the three case-study countries is still in the early stages of development [4]. Despite the significant natural resources of Barbados, Grenada, and St. Vincent and the Grenadines, as well as the opportunity to implement integrated Blue Economy approaches, the rate of adoption has been relatively slow. Currently, insufficient infrastructure is in place for the development of the fisheries and aquaculture sectors of Grenada, Barbados, and St. Vincent and the Grenadines [4]. However, the potential of these sectors is significant, but only if the appropriate development investments are made [4]. In addition, the current regulatory and policy environment is also inadequate for attracting investment and funding for the Blue Economy (and thus fisheries and aquaculture) [4].

Significant development funding, including official development funding (ODA) and other official flows (OOF), has been directed to the Caribbean region (Table 1; Ref. [10]). The Caribbean region receives an estimated 8.8% share of the total global ODA funding (Table 5 p. 20 in [11]). However, Grenada, St. Vincent and the Grenadines have received relatively small amounts of development assistance compared to other countries in the

Caribbean (Table 1). There is no recorded data available for development finance allocated to Barbados after 2010 [10]. Since receiving development funding support, neither Barbados, Grenada, nor SVG have developed stable, productive national economies nor sustainable local societies. This may be due to the comparatively limited funding received by these countries, which highlights an opportunity for significant national development through increased funding support in these countries. There is no pattern in this data (Table 1) to suggest that the amount of ODA funding is likely to increase significantly going forward, further highlighting the need for innovative financing mechanisms to be developed in these countries. In implementing such mechanisms, these countries could generate development finance themselves and reduce their reliance on ODA funding support for national development goals. The development of the Blue Economy of Grenada, Barbados, and St. Vincent and the Grenadines could generate the synergies needed to facilitate long-term finance [4].

Table 1. Total official flows (sum of ODA and other official flows) to Caribbean states from 2016 to 2022 (represented in millions of USD, from [10]).

Country	2016	2017	2018	2019	2020	2021	2022
Grenada	6.41	1.09	0.65	1.65	3.42	3.30	2.26
St. Vincent and the Grenadines (SVG)	2.99	4.30	0.63	10.92	3.75	5.91	9.12
Montserrat	44.13	41.76	39.04	36.36	47.19	37.37	42.74
Haiti	744.43	712.668	635.033	463.29	483.40	434.89	450.21
Caribbean (total)	367.91	1254.48	1221.13	748.764	984.413	1292.16	1104.86

The aquaculture and fisheries sectors of Barbados, St. Vincent and the Grenadines (SVG), and Grenada are currently underdeveloped yet have the potential to contribute to each country's Blue Economy once commercially viable [3,4]. The financing needs for Caribbean fisheries and aquaculture sectors have recently been identified by March et al. [4], contextualising the challenges and opportunities in the sector. This paper continues to build on the work of March et al. [4] by discussing solutions and options for public and private financing for aquaculture and fisheries development in Barbados, Grenada, and St. Vincent and the Grenadines (as part of the 'SDG Joint Fund Programme: Harnessing Blue Economy Finance for SIDS Recovery and Sustainable Development' consultancy) as this has not yet been conducted in the available literature, such that the "right investments can be made". The paper also discusses steps towards generating an enabling environment for blue financing in the Caribbean. While the paper focuses on Barbados, St. Vincent and the Grenadines (SVG), and Grenada, its content is not limited to these countries and may be applicable to SIDS in the greater Caribbean region as a whole. This review is intended to aid financing institutions, Blue Economy developers, and specifically Caribbean fisheries and aquaculture stakeholders, governments, and decision-makers.

2. Approach

This review supplements and directly builds upon this previous research [4], which contextualised the fisheries and aquaculture sectors of Grenada, Barbados, and St. Vincent and the Grenadines. Together, the current work and March et al. [4] constitute the findings of the 'SDG Joint Fund Programme: Harnessing Blue Economy Finance for SIDS Recovery and Sustainable Development' consultancy. This manuscript's content is based on a literature review of relevant documents relating to the financing of fisheries and aquaculture sectors, as well as stakeholder engagement and consultation through workshop events. The consultation process involved correspondence and meetings with parties with vested interests at a national level, comprising state and various sector representatives at the industrial, semi-industrial, and small-scale levels, who are able to implement blue financing strategy and identify gaps and needs in the current system (under the 'SDG Joint Fund Programme: Harnessing Blue Economy Finance for SIDS Recovery and Sustainable Development'). The

consultation was necessary for the identification of projects that would be suitable for blue financing solutions and was conducted from October 2022 to December 2022. A series of regional workshops were also hosted during this period and included the countries of Barbados, St. Vincent and the Grenadines, and Grenada, as well as regional development organisations, specifically the United Nations Environment Programme (UNEP), United Nations Development Program (UNDP), and the Fisheries and Aquaculture Organisation (FAO). Participants varied over the course of the workshop series. However, workshops consisted of a minimum of 20 different stakeholders per workshop. In-person workshops were run over the course of a workday and involved presentations and Q&A sessions concerning prepared questionnaires that were developed for different stakeholder groups (as above).

March et al. [4] identified financing needs for the fisheries and aquaculture sectors of these countries, highlighting the development needs of the national aquaculture and fisheries sectors, the lack of adequate policy and regulatory frameworks for the sectors as well as the structuring of the respective national blue economies, and highlights the specific opportunities for the development of the fisheries and aquaculture sectors of these countries. The authors state that dedicated blue financing funds and mechanisms are needed for the development of the currently immature aquaculture sector [4], which can be applied to the fisheries sector as well. The authors identify the need for an enabling environment for such development and the necessity of contextual analysis to develop tailored financing options and solutions for the fisheries and aquaculture development within each respective country's context [4]. The content of this manuscript is in direct response to the needs and opportunities identified by March et al. [4] by proposing the "how" of mobilising finance for facilitating the development of the fisheries and aquaculture industries in Grenada, Barbados, and St. Vincent and the Grenadines.

Section 3 reviews proposed financing solutions (specifically) available for the common development needs and priorities for fisheries and aquaculture development (as identified in [4]). The proposed range of financing solutions (non-exhaustive) was synthesised from the author's own experience in developing national Blue Economy strategies and from the advisory documents for other island nations (such as Madagascar in [12] and Seychelles Blue Economy Action Plan, in [13], Africa Blue Economy Strategy, in [14], among others). Non-return-seeking finance solutions (like public finance) have been omitted from this review as they are unlikely to incentivise investment by not providing any benefits for potential investors who engage with them. Mutual benefits (i.e., benefits for both/multiple parties involved) form the basis of the mechanisms discussed herein. Furthermore, given that investor returns are fiscally based, fisheries and aquaculture development are generally assumed to be reflected by changes in industry/sector productivity (which is easily quantifiable as catch/production data) as a result of improved ecosystem health. However, industry development may also include other indicators, such as increases in job creation or in the nutritional quality of fish products. The financing solutions are summarised in Table A1: Summary of various financing mechanisms for use in fisheries and aquaculture sectors of Caribbean states. (Appendix A), with their optimal use case being contextualised with the previously identified common financing needs among the case study countries in Table A2: Linking financing instruments with financing needs in the fisheries and aquaculture sectors in Barbados, Grenada, and St. Vincent and the Grenadines (Appendix A).

Section 4 discusses the development of an enabling financing environment for fisheries and aquaculture, the features of which are recommended to be developed in each of the case study countries. Section 5 concludes the paper, emphasising key take-aways in financing fisheries and aquaculture development in Grenada, Barbados, and St. Vincent and the Grenadines.

3. Finance vs. Financing Solutions

A framework that supports sustainable long-term financial support for fisheries and aquaculture development requires the distinction between finance and financing and the integration of the two in a clear, targeted manner.

Finance is the mobilisation of fiscal resources, but ("throwing money/currency at the problem") should not be viewed as a once-off solution to solve the challenges that face the fisheries and aquaculture industry. For finance to be invested in sustainable fishing practices, the goal/purpose of new and sustainable fishing techniques needs to be communicated to current and prospective fisheries stakeholders, as well as the legitimacy of sustainable management practices [15] to increase investor confidence and buy-in. The legitimacy of sustainable management practices and fishing methods can be communicated by providing evidence of widespread consensus (regional/global or among the scientific community) as to the practices used, a historical track record of mutual benefit (between investors and the industry), and the presentation of reliable data that represent the impact of the sustainable methods in question by reliable indicators in the relevant industry. Examples can include the amount of national public finance that is allocated to the development of the national fisheries and aquaculture sectors, ODA funding, and development project funding for fisheries and aquaculture projects [15]. Public authorities are encouraged to support the transition of current fishing mechanisms to more sustainable practices, as well as promote an environment which upholds and maintains the regulations and development of fisheries and aquaculture. Much of the funding that is available to support sustainable (fisheries and aquaculture) development is from grants for time-limited projects, which can inhibit the momentum of innovation [15]. A further potential disadvantage of short-term funding is that the experience and expertise built up in short-term project teams are not retained, and thus, the stakeholder relationships that build trust between government bodies and public sector officials at the termination of the project [15,16]. For these reasons, it is unlikely that finance alone will be able to incentivise consistent development in aquaculture and fisheries and identify the need for long-term financing structures and frameworks [15,16].

Financing includes the fiscal mechanisms or arrangements that facilitate returns on investment (whereas finance itself does not inherently seek any returns [15,16]. These include debt and equity instruments, insurance products, securities, derivatives, and others. These mechanisms encourage the maintenance and development of whatever initiatives they are invested in, which will consistently produce a return on investment, making them more suited for long-term sustainable development projects.

The consistent supply of seafood and the concurrent conservation of marine ecosystems will require financing from both public and private fisheries and aquaculture stakeholders. The conservation of natural ecosystems and exploitation of marine capital can be both revenue sources and costs, and they are in need of financing [15,16]. Capture fisheries and aquaculture (as well as other terrestrial-based industries) exert pressure/strain on marine ecosystems. The aim is thus to create financing mechanisms and frameworks that facilitate industry initiatives/operations to limit negative ecosystem impacts and promote environmental sustainability. The protection of ecosystems provides critical services (such as supplying safe nursery environments for juvenile fish) for the production of seafood for a country's people, even if conservation and maintenance costs are likely to be greater than the revenue produced. This is particularly important for Caribbean countries as the region's economy is largely centred around tourism and ecotourism, which is reliant on inherent natural capital. Prioritising the funding and financing of natural assets of Barbados, Grenada, and St. Vincent and the Grenadines not only benefits the fisheries and aquaculture sectors but also synergises with the tourism sector and the development thereof.

3.1. Fiscal Policy for Fisheries and Aquaculture Development

Fiscal policy covers state spending and the state's generation of revenues. State governments also have multiple sources of revenue: taxation, fees (from government authorisation documents like licences), state asset ownership, state-owned enterprises

(SOEs), and relations of debt and credit [17]. Budgetary governance is also classified as fiscal policy and deals with the administrative and institutional systems that control the fiscal flows of the state [18].

Table 2 summarises different financing structures that may be applicable to the development of Caribbean fisheries and aquaculture. These can be applied to the relevant environments and ecosystems that are aligned with the interests of aquaculture and fisheries development. State-owned enterprises with environmental objectives, state-mandated tourist fees and revenues generated, and leases and licences are all (directly or indirectly) part of environmental fiscal policies. However, different parts of public fiscal policy can be revenue generators and liabilities at different times and at different levels of the organisation. For example, state-owned enterprises with positive profits generate revenue for governments, but they can also be a liability due to their indebtedness. The specific application of fiscal policy thus requires an in-depth understanding of the relevant industry (fisheries and aquaculture) for optimal use as a development mechanism, including government support of lending activities that promote sustainable development or minimise environmental harm.

Table 2. Government financing structures that are applicable to the development of Caribbean fisheries and aquaculture.

Type of Arrangement	Description
Environmental taxes	An environmental tax is meant to target activities that cause environmental degradation or pollution, but this does not imply that the tax has a proven effect in terms of minimising environmentally degrading or polluting activities. Rather, the minimum definition of an environmental tax is that it increases the costs of pollution activities [19]. Nonetheless, the actual application of an environmental tax is likely to have the effect of incentivising some activities whilst disincentivizing others.
Leases, licences and fees	Whereas a tax is compulsory, a lease, licence or fee can be seen as a form of exchange between a public authority and a (legal) person, which grants the latter a certain right or privilege. Another difference between this category of public fiscal revenues and taxes is that these leases, licences and fees remain stable regardless of the incomes that the payer may generate as a result.
State-owned enterprises (SOEs)	SOEs are rarely thought of as part of fiscal policies. Nonetheless, they are and many of the types of companies that have historically been state-owned around the world have some clear environmental impacts. Public utilities companies such as water companies and energy companies quite explicitly have an environmental aspect since they usually have environmental quality or resource efficiency as key objectives. Other types of SOEs, like transportation companies, may increasingly incorporate environmental objectives. SOEs can be run with a focus on generating profits, but they can also seek to strategically increase public goods and services through their operations. SOEs can be a source of revenue when they generate profits while their inventory and equipment can be seen as capital goods. Meanwhile, SOEs can also hold liabilities in the form of debt.

Table 2. *Cont.*

Type of Arrangement	Description
Debt and lending	Debt can be an income for public entities as well as a cost and liability. Lending from development banks under national control, lending from sovereign wealth funds and debt in the form of deferred taxes (with potential interest added) are examples of the state as creditor and debt as a source of public incomes. By contrast, sovereign debt is a continuous source of public expenditures. Lending practices, both when the state is the creditor and debtor, can be explicitly targeted towards the objectives of sustainable aquaculture and fisheries development. (see Section 3.3)
Public finance support (government subsidies)	Public finance such as grant funding or philanthropic contributions (while not directly a financing mechanism as previously defined) can be used as a financing mechanism to garner private investment. This can be performed in the form of government subsidies, where public finance is directed towards development mechanisms or initiatives that also require further private funding to be implemented. The total cost of the fiscal contribution from the private sector is lowered, thus incentivising private investment in an industry (fisheries and aquaculture). This mechanism can thus facilitate affordability of industry (aquaculture and fisheries) development for the private sector.

Blue Levies and Stakeholder Taxation

Several countries impose levies that are targeted at environmental protection, usually in the form of environment or tourism enhancement levies. Similarly, this kind of mechanism can be used to enhance the fisheries and aquaculture industries in various ways, such as environmental protection, MPA management, and infrastructure development. These levies are usually applied in different ways, at different rates and at different levels of organisation, like on importation, consumption, accommodation, service, or travel. For example, the British Virgin Islands (a known SIDS country) imposed an Environmental and Tourism Levy of US$10 to be paid on arrival at all ports of entry [15]. The tourism, hospitality, cruise and charter, extraction, and ports and ship-building industries could be potential targets from which the proceeds of blue levies could be directed to support fisheries and aquaculture in Barbados, Grenada, St. Vincent and the Grenadines.

Environmental taxes (or levies) could be applied to organisations that rely on natural resources on which fisheries and aquaculture industries are reliant as well and are known to negatively affect those environments. However, the degree to which this occurred may not necessarily have been quantified [20]. The fisheries industry is known to pollute the marine environment, such as due to the use of old and outdated equipment that breaks and is lost at sea [21–23] and thus should not be exempt from this kind of tax (they could also be taxed for unacceptable bycatch of non-targeted species). The proceeds from these taxes could then be used to reverse the degradation and further improve the environment or intensify the ecosystem service these areas provide to fisheries [20]. Similarly, an organisation can be incentivised to proactively develop these environments of importance and, in exchange, receive specific tax exemptions, thereby fostering an enabling environment of coastal systems protection, which would ultimately benefit the fisheries and aquaculture sector. Potential industries that can be targeted are tourism, terrestrial agriculture, fisheries and aquaculture, and maritime transport. A regional environmental tax could be established to support fishing grounds shared by multiple states or multiple sectors, ensuring that no one country or industry is more negatively affected by another (similar to the idea of the "tragedy of the commons" with many actors depleting unregulated finite resources [24]). This would require transparency and control over the number of vessels from each country allowed to access such a particular fishing ground. Various mechanisms for managing and regulating shared resources have been discussed elsewhere [25].

Environmental taxes and fees were, on average, 1.19% of the Latin American and Caribbean (LAC region) GDP in 2019 [19]. This level was slightly lower for Barbados, which

only generated taxes equivalent to 0.81% of its GDP ([19]; numbers are not included for Grenada and St. Vincent and the Grenadines). Caribbean environmental taxes, as a share of GDP, were roughly equal to the entire LAC average and were greater than that of South America and below Central American and Mexican tax levels [19]. There is an opportunity for increased environmental taxes and fees in countries like Barbados for development revenue generation, where existing taxes and fees fall below regional averages or when the current taxes as a proportion of national GDP are generally limited (for example, less than 3% of national GDP).

3.2. Compensation Mechanisms for Natural Capital

Compensation can be classified as a type of fee payable for the renting of a resource or for degrading a natural asset or ecosystem (but this needs to be quantified). The design of compensation mechanisms can vary immensely. These mechanisms can be designed to directly benefit the environments that underpin extractive industries, such as capture fisheries and unsustainable aquaculture, particularly payment for ecosystem services (PES schemes) and biodiversity offsetting. By contrast, where compensation is linked to environmental outcomes, levies, fees, or licences are not necessarily linked to environmental outcomes, but their proceeds may still be directed to benefit fisheries and aquaculture (non-environmental benefits).

Payment for ecosystem services (PES) schemes are known by five characteristics [26]: "(1) a voluntary transaction where (2) a well-defined ecosystem service (ES, or a land-use likely to secure that service) (3) is being 'bought' by a (minimum one) ES buyer (4) from a (minimum one) ES provider (5) if and only if the ES provider secures ES provision (conditionality)." PES schemes thus entail the voluntary buying and selling of ecosystem services based on the seller protecting an ecosystem.

Although PES implementation mechanisms for marine sustainability have been limited in the Caribbean region, they can be designed to benefit the ecosystems that provide the underlying support for fisheries in the Caribbean region. Most historic PES schemes are drawn from the forestry industry and indicate that PES can work as a subsidy [27], encouraging resource users to implement environmentally sound practices [28]. This can take the form of fisheries stakeholders using fishing equipment that is less damaging to the environment (such as moving to trawling as opposed to dredging). Despite most PES programmes being thought of as a market-based approach, most programmes are based on compliance with government regulations [29]. However, these subsidy-PES programmes are only as good as the (government) authorities that implement them since PES requires enforcement of regulations. Subsidy-based PES schemes are potentially more difficult for cash-strapped governments to maintain.

Carbon sequestration, biodiversity protection, watershed protection and ecosystem beauty are central types of ecosystem services [26], and these benefit several industries beyond just aquaculture and fisheries (replenishing fish stocks and providing safe nursery grounds). Biodiversity offsetting, carbon and other nutrient trading credits, as well as listing natural environments or protected areas on the stock exchange, are other forms of PES that are able to finance the natural environments that support and underpin fisheries and aquaculture. Table 3 summarises a few examples of PES for marine environments that support fisheries and aquaculture (but more detailed information is presented in Trends [30]).

As an example, the CARIPES project (started in 2011) aims to facilitate the active participation of coastal fishermen in the conservation and sustainable use of available marine resources in Caribbean marine protected areas (MPAs). The project further aims to leverage the use of local fishermen's knowledge of the coastal and marine biodiversity within pre-established MPAs, facilitate resilience development among marine ecosystems towards global climate impacts, and develop appropriate PES schemes in the Caribbean through the use of such local knowledge. The project has been active in the islands of Grenada, St Eustatius, and Martinique and further endeavours to generate avenues for

the development of compensation mechanisms (payments for ecosystem services) while supporting fishers reaping the associated economic benefits of such protected areas. Such a project could be replicated on other islands of concern, such as Barbados and St. Vincent and the Grenadines.

Table 3. Examples of payment for ecosystem services for marine environments (based on Trends [30]).

PES Type	Elaboration	Examples
Regulated markets	Cap and trade markets require resource users to hold a purchasable right to the resource they use. It sets a limit to resource use and allocates a tradable share of the resource to an asset owner. A licence is not necessarily tradable and the issuer of a licence does not necessarily set a limit to damages to an ecosystem, but it still constitutes a transaction based on compliance.	Fishing can in different ways be governed through mechanisms that can reasonably be seen as PES. On the most simple level, recreational fishers are in some jurisdictions required to pay for fees or hold annually paid licences. Another example are individual transferable quotas (ITQs) that are used to allocate annual fishing rights within an exclusive economic zone (like quota's per fishing ground). ITQs can then be traded and leased amongst fishers. By using the regulated ITQ marketplace, a sustainable fishery and ecosystem services market can be achieved [31], through the trading of rights to exploit the fish provisioning service of an ecosystem within identified sustainable harvesting limits. The rights to a proportion of the total fish population (fishing quota) has to be identified beforehand and the total harvestable quota must be within the sustainable harvesting limits of the ecosystem, for this mechanism to be effective. Government mandated fees related to ecosystem services can likewise be seen as a form of PES based on compliance. This can for example be tourist fees associated with entering (marine) protected areas, that in this case are of importance to fisheries and aquaculture.
Voluntary transactions	Voluntary PES transactions can involve private and public sector actors alike. Governments, private individuals, NGOs and development organisations can all pay private actors to change practices or avoid harm to ecosystems.	The Marine Legacy Fund of Tanzania is an example of voluntary PES. It is a revolving fund whose original sources of revenue as well as its spending can be seen as forms of PES. It gains revenue from tourist fees, fossil fuel taxation and fishing licences. However, the fund uses this revenue to finance the protection of coastal habitats and important marine sectors. Whereas its sources of revenue are based on compliance, its spending can be seen as voluntary PES. This kind of structure can be applied to countries individually, or regionally, due to shared fish stocks (or other shared resource use).

Stakeholders (public or private) that make use of the same natural environments on which fisheries and aquaculture rely (eco-tourism, for example) can be mandated to contribute to its optimal natural functioning, maximising the ecosystem services they provide to the aquaculture and fisheries industries, which would also benefit other sectors such as the tourism industry.

3.2.1. Biodiversity Offsetting

Biodiversity offsetting is a form of compensation that is based on counterbalancing any lost biodiversity from a development project by investing in equivalent biodiversity somewhere else, thus aiming to maintain biodiversity despite economic development (or

environmentally harmful extraction processes). It is relevant to consider biodiversity offsetting here as it has previously been used to preserve marine biodiversity and wetlands [32]. The ideal application of biodiversity offsetting is the application of the "mitigation hierarchy" when considering the predicted negative biodiversity impacts of development initiatives [33,34]. If developers follow the mitigation hierarchy (avoidance—minimisation—restoration—offsets), they should try to avoid negative impacts in the first place, secondly consider the minimising of impacts, thereafter restoring any negative impacts stemming from the development, and finally using biodiversity offsets to compensate for the unavoidable biodiversity loss stemming from development projects [33]. Thus, biodiversity offsetting is only meant to counter biodiversity loss, which cannot be prevented [34].

In the case of other extractive industries, a portion of revenue earmarked for biodiversity offsetting could be invested into supporting the fishing grounds that a state or region relies on through examples such as investing in sustainable fishing programmes, the acquisition of sustainable fishing equipment, financing the prevention of illegal, unreported, and unregulated (IUU) fishing. The associated biodiversity loss that is found with dredging, trawling, or new aquaculture infrastructure developments can be offset by investing a portion of the proceeds into less damaging subsectors, such as domestic handline fisheries, sustenance fisheries or developing restocking programs that use the available nursery habitats already present on Barbados Grenada, or St. Vincent and the Grenadines (such as the development of mangroves and seagrasses). Furthermore, different levels of compensation can be mandated due to the perceived value of the affected (extracted or displaced) species or environment in question.

However, determining an equivalent unit of biodiversity is extremely difficult, relies on simplifying conventions, and includes several moments of uncertainty. One issue, for example, is whether to consider biological diversity at a species level or at a system level. In other words, is an equivalent sum of biodiversity required or is an equivalent ecosystem required? To even approximate the latter is certainly difficult, but even if offsetting is limited to a species level, another question that emerges is whether compensation should be of the exact same species or if another species of equal importance can be considered for compensation (for an in-depth analysis of difficulties pertaining to biodiversity finance, see [35]). For example, for every shark that is caught and succumbs to bycatch, should 50 individuals of its primary prey species be required as compensation for (restocked) or the protection of another shark? It is likely that biodiversity offsetting is further complicated by the extraction of mid-trophic level species, as the effects on trophic levels above and below it could destabilise a functioning ecosystem (in a multi-directional "trophic cascade", despite being defined as top-down interactions [36]), and potentially risk the collapse of an entire fisheries sub-sector. For this reason, it is advisable that ecosystems as functioning units be considered [37,38]: where two ecosystems are available as fishing grounds, one should be protected and demarcated as an MPA, whereas the other may be afforded less regulation. This would be considered a form of biodiversity offsetting if the productivity of each system were initially similar (this further emphasises the need for accurate and detailed ecosystem evaluation).

Accurate offsetting requires establishing baseline levels of biodiversity at the sites that provide offsets. A significant risk is that baselines may be set too low and thus give developers an unwarranted amount of credits. If an area is invested in due to offsetting (an MPA, for example), the response of the investment needs to be equitable to the initial biodiversity loss. This requires sufficient long-term data on that area to assess historical performance or attributes, and where this is not available, data would first have to be collected. This limits the potential number of sites for immediate biodiversity offsetting, as only sites with historical data would be able to provide accurate indications of developmental productivity (historical fisheries catch data may be particularly useful). However, cost-efficiency for environmental changes in biodiversity also changes [39]. Thus, these become economic issues and require funding and financing themselves. Given that the extent of habitats that provide key ecosystem services (such as mangroves) is low and

decreasing in Barbados, Grenada, and SVG [6,40–42], extensive monitoring is necessary to establish what the historical coverage of such a valuable habitat was. This enables an appropriate response elsewhere, like conserving and fostering the development of the coral reefs in areas where they are relatively underdeveloped (as in Barbados and Grenada).

The difficulties of appropriately managing a biodiversity offsetting programme imply that taxation and fees are better as a form of environmental compensation and compensation for a developer's renting of the ocean as a public resource. The fee could be applied as part of licensing programmes and could secure an appropriate minimum public revenue. One of the potential benefits of biodiversity offsetting is that funding from development projects becomes earmarked specifically for biodiversity purposes. The challenge for regular fees and taxation is to ensure the political will and administrative capacity to ensure an appropriate share of the public revenue is directed towards the improvement and protection of ecosystems that support fisheries and aquaculture.

3.2.2. Carbon and Other Nutrient Trading Credits

Coastal environments are likely to offer nutrient capture and sequestration services (such as blue carbon) in addition to the benefits they provide to fisheries and aquaculture [5]. These services can be capitalised upon and leveraged as pollutant offsets (on international and domestic markets) from which revenue can be generated to further support the protection, optimisation of services, and maintenance of the environments themselves or be directed towards development in other areas of fisheries and aquaculture.

Blue Carbon entails the use of coastal and marine ecosystems as vehicles for carbon capture and sequestration. Mangrove forests, salt marshes, algae, wetlands and even whales contribute to carbon storage in coastal and marine environments [43,44]. Blue carbon, thus, refers to processes where biological organisms permanently store carbon as long as the organism (tissues) remains intact and alive. Beyond this broad conceptualisation, blue carbon is usually used to refer to the active promotion of blue carbon processes in order to generate carbon credits through carbon sequestration for use in international climate commitments or carbon markets. Since the majority of carbon sequestration happens in coastal and marine areas, their applicability to SIDS states and their support for the sustainable development of SIDS states are considerable. Many of the ecosystems that promote blue carbon (such as mangroves) also provide other co-benefits like nursery/feeding grounds for fish and wave attenuation, which contribute to the reliance and longevity of infrastructure along SIDS' coastlines. While historically, there have not been many examples of development projects tapping into the nutrient credit markets in the Caribbean region, the conservation and development of the mangrove habitats on the islands of Barbados, Grenada, and St. Vincent and the Grenadines present an ideal opportunity to access nutrient trading markets (such as the carbon credit market) which can further finance the development of these key ecosystems, thereby stimulating the performance of the fisheries and aquaculture sectors.

Applicable to other nutrient offset projects, a central concern with any type of carbon mitigation programme is that it is inherently reliant on carbon accounting methodologies and frameworks [45], irrespective of whether these are used for national development contributions (NDCs), voluntary markets or compliance markets. Many blue carbon projects face data limitations (due to determining the appropriate and market-accepted measurement techniques of these ecosystems) and may limit the amount of attention and funding these projects are able to garner to either fund their own development or the industries the ecosystems underpin (fisheries and aquaculture). The implication is that priority is not inherently given to the carbon sequestration projects that lead to the optimal carbon outcomes, but rather that prospective investments may be preferentially directed to the projects where the extent of carbon capture and sequestration impact can most easily be traced and tracked, at the lowest costs.

The market uptake for carbon credits and carbon offsets has been somewhat limited, one reason being the high demand in compliance markets. Market conditions for carbon

credit prices have continuously been changing. The price of carbon in the EU emissions trading system (ETS) has been increasing since the end of November 2020, at around 22 Euros per tonne of carbon dioxide (CO_2). Prices peaked at around 96 Euros in February 2022 but fell later in the same year [46]. Whereas the carbon market fluctuates somewhat regularly, other nutrient credit markets may be more stable. Other elements, such as nitrogen, may be charged and capitalised on in a similar manner as carbon, thus potentially increasing the value of any one ecosystem. By harnessing the multiple ecosystem services it provides on trading markets, especially considering the effective bioremediation services that ecosystems like mangroves and seaweeds provide in reducing the negative effects associated with complex pollutants or fertiliser runoff (i.e., addressing multiple pollutants concurrently). However, given that nutrient offsetting (such as carbon offsetting) is still a nascent industry, a stable market price for specific nutrient offset credits would allow for the necessary confidence and risk assessment in employing this type of funding scheme for revenue generation, as well as increasing investor confidence.

Any type of blue carbon project is likely to involve either NDCs or the voluntary carbon market. Towards the end of 2021, carbon prices were rising on voluntary carbon offsetting markets, which several stakeholders expected to continue in 2022 [47]. Major companies are making net zero pledges and increasing their voluntary commitments to mitigating climate change privately. This opens up the possibility for the ecosystems of Caribbean countries to capitalise on the voluntary blue carbon market. An increase in the demand for blue carbon projects is thus expected. However, a concern has been the lack of quality, verified projects and carbon offsetting. The classification of an environment that provides such carbon removal and sequestration services (such as declaring a marine environment as an MPA) may increase the perceived reliability with which the offsetting can be expected to be available year on year (if that environment were involved in a carbon sequestration and offsetting programme). Such protected status further facilitates buyer confidence that the service will be improved upon in future and that nutrient credits may become cheaper in the future (similar to developing more sophisticated computer product offerings year on year). Declaring where proceeds are re-invested in a transparent manner may further encourage buy-in from offset buyers through contributions to development in other areas, such as NDCs or fisheries and aquaculture development. In addition, this may incentivise continued participation of stakeholders from such industries in blue carbon projects, as it would benefit their own sector as well (i.e., added benefits to carbon offset investing or investing in blue carbon development projects if the habitat in question also provides benefits such as fisheries stimulation). However, voluntary offsetting is an additional expense relative to the operations of the companies buying the offsetting, which limits their incentive to invest—if faced with an economic slump (or the risk of one), there is a chance that companies will discontinue their voluntary offsetting arrangement or switch to cheaper, lower quality credits.

When considering nutrient offsets (like blue carbon), it is essential that existing local practices and livelihoods (social development) are taken into account. Research on carbon projects shows that local community involvement facilitates project success, as compared to if it were not present [48]. This includes free, prior and informed consent (FPIC), but successful project implementation cannot be limited to a formal exercise of securing FPIC. It needs broad support from a community that can see themselves in the project, as well as the potential for livelihood development. For example, blue carbon projects that seek to preserve seagrasses may collaborate with fishers that usually pass through marine areas with seagrasses. Collaboration with local fishermen and women could be more cost-effective and provide additional income streams if integrated into a seagrass monitoring scheme.

3.2.3. Natural Capital as Publicly Traded Equities

The Intrinsic Exchange Group (IEG) has collaborated with the New York Stock Exchange (NYSE) to create a new asset class: Natural Asset Companies (NACs). The purpose of such NACs is to maximise the performance or delivery of the natural asset they are

associated with, either through ecosystem services provisioning, the use of the asset for restorative or regenerative agriculture (including aquaculture), or hybrid cases. NACs have the explicit mandate to actively manage, maintain, restore and grow the value of the natural capital they are associated with. A NAC may also use payment-for-ecosystem services mechanisms such as producing carbon credits, other nutrient credits, and biodiversity credits (i.e., verified ecosystem services delivery) in which the NAC, as a company, trades. The NAC itself is listed on the stock markets and, based on its performance, may attract investment support.

Prospective NACs are evaluated by the IEG and then listed for trading on world platforms, enabling the conversion of natural assets (such as publicly owned land) into revenue. This process has the potential to facilitate environmental, social, and industrial benefits at scale, contributing towards a shift to a more sustainable and circular economy [49]. One such example is in Costa Rica, where IEG is collaborating with the local government to explore the creation of a NAC to value and finance conservation and social priorities and meet national and global commitments (e.g., High Ambition Coalition 30 × 30 goal). The coral reefs that support the livelihoods of many locals in Barbados, Grenada, and particularly St. Vincent and the Grenadines (having the largest expanse of coral reefs among the three) can be registered under public-private NACs (between governments and the national population) to generate revenue for the development and conservation of these valuable ecosystems from the stock markets.

However, the evaluation criteria and indicators of performance used to assess the natural assets in question need to be standardised and recognised (i.e., agreed upon). This constitutes a major hurdle as discrete natural assets (for example, in different countries) face different stressors (whether ecological, climate, social, or political), which determine their functioning and performance. Thus, establishing an optimal functioning baseline of performance becomes inherently difficult and is subjective to what historical data is available for each region, as well as to whoever is performing the evaluation.

Nonetheless, the sustainable management of the environmental areas that underpin fisheries and aquaculture industries (such as fishing grounds and MPAs or other natural assets) such that the maximum amount/number of benefits are realised is thus incentivised by potentially global markets through the use of NACs. This mechanism presents a catalysing mechanism for fisheries and aquaculture development while concurrently incentivising sustainable and social development as well.

3.3. Debt for Nature Swaps and Debt Buy-Backs

A debt-for-nature swap (also known as a "debt buy-back") can be defined as a scenario where a creditor forgives debt owed to them in exchange for a commitment by the debtor to use the outstanding service payments for a particular investment [50]. This can be explained differently as a creditor agreeing to sell a portion of the debtor's debt for an agreed purpose under agreed conditions. The redemption of debt can thus be conducted at a discount. The service repayments can be invested into whatever project or initiative is agreeable to both parties in the transaction, such as for fisheries and aquaculture industries or environmental and social-based projects. Furthermore, third parties can facilitate such transactions by providing a loan or guarantee to the debtor. These can be used to finance marine-related development, including fisheries and aquaculture, as well as reduce debt repayments. Debt swaps can present an enticing opportunity for the governments of (SIDS) countries hoping to simultaneously facilitate development and reduce the country's historical debt.

Historically, debt swaps have not been considered for the protection of marine environments (MPAs). However, this changed with the Seychelles Debt Swap of 2015, which was the most successful debt-for-nature swap for a SIDS [51]. This deal, facilitated by The Nature Conservancy (TNC), converted US $21.6 million of sovereign Seychelles debt to the Paris Club of Creditors. The issuance was made possible due to World Bank expertise and guarantee, a Global Environment Fund (GEF) non-instrument grant to reduce the coupon

rate, and technical expertise from the then Prince of Wales International Sustainability Unit. The bond was purchased by three impact investors, and the blue bond proceeds led to the establishment of an environmental trust fund—Seychelles Conservation and Climate Adaptation Trust (SeyCCAT) and committed the Republic of Seychelles to protect 30% of its EEZ as marine-protected areas (MPAs). The many ecosystem services and industry opportunities that MPAs can provide to a country's people and economy indicate that deals such as these have the potential to galvanise a country's future development in a sustainable way. Given the similar context that many SIDS countries share with one another, such debt swap structures can be applied to Barbados, Grenada and SVG, addressing both the historical national debt and nature conservation challenges they face simultaneously.

Many Caribbean countries (Haiti, Jamaica, and others) have been involved with debt swaps since the 1990s, but these have rarely contributed to a significant reduction of debt in the region [52]. For example, in 2012, Antigua and Barbuda negotiated a 'debt for climate adaptation with coastal zone management swap' with Brazil for USD 18 million, but it did not come to fruition due to delays with the Brazilian Parliament [52].

Challenges that arise with the mobilisation of debt swaps include the composition of creditors (where the heterogeneous composition of sovereign credit transactions can make it difficult to make enough actors agree on the terms and conditions of debt swaps). As is often symptomatic of debt-swap deals [53], another challenge is the size of the deal. As a country develops and creditors become more confident of a country's ability to repay their loans, the creditors become less willing to sell the loans at a discount, debt being swapped at lower valuations and thus resulting in smaller deals. However, there are exceptions: a recent Belize debt-for-nature swap raised US $364 million to buy back US $553 million of debt by the Belize government (at a discounted rate). The debt conversion was made possible by a loan and guarantees from TNC, Credit Suisse, and the Inter-American Development Bank (IDB). The scale of the transaction benefited from high discounts on Belizean debt and new structuring practices [54].

Political controversies may also bring the legitimacy of debt swap deals into question and thus cast doubts on the legitimacy of any resulting development. Political controversies ascribed to debt swaps can be seen as a question of whether the high indebtedness of SIDS is legitimate in the first place or if a debt swap is a solution to immediate economic and environmental problems. If, on the one hand, existing debt levels are taken for granted, a debt swap may be seen as a pragmatic tool to achieve different policy objectives. By contrast, if the original debt is essentially considered politically illegitimate, actors may see a debt swap as equally illegitimate. The *de facto* loss of sovereignty that is associated with government debt swap may be another point of contention. When the debt swap is used to create an environmental trust fund, a way to ensure that the government is at arm's length of the trust is to not have a government majority on the board [55]. However, this makes it more likely that a deal is going to be perceived as illegitimate [55]. A debt swap can best be seen as a means of establishing and incentivising policy consistency on the part of the government. Whether or not this should be thought of as a *de facto* loss of sovereignty is a political question. On the one hand, it is a commitment that the government voluntarily enters into. On the other hand, it makes it difficult for a government to change course, which can be beneficial as different government offices come and go during elections/regime changes.

The efficacy of debt swaps as a solution for reducing national historical debt is controversial and debated, as debt conversions do not necessarily lead to long-term debt sustainability (see [56]). Perry et al. [57] provide further context for the source of historical debt among Caribbean island states, as well as comment on the socio-cultural and political implications of debt swaps (and other financing mechanisms herein discussed). However, the author does not provide pragmatic alternatives to overcoming historical debt beyond demanding recompense for the injustice of a colonised past. Long-term sustainable debt reduction through debt swaps would more likely arise from investing in long-term projects which have the potential to facilitate a country's future economic development in a sustainable way, as well as enhancing the country's future resilience to the phenomena that create the debt in the first place (such as

resilience to destructive weather). One such example is the stimulation of the fisheries and aquaculture industries through the development of nature-based solutions, such as MPAs, which protect ecosystems with multiple benefits (such as wave damping, blue carbon, and providing fish nursery and feeding grounds). Such solutions that involve local communities are also more likely to last as local buy-in in the initiative/project would more likely maintain any development (or identify alternative funding and financing) even if debt repayments were late or discontinued. However, this would require informed communities to have access to possible financing mechanisms, potentially through a local financing unit. Despite the challenges associated with debt swaps, they have the potential to resolve some of the historical debt of some Caribbean SIDS as well as other national development needs but are likely not the only solution to this challenge. The use of debt swaps, together with other financial mechanisms and arrangements, likely offers the greatest possibility of success in resolving national historical debt.

3.4. Blue Bonds and Other Sovereign Bonds

Blue bonds have been promoted as a means of financing Blue Economy developments amidst the fiscal constraints that SIDS are facing. Similarly, blue bonds can be used to finance the development of fisheries and aquaculture. Blue bonds, like other bonds, are tradable fixed securities issued by an authority to raise funds on global markets and increase the issuer's debt. The World Bank defines blue bonds as "a debt instrument issued by governments, development banks or others to raise capital from impact investors to finance marine and ocean-based projects that have positive environmental, economic and climate benefits" [58]. Issuances of blue bonds are conducted based on a per-case basis and case-specific environmental and economic returns, but generally the criteria for bonds to be considered "blue" require that the investment be used for oceanic or marine resource development.

Barbados is among some of the first countries to partner with The Nature Conservancy (TNC) on a Blue Bonds project after Seychelles. A novel co-guarantee structure with a $50 million guarantee from TNC, alongside a $100 million guarantee from the Inter-American Development Bank (IDB), was used to facilitate a $150 million debt conversion that will facilitate the expansion of Barbados' marine protected areas from virtually zero to approximately 30% and improve management for all marine waters within its jurisdiction [59]. This project is expected to free up approximately $50 million to support environmental and sustainable development actions in Barbados over the next 15 years, making both the country and its people more resilient in the context of climate change. Barbados worked with Credit Suisse, who acted as Global Lead Arranger, to raise approximately $150 million through a dual currency term loan facility (with CIBC FirstCaribbean as Domestic Lead Arranger). This Blue Loan funded the buyback of a portion of Barbados' existing debt and was partially funded through the implementation of Blue Bonds in capital markets. The new financing featured a lower interest rate than the old debt, with both TNC and IDB each providing repayment guarantees on the country's behalf, and 100% of the resulting cost savings will be directly allocated for marine conservation [59].

Using blue bonds as a financing mechanism supports an environment that stimulates the development of a country's entire Blue Economy by presenting financial capital to private actors wishing to make a sustainable change at low risk to investors [60]. When considering a bond issuance, it is critical that the bond structure is fit for purpose (in this case, the development of fisheries and aquaculture industries), ensures the highest degree of environmental and social impact, and that the issuer receives the lowest possible interest rates on repayments. March et al. [61] discuss the challenges involved when designing blue bond financing for Caribbean SIDS, using the Bahamas as a case study example. Three different bond structures may be applicable for the development of Caribbean fisheries and aquaculture sectors: catastrophe bonds, environmental impact bonds, and use-of-proceeds bonds (see also [62,63]).

The mechanism of catastrophe bonds is that a trigger level (like the wind speed of a hurricane) for a specific area is determined before the phenomenon occurs. If the trigger

level is surpassed, the insurer pays out to the insured party. However, this bond differs from insurance in that it pays out before the phenomenon has struck, whereas insurance pays out afterwards [61]. One challenge of catastrophe bonds is that they only imply that very specific events are being insured and that these events have to fulfil specific conditions. Furthermore, no payout is required if the trigger level is not surpassed, but damage is still widespread because of the phenomenon. Environmental bonds raise capital, but the return on investment is based on the success of an environmental programme or project, as defined by pre-determined key performance indicators (KPIs). Before using such a financing mechanism, it is advised that the developmental sector has clearly defined key performance indicators (KPIs) to provide added confidence and clarity for potential investors [61]. In the case of fisheries and aquaculture development, this could be achieved by achieving a maximum sustainable yield of a fish stock within two years, for example, or the protection of 20 hectares of mangroves as fish nursery grounds. A use-of-proceeds bond entails the upfront promise that proceeds will be used towards blue development (not necessarily environmental development). These bonds are at risk of "environmental non-performance", where returns as benefits of the environment do not materialise, but the economic returns do [61]. This type of bond may be particularly suitable for the development of fisheries and aquaculture infrastructure (equipment, value-addition practices, workspaces, etc.), given that no explicit environmental benefit is mandated.

3.5. Blue Tokens and FinTech

"Fintech" or financial technology refers to the use of new technology to improve management and access to financial operations and processes. It involves the use of specialised software, algorithms (machine learning), and artificial intelligence to achieve improved management of finances [15]. This has expanded into the insurance and investing industries. Fintech has enabled improved compliance and faster transactions and has further allowed financing to be raised on open markets with far less friction or difficulties.

Blue tokens are a proposition where fintech and blockchain technology are used to raise money for blue (fisheries and aquaculture) development projects [15]. An issuer could set an amount they would like to raise, for example, US$10 million, with an initial fixed repayment coupon. The initial price of each token could be set at US $10 (predetermined), with one million tokens being issued on a secure blue token market or platform. Any investor who has been approved through rigorous identity checks, like Know Your Client (KYC) and anti-money laundering (AML) checks, can then buy tokens and either hold them to maturity or trade them among other investors on the blue token platform. A Blue Economy credit rating agency (alluded to before) could also rate the issuance (initially and later annually) for development outcomes and financial viability, thereby giving investors maximum information to assist with their investment decisions [15].

The use of blue tokens could democratise investments, making the opportunity to invest in the development of the Blue Economy, or in this case, fisheries and aquaculture industries, accessible and giving all stakeholders a real stake in the Blue Economy. With the establishment and development of blue bonds, blue tokens can thus give the citizens of Barbados, Grenada, and St. Vincent and the Grenadines the ability to invest in the future of their nations as big ocean developed states (BODS) rather than SIDS [15]. They are also able to invest in blue tokens from other countries' blue bonds, fostering development support where such structures are in place, even if not in place in their own nation yet. This may be applicable for blue bonds issued towards the development of coral reefs in SVG: the largest coral reefs among the three counties are likely to facilitate the greatest economic returns (among the reefs of the three countries), garnering more attention than others in terms of interest for development.

3.6. Insurance

Instead of being a source of new finance, insurance can be viewed as a tool with which to support the financing of fisheries and aquaculture projects. Insurance can create confi-

dence for a potential project developer or investor in that it limits the risks that the project may face, potentially reducing the costs of capital investment. The role of risk management, risk pooling and risk transfer has become important for any potential development in the Caribbean as the intensity of natural disasters like hurricanes increases [15]. Marine insurance can be explored and tailored to specific industries within the Blue Economy, like fisheries and aquaculture.

Parametric insurance is one type of ex-ante disaster financing and makes payments based on the intensity of a disaster event and the amount of loss calculated using a model previously agreed to by both parties [15]. This type of insurance is different from indemnity settlements in that there is no on-site assessment of individual losses but rather depends on a triggering mechanism (based on variables out of the control of both the policyholder and insurance issuer). This may be of interest to stakeholders in the fisheries and aquaculture sector, where infrastructure is swept away or is unrecoverable for assessment of damages, or instances where a natural environment that underpins the industry gets damaged, and objective ecosystem valuation becomes skewed by lack of historical data (however in such a scenario, ownership or shared ownership may have to be allocated and proven, like through an NAC). Another example is the Caribbean Oceans and Aquaculture Sustainability Facility (COAST), a parametric insurance facility developed jointly by the Caribbean Catastrophe Risk Insurance Facility—Segregated Portfolio Company (CCRIF-SPC), the United States Department of State, the World Bank, TNC and the Food and Agriculture Organisation. COAST targets the fisheries sector specifically and is geared towards addressing the impacts of natural hazards on the food security and livelihoods of those working in the fisheries sector of the Caribbean. This policy was first issued and piloted in July 2019 for Grenada and Saint Lucia. The Caribbean would benefit from drawing lessons learnt from these examples and scaling up insurance for other Blue Economy areas [15].

Public social protection programs, as well as private and community savings arrangements, can function as insurance, too. Such savings clubs can be used to finance different needs, including insurance, but savings can itself function as an economic buffer for times of crisis or a short-term economic downturn [54]. Savings and insurance are, of course, not new sources of financing, but they can create support during periods of hardship. These savings programmes can be managed and used to recover local fishing and aquaculture projects that provide direct benefits to the local communities before contributing to the industry at large (such as local job creation and food provisioning). Types of development projects that may be of high priority after a catastrophe include fisheries (small and large-scale), shipbuilding and repair, and natural ecosystem recovery (particularly those that underpin essential fisheries). Such projects lead to revenue generation that could expedite the recovery from natural disasters sooner.

Many different insurance products exist (catastrophe and resilience bonds), each with its own advantages and potential pitfalls. The demand for high premiums on insurance products is likely to present a barrier to entry to their use in Caribbean SIDS, where finance and financing are already in short supply. Insurance companies that assign their risks on a biannual or annual basis also assume greater risk as the insurance products would have to cover longer expanses of time, increasing the likelihood of a higher number of severe weather events and thus payouts [64].

4. Generating an Enabling Environment for Financing Fisheries and Aquaculture in the Caribbean

Generating an enabling environment to encourage investment and financing, thereby reducing barriers to spontaneous entrepreneurial development in the private sector, will have knock-on benefits across the entire Blue Economy in the Caribbean as a whole [65], including the fisheries and aquaculture sectors. As the Caribbean is a developing region, there is limited private sector finance support available from governments in the region, as funds are directed to more critical or prioritised development needs elsewhere. It is thus necessary to put into place the structures that can facilitate the long-term financing

of sustainable (environmentally, socially, and economically) fisheries and aquaculture development projects that arise from the industry itself, such that new development is incentivised through potentially greater fiscal returns for the investment made. In addition, the development of an enabling environment is proposed as the solution for overcoming the capacity constraints and regulatory barriers to new development in the fishery and aquaculture sectors of Barbados, Grenada, St. Vincent and the Grenadines [4]. Together, these (following) structures contribute to an enabling environment that facilitates industry development for the fisheries and aquaculture industries and the Blue Economy and have been curated from the national development strategies of other successful island nations and advisory documents (for example, such as from Africa Blue Economy Strategy [14]; The Seychelles Blue Economy Action Plan [13]; Madagascar Blue Economy Strategy for Fisheries and Aquaculture [12]). However, their effectiveness may vary and is specific to different national development contexts, including different fisheries and aquaculture sectoral contexts.

4.1. Sustainable Blue Economy Finance Principles

Banking mechanisms for blue development, such as for fisheries and aquaculture, are lacking in Grenada, Barbados, and SVG, as are the associated governmental policies. A transparent policy framework that follows blue financing principles has the potential to increase investor confidence, thus increasing the availability of working capital to industries. Underdeveloped financial markets and large historic national debt only further emphasise the need for an enabling and sustainable investment policy framework [66,67].

Emphasising sustainable Blue Economy finance principles would encourage the use of sustainable finance mechanisms for the fisheries and aquaculture sectors. These principles were launched in 2018 and present the world's first guiding framework for banks, insurers and investors to finance sustainable development [68]. The framework promotes Sustainable Development Goal (SDG) 14 (Life Below Water) and establishes specific standards related to sustainable development in financial ocean sectors. The European Commission, WWF, the World Resources Institute (WRI) and the European Investment Bank (EIB) collaborated to develop these principles, which are also hosted by UNEP FI as part of the Sustainable Blue Economy Finance Initiative [68]. These principles can be integrated into the policy and regulatory frameworks of Barbados, Grenada, and St. Vincent and the Grenadines. However, regional or national efforts can be directed towards the development of financing principles that align with NDCs.

4.2. Integrating Aquaculture and Fisheries into the Greater Blue Economy

At present, current policies operate disjunctively, with insufficient overarching frameworks to support financial investment or mitigate the risks of climate change and habitat health reduction to the fisheries and aquaculture industries. The maximum potential of fisheries and aquaculture and their capacity to add to the development of the broader Blue Economy is not reflected in the current unintegrated (and not sufficiently holistic) policy structure. Existing frameworks can be characterised as a disjunct assemblage of fisheries agreements and programmes, and they are often dated and thus inappropriately formulated national laws at various levels for current development challenges. New legislation has been drafted (e.g., in Barbados), but these have not yet been approved by the cabinet, with fisheries management being excluded from coastal and marine resource management, other environmental agendas, and tourism management [4]. Furthermore, the significance of the ecosystem services that natural environments provide to the fisheries and aquaculture sectors (such as habitat provisioning, nursery grounds provisioning, and fisheries stimulation) remains ignored, resulting in gaps in implementation and duplication of development efforts across institutions and agencies, at national and regional scales. The lack of sustainable blue financing and an overarching integrated governance framework to coordinate various pressures on coastal and marine resources continues to hamper development efforts in valorising the fishery and aquaculture sectors [69–71]. Further barriers to

policy integration are due to a lack of consistent and integrated data collection with which to inform policy-making decisions (at both national and the subsequent regional scale), lack of coordination among governance structures leading to duplication of efforts, and differing prioritisation of development goals due to different national development needs.

The fisheries and aquaculture industries should remain a priority when considering Blue Economy development because fisheries will continue to provide the majority of animal protein to the people of Barbados, Grenada and St. Vincent and the Grenadines, as well as supplying a majority of jobs (ever more so with the increasing spread of aquaponics and aquaculture). These sectors have the potential for considerable wealth creation opportunities should value addition be facilitated within each country prior to export [72]. Such wealth creation is possible within the Blue Economy concept, as it promotes the development of biodiversity within coastal habitats by facilitating the development of solutions that are beneficial for both biodiversity conservation and climate change mitigation and adaptation. Furthermore, fisheries have the opportunity to play a central role in the conservation and rehabilitation of key ocean habitats as the main observers of changes in the open sea. These are key indicators for the status of ecological and ecosystem health, as they observe associated changes in fisheries' productivity (a less productive fishery relative to the past, indicating that the ecosystem may be degraded).

The development of the Blue Economy in Barbados, Grenada, and SVG is nascent [4]. Despite the significant natural resources of Barbados, Grenada, and St. Vincent and the Grenadines, as well as the opportunity to implement holistic Blue Economy approaches, the rate of adoption has been slow. Grenada is the first Organisation of Eastern Caribbean States (OECS) member country to have developed a vision for its blue growth economy. The county's blue growth vision is to become a world leader and international example of blue sustainability by optimising its coastal, marine, and ocean resources. Comprehensive, holistic preparation, design, and capacity development are needed to consolidate and coordinate sectors and industries to create synergies and development considerations between sectors. There is significant potential for generated synergies to facilitate finance for the development of the Blue Economy in each country, further emphasising the importance of mediating collaboration.

The Ocean Governance Committee (OCG) is in place in most OECS Member States. They have, in most instances, identified and mandated the creation of National Coordination Agencies that work closely with the OECS Ocean Governance and Fisheries Unit (which leads and coordinates activities at the regional level). OECS Member States are at various stages of establishing national OGCs to serve as standing committees of public sector departments, statutory bodies and non-governmental organisations. Their goal is to facilitate inter-sectoral coordination on ocean governance issues. They may thus have an important role to play regarding the management of shared fisheries stocks and the conservation of the natural environments that underpin those important fisheries. Although the OCGs offer regional consistency and the ability to provide some support to nations seeking to implement Blue Economy approaches, the mechanism still requires enhancement. Barbados, despite being in the eastern Caribbean, is not a part of the OECS [73], thus limiting regional consistency by hindering the establishment of a Barbadian OCG and the associated benefits therefrom. The Regional Ocean Governance Team (OGT) (funded by the World Bank) provides technical support to the national technical committees through the OECS committee on matters related to ocean governance and the Blue Economy.

4.3. Finance and Financing Coordinating Facility

A regional Caribbean Blue Economy financing facility (or unit) may help address some of the challenges which are anticipated if financing for the fisheries and aquaculture industries is to be scaled up, as well as investments into the Caribbean Blue Economy as a whole [15]. One such example is managed by the International Union for Conservation of Nature (IUCN) and has a global reach: the Blue Natural Capital Financing Facility. A national or regional financing facility would be responsible for the coordination and devel-

opment of financing solutions/instruments for development projects that align with the objectives of the Blue Economy and leverage existing resources more efficiently [15]. This would include activities such as market research and valuation studies to inform investment into the Blue Economy and, by extension, the fisheries and aquaculture industries as well. The facility would have the potential to serve as a connection hub for development partners and private funders and act on behalf of national or regional governments to issue financing mechanisms aligned with the development of Blue Economy projects. The agency would ideally also seek to contribute towards capacity building to aid in project implementation, as well as monitor the results and effectiveness of those projects for which it has put financing structures in place [15]. The facility could further be responsible for testing innovative finance and financing instruments, facilitated through structures like innovation networks, accelerators, and incubators, which could source local and global financing knowledge and information, leveraging it for the benefit of the Caribbean communities. For instance, the Caribbean Science Foundation uses various platforms to engage and educate aspiring engineers and scientists across the region. Similarly, "Ten Habitat", a start-up ecosystem, has mushroomed across the region, where potential entrepreneurs are supported and funded using a range of practical tools, including networking and mentorship [15]. Such a unit may be most useful when part of pre-existing government structures (i.e., not independent), thereby serving as an example of a successful public-private partnership (PPP) benefiting both parties involved.

A regional coordinating facility might best be situated in locations that are easily accessible to the rest of the Caribbean region. However, given the complexity of the Caribbean's governance structures, a regional coordinating facility for finance and financing may best be located where previous governance structures have been situated or within such structures themselves. Examples include the seat of the Caribbean Community and Common Market (CARICOM) secretariat in Georgetown (Guyana) or possibly the seat of the CRFM secretariat in Belize City (Belize). The benefit of such a placement, beyond mere ease of access, is that it allows for increased awareness of regional development programmes, initiatives and opportunities among multiple governance structures. This facilitates synergies and integration across multiple departments with an increased likelihood of actual impact throughout the Caribbean region. Such a regional facility will be able to better undertake the explicit actions and research specifically directed towards finance and financing Blue Economy development, which may fall out of the purview of CARICOM (which is concerned with more than just financing the Blue Economy) and the CRFM (which although concerned with financing development in the fisheries and aquaculture sectors, also concerns itself with other aspects of these industries such as coordinating catch data for example).

4.4. Development Tools and Reporting Infrastructure

4.4.1. Screening Tool

The Sustainable Seas Draft Blue Economy Investment (BEI) project screening tool/criteria (by Jonathan McCue, Service Agreement Number: BBRSO145916) has been created for assessing and prioritising different potential development projects to finance, specifically for the development needs of Barbados, Grenada, and St. Vincent and the Grenadines. The criteria used to assess each project are based on the cornerstones of Blue Economy development: environmental sustainability, social responsibility, and economic impact. The tool includes criteria for development projects across all Blue Economy sectors as well as fisheries and aquaculture industries. The use of this tool has the potential to facilitate the most significant available returns of investment for investors in determining appropriate development projects to finance while also increasing the likelihood of multi-sector development. The use of this tool should ensure the financing of projects with minimal environmental, social and economic impact, thus avoiding further accruement of debt.

4.4.2. Data Reporting and Infrastructure

The importance of data reporting for fisheries management (and thus ecosystem management) should be emphasised, as the effectiveness of any management decision is reliant on the data that represent the real-time scenarios affecting the industry. The integrity and honesty of the data being reported should thus be maintained and encouraged as much as possible.

The development of the fisheries and aquaculture industries necessitates national centralised data reporting structures. The Caribbean Regional Fisheries Mechanism (CRFM) is a regional-scale example. However, national-level platforms can more easily facilitate the reporting of fisheries catch data, which would allow for better management of local fisheries sub-sectors, address national-level issues and concerns, and more engaging management of national marine environments that underpin local fisheries. Providing a tool or platform for the hassle-free reporting of catch and aquaculture production data, as well as the methods and locations associated with those data, can facilitate the creation of tailored financing solutions for those practices or projects, allowing for more efficient industry development, management, and effectiveness (profitability).

Currently, monitoring approaches such as accounting for activities associated with the Blue Economy have not been conducted in a coherent manner. Blue accounting data need to be recorded and catalogued from isolated sources to produce a comprehensive view of the Blue Economy industries and their impact on the livelihoods of nationals of Barbados, Grenada, and St. Vincent and the Grenadines. There are also gaps where no data are recorded for certain sectors (like vessel maintenance). Such gaps lead to a skewed interpretation of the industry and facilitate unoptimised management decisions. Critically, ecological components of the Blue Economy need to be accounted for, particularly of environments of key development sectors such as fisheries and aquaculture, as the ecosystem services provided by these habitats directly facilitate the developmental prospects and functioning of these industries. The implementation of nationally determined contributions towards sustainable development (and climate change) will necessitate the need for blue and green accounting frameworks for assessing developmental change that relates to environmental sustainability (of those that underpin key industries).

Partnering with the Global Ocean Accounts partnership (GOAP) may offer benefits to national governments in the Caribbean in facilitating the establishment of ocean accounts and monitoring protocols for national Blue economy accounting. GOAP aims to build a global community of practice for ocean accounts (also known as "blue accounting") with an international network including national governments, the World Bank, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and specific fisheries departments like Fisheries and Oceans Canada. GOAP encourages countries and stakeholders to include the use of other indicators beyond only gross domestic product (GDP) in their measurement and recording of progress towards sustainable development, as the reliance on only GDP as a yardstick for development has led to previous misinformed policy decision-making (see [74] for a detailed analysis on this topic).

4.4.3. Spatio-Temporal Planning Tools and Prospective Approaches

The use of integrated and prospective approaches to the management of marine ecosystems is lacking in the three study countries. This is likely due to growing blue economies in their nascent stages in Barbados, Grenada, and St. Vincent and the Grenadines. Furthermore, the large marine ecosystem approach (specifically the Caribbean LME) has not been integrated or institutionalised into national environmental management frameworks. The adoption of such a paradigm would facilitate a better understanding of the dynamics of coastal and marine ecosystems. The use of approaches such as blue accounting and data reporting of key ecological indicators (biological productivity/fish biomass, pollution, ecosystem health) would facilitate improved resource management.

For countries like Barbados, Grenada, and St. Vincent and the Grenadines, where resources are limited, sustainable and optimal use of them is critical to economic prosperity.

As such, marine spatial planning (MSP) is particularly important and has been lacking in these three countries. "Marine Spatial Planning (MSP) is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process" [75]. The use of MSP usually forms part of a country's national Blue Economy development strategy and implementation plan, particularly where shared resources are shared by multiple stakeholders (such as fisheries stocks). Despite potential challenges, the use of MSP has the potential to facilitate an enabling environment for national development and has been shown to be effective in other SIDS countries like the Seychelles.

4.5. Development of Sustainable Micro, Small, and Medium-Sized Enterprises (MSMEs)

Considering that many fisheries and aquaculture operations are more likely to operate at smaller scales than large commercial-scale fishing fleets, it is thus necessary to focus on the sustainable development of micro, small and medium-sized (MSME) enterprises in the fisheries and aquaculture sectors [76]. MSMEs that already operate on a successful (environmentally) sustainable business model are likely to perpetuate that model when operating at larger scales, as it has already proven to be profitable while benefiting the environment. Moreover, an enabling environment for the development of MSMEs encourages participation in the fisheries and aquaculture industries as support services are available for future business growth and expansion. The growth of small (subsistence) scale fishers is thus facilitated by an enabling environment for MSME, presenting a route for transitioning from a subsistence-based livelihood to entrepreneurship, which in turn may afford improvements in the livelihoods of Caribbean locals.

MSMEs can be considered as the "missing middle" and lack access to capital [76]. These include organisations that are raising USD 500 K–10 M (with revenues exceeding USD $250 K) annually. MSMEs are challenging for financiers because banks are not interested (as the company is likely unable to offer sufficient collateral for loans and presents a security risk for the investment), and MSMEs are too small for bonds or private placements. Microfinancing is too expensive, and MSME fragmentation presents an elevated risk, disincentivising investment [76]. Yet MSMEs represent the majority of employment in developing countries (such as in the Caribbean region) and represent the majority of industry stakeholders [76]. Moreover, investors require MSMEs as the mechanism with which to actualise returns and impacts of investments, such as through blue bonds, development banks, industry ventures, and impact funds (and many others [76]). An evaluation of the finance gap, such as that of Asian Blue SMEs (at the value of USD 2 trillion [76]), is a recommended starting point for MSME development in the Caribbean.

National or regional programmes that facilitate scaling offer readiness training and access to finance and financing, which present avenues with which to develop MSMEs to benefit the fisheries and aquaculture industry. A similar programme to SME BlueImpact Asia could be developed for the Caribbean region. The BlueImpact programme is an initiative to raise capital for sustainable SMEs in the Asia and Pacific Blue Economy by acting as a platform that connects qualified investors with Blue Economy SMEs. The programme thus supports catalytic funding and mobilises appropriate matching private sector enterprises [77]. The programme also aims to replicate successful business models across the Asian and Pacific region through this programme, thus facilitating Blue Economy development [77].

The integration of MSMEs (and small-scale fishers) into the broader Blue Economy can be accomplished by establishing a programme similar to 'Abalobi' (in South Africa). The non-profit organisation strives to connect individual small-scale fishers and fishing communities to buyers through its technology platforms. Their community-supported fishery model promotes fair market access, transparent supply chains, national food security, and "fish with a story" (presenting the people and communities behind the produce). The organisation has global international partners, such as the Seychelles Hook and Line

Fishers Organisation and the World Wildlife Forum, already replicating the model in other countries [78].

4.6. Public-Private Partnerships (PPP)

While no single definition satisfies all demands, (at a generic level) public-private partnerships (PPP) is an encompassing term that covers many forms of collaboration among public, private, and civil sectors [79]. The "Canadian Council for Public-Private Partnerships" defines a PPP as "a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs for services or infrastructure through the transfer between partners of resources, risks and rewards". Two important elements of this definition are that the arrangement is to provide public services and that partners share any associated risk. The aim of PPPs is to structure the relationship between the public and private sectors, allocate the risks to the parties that are best able to manage them and add value to public services by using private sector skills and competencies [79]. However, it is important to make the distinction that PPPs are not incentives or subsidies given by the public sector to attract private investments.

PPPs are important as mechanisms for developing technologies where normal private sector market incentives fail. Furthermore, PPPs improve the quality of the delivered service by facilitating optimal participation of both sectors: the government acts as the regulator and is tasked with monitoring performance and the planning of services, whereas the private sector's attention is on managing and optimising the daily delivery of the service [79]. PPPs thus improve the cost-effectiveness of services (and risk management), the savings of which can finance other services or development in industries of importance.

Despite PPPs having the potential to bring about significant economic benefits, they are challenged by internal and external risks to both parties in the partnership. Of the many risks that exist, reputation damage is likely the most limiting in engendering future investor confidence and being offered future development project opportunities [79]. External risks can arise from events beyond the scope of the project as well as from changes in government, legislation or the political climate. Such risks may be addressed in PPP contracts but are fundamentally outside the project itself and may be beyond the control of the private sector [79]. Internal risks are particular to the project or the way it is constructed and operated and are generally under the control of the contracting parties. The contracting arrangement should explicitly allocate risk among the signatories to ensure no disagreements arise with the onset of internal risks. One of the critical internal risks is that demand will be insufficient to allow the project company to repay its financial obligations from project revenues. Given that demand risk is difficult to estimate, even more so in developing or recovering economies (common among SIDS states), the public sector commonly assumes that the private sector should shoulder demand risk. However, when it does so, the private sector is likely to ask for more support from the government in the form of subsidies, grants or guarantees to mitigate this risk [79].

There is a wealth of resources to provide assistance in the establishment of business-related PPPs. Development aid is available for the development of PPPs from organisations like the United Nations [79]. Such arrangements may be particularly suited to the development needs of fisheries and aquaculture in Barbados, Grenada, and St. Vincent and the Grenadines, as they have been shown to assist the governments of countries that have difficulty in fostering public sector investments to improve local infrastructure and product chains that meet international rules [79].

Most countries also have PPP knowledge centres or units from which assistance can be gained [79]. Such a unit is beneficial for leading the implementation of PPP programmes and training government authorities responsible for local implementation. It should give advice regarding the rules and regulations for PPPs in the country. Recommended as places to start searching for further information on general principles and approaches are the World Bank's Private-Public Partnership in Infrastructure program, Institute for Public-Private Partnerships, Inc., and Public-Private Infrastructure Advisory Facility [79].

Allam and Jones [80] propose a development framework specifically for SIDS to develop climate change and economic resilience, largely based on urban and cultural heritage PPP. However, given that many cities in Barbados, Grenada, and St. Vincent and the Grenadines are small, the framework may only be applicable for Bridgetown (Barbados), as it is the largest city of the three countries (with an estimated population of 98,500). Nonetheless, it may facilitate the development of fisheries through PPP as the city is likely a hub of trade (of fish, an important resource likely tied to the cultures of island inhabitants).

4.7. Enabling Policy Environment for Financing

The regulatory environment can have a significant impact in facilitating sustainable development of the fisheries and aquaculture sectors and the Blue Economy. An analysis of the existing regulations and policy environments for Grenada, Barbados, and St. Vincent and the Grenadines has been conducted [4]. In addition, aspects of the regulation and policy framework have been discussed, namely fiscal policy mechanisms for fisheries and aquaculture development (Section 3.1) and the implication of sustainable Blue Economy finance principles (Section 4.1). However, the development of a regulation and policy environment that enables and facilitates finance for the fisheries and aquaculture sector (and the Blue Economy at large) was not discussed but identified as a development priority [4].

An enabling financing environment alongside integrated national (and regional) Blue Economy frameworks can offer increased security for investments, incentivise investment and thus facilitate development for the fisheries and aquaculture industry [12–14]. We suggest that an ideal enabling regulatory environment may optimally facilitate the financing of sustainable industry development, such as fisheries and aquaculture, when constructed with consideration of the following:

- Facilitates and encourages the use of fiscal policy for sustainable development (Section 3.1)
- Supports the implementation of sustainable Blue Economy principles (Section 4.1)
- Facilitates local and international entrepreneurship
- Supports a mixed economy (with private—and state influence) and encourages free-market environmentalism.

The principles of the Blue Economy overlap with those of free-market environmentalism along the axes of environmental sustainability and economic sustainability, and free-market environmentalism does not specifically exclude social sustainability. Free-market environmentalism integrates the goals of preserving the environment with the concepts of a free-market economy. It recognises the potent incentives for conservation and environmental care that markets can offer, emphasising the use of private property rights and contracts as effective tools for environmental protection [81,82]. Consequently, we also suggest that policy and regulation surrounding property ownership rights be elucidated for the optimal leveraging of financing mechanisms (for example, payment-for-ecosystem services). We suggest that existing financing regulatory frameworks be reviewed to integrate the above considerations, thus developing a more enabling financing environment for the fisheries and aquaculture industries and the Blue Economy.

5. Conclusions

This review discusses various finance and financing mechanisms for supporting development projects in Caribbean fisheries and aquaculture industries. Developing financing mechanisms to support and drive the maximal sustainable exploitation of the environments that underpin fisheries and aquaculture will facilitate an increased contribution to national and regional blue economies, as well as avoiding exhaustion of the resources on which Caribbean livelihoods are dependent for years to come. Many of the fisheries and aquaculture industries of Caribbean countries face complex problems, but the improved use and management of natural environments and the development of PPPs as management tools for sectoral development have been suggested elsewhere [4]. The leveraging of natural capital forms the base around which the benefits of PPPs can be utilised for optimal delivery

of ecosystem services and provide numerous opportunities for multi-sector development synergies that can ultimately benefit multiple sector stakeholders. However, policy regarding the ownership rights to natural environments would need further development and elucidation to determine who can leverage the multitudes of financing mechanisms suited to a specific ecosystem. The boundaries of ecosystems need to be well-defined and clear to all its users to limit confusion regarding ownership and property rights. Doing so is further necessary for leveraging natural capital for funds to finance Blue Economy development projects, as ownership of the natural capital (or services therefrom) may need to be used as collateral security. Further policy development may be directed towards determining whether the number of financing mechanisms employed per ecosystem should be capped or not. Regardless, the development of accurate ecosystem accounting programmes and mechanisms (to determine the value of ecosystem services) is essential in realising the benefits of sustainable management and ensuring returns for potential investors.

The various common financing needs of the fisheries and aquaculture sectors of Barbados, Grenada, and St. Vincent and the Grenadines [4] have been matched with the most suitable financing mechanisms (Table A2, Appendix A). Blue levies are generally recommended and applicable in almost every scenario, as they allow the fisheries and aquaculture industry to drive its own development in financing research and conservation projects (to its own benefit). The use of blue tokens with sufficiently low repayment coupons allows development projects to gather public support for fisheries, thereby increasing the likelihood of the project being successful through community buy-in. The possibility of natural capital being traded as public equities as "Natural Asset Companies" provides the opportunity for development projects to fund themselves. An enabling environment for debt and lending with low-interest loan repayments is also applicable to almost every scenario, as it facilitates access to capital finance for infrastructure development and the acquisition of increasingly sustainable fishing equipment. The development of an enabling environment through the development of dedicated financing institutions and PPPs and the establishment of sufficient data reporting infrastructure for the fisheries and aquaculture industry is essential for driving development in these sectors.

There are complex challenges for the development of the fisheries and aquaculture sectors to be addressed, such as overfishing, pollution, and the introduction of invasive species (and others). An injection of finance does not necessarily translate into meaningful development or solutions to these problems. However, finance is a tool to help mobilise action to facilitate the transition to a sustainable Blue Economy. Without finance or the mechanisms which generate finance, limited action takes place, particularly in terms of policy development, government coordination, and implementation and enforcement of development policies. The use of financing mechanisms has the potential to facilitate finance sustainability within sectors of the Blue Economy, enabling each industry to fuel its own development. In addition, the conditions that enable an increased degree of finance to support development through the Blue Economy need to be developed and maintained. These conditions include low corruption, efficient processing of finance transfers (through dedicated secure financing institutions), good governance, strong societal and environmental standards to guide industry development, and transparency of any non-private development. Developing methodologies, regulations, and policies to facilitate these conditions ensures that any finance that is injected into a sector and the Blue Economy results in tangible impact and sustainable development.

Financing mechanisms can facilitate the optimally sustainable exploitation of the fisheries and aquaculture resources in the Caribbean, thereby ensuring the ability of these industries to support developing Caribbean Blue Economies for future generations. One of the largest limiting factors in financing the fisheries and aquaculture industries in the Caribbean is likely to be awareness of the range of finance and financing mechanisms available to industry stakeholders, as well as an enabling environment for financing the Blue Economy sectors. This review is thus intended to aid financing institutions, Blue Economy developers, and specifically Caribbean fisheries and aquaculture stakeholders

and Caribbean governments by raising awareness of the financing mechanisms available, encourage the incorporation of their use in the fisheries and aquaculture industries in the Caribbean, and encourage policymakers to create an enabling environment for financing development in these crucial sectors. The authors advocate for the establishment of financing mechanisms that generate finance for an industry as opposed to once-off finance contributions and support, as the former is more likely to have a consistent impact over the long term.

The methods used here, as well as March et al. [4], can be applied to the holistic Blue Economy development of other nations, including other SIDS, as follows:

1. The identification of capacity constraints and development opportunities (in alignment with national development priorities).
2. Identification of potential finance and financing mechanisms.
3. Analysis of the enabling environment at the national level.
4. Matching of suitable finance and financing mechanisms with previously identified financing needs in light of the current enabling environment.
5. Review of identified development solutions in light of other sectors' development prospects.

Discussion of the various elements of an ideal enabling financing environment usually occurs at a more general overarching level. However, the implementation of these various elements differs in their suitability and effectiveness in supporting development at a national or regional level. Given the need for the development of national Blue Economy strategies and frameworks to address the unique development needs of any one country (as these needs may differ between neighbouring countries), the appropriate resolution for implementing elements of an ideal financing environment may be best suited to the national level. In this manner, the enabling environment can be developed by supporting national Blue Economy strategies through synergies facilitating sustainable development. While the work in this paper completes only a part of what is required for meaningful development, future work can involve analysis of the local enabling environment at the national level of each of the countries discussed, such that the most suitable financing mechanism can be implemented effectively in addressing the identified financing needs for national fisheries and aquaculture sectors. Thereafter, the identified solutions should be reviewed in relation to the development needs of other Blue Economy sectors so that non-limiting solutions (to the development of other sectors) are implemented. In addition, future work should include a detailed analysis of the feasibility and potential risks (financial, environmental, and social) associated with the implementation of the mechanisms (at the national level) herein discussed.

This work focussed on the development of fisheries and aquaculture sectors as part of the Blue Economy due to these sectors having a disproportionately larger influence on the national economy and local livelihoods. However, the Blue Economy advocates for a holistic approach rather than a siloed or sectoral approach. We suggest that the development of priority sectors (such as fisheries and aquaculture for SIDS) be prioritised with the explicit consideration of the future development needs of other sectors in mind. While non-priority sectors may be underdeveloped, the development of priority sectors should not occur in such a way that it limits the development prospects of other sectors of the Blue Economy [65]. The most optimal method of concurrent holistic development of Blue Economy sectors with limited resources still remains a challenge, but the use of innovative sustainable financing mechanisms (as they develop) has the potential to contribute to sustainable development in Blue Economy sectors.

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Appendix A

Table A1. Summary of various financing mechanisms for use in fisheries and aquaculture sectors of Caribbean states.

Financing Instrument	Description	Requirements
Fiscal Policy	Fiscal policy covers state spending and the state's generation of revenues. Budgetary governance is also classified as fiscal policy, and deals with the administrative and institutional systems that control the fiscal flows of the state. Different parts of public fiscal policy can be revenue generators and liabilities at different times, at different levels of organisation. The specific application of fiscal policy thus requires an in-depth understanding of the relevant industry (fisheries and aquaculture) for optimal use as a development mechanism.	
Environmental Taxes	The minimum definition of an environmental tax is that it increases the costs of pollution activities [19]. An environmental tax is meant to target activities that cause environmental degradation or pollution, but this does not imply that the tax has a proven effect in terms of minimising environmentally degrading or polluting activities. The actual application of an environmental tax is likely to have the effect of incentivising some activities whilst disincentivizing others.	Public awareness Monitoring of pollution among stakeholders (Pollution accounts that track equipment lost at sea for example) Identification of the locus of implementation (individual, organisational, national, regional) Incorporation into legal structure (policy-making)
Leases, Licences, and fees	Whereas a tax is compulsory, a lease, licence or fee can be seen as a form of exchange between a public authority and a (legal) person, which grants the latter a certain right or privilege. These leases, licences and fees remain stable regardless of the incomes that the payer may generate as a result.	Public awareness. Easy-to-use infrastructure for applications, and issues. Controlled public register of licences and rights issued. Public enforcement mechanism (such as harbour officials checking permits for access to fishing grounds)
State-owned enterprises (SOEs) and public-private partnerships (PPP)	SOEs are a form of fiscal policy, where SOEs have some clear environmental impacts beyond only service delivery. Public utilities (water and energy companies) explicitly have an environmental aspect since they usually have environmental quality or resource efficiency as key objectives. Other types of SOEs, like transportation companies, may increasingly incorporate environmental objectives. SOEs can be run with a focus on generating profits, but they can also seek to strategically increase public goods and services through their operations. SOEs can be a source of revenue when they generate profits while their inventory and equipment can be seen as capital goods. Meanwhile, SOEs can also hold liabilities in the form of debt. PPPs are a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs for services or infrastructure through the transfer between partners of resources, risks and rewards. The aim of PPPs is to structure the relationship between the public and private sectors to allocate the risks to the parties best able to manage them, and to add value to public services by using private sector skills and competencies. However, it is important to make the distinction that PPPs are not incentives or subsidies given by the public sector to attract private investments. Examples applicable to fisheries and aquaculture include organisations that facilitate data recording of fish catches, vessel regulatory bodies specifying monitoring equipment used, fisheries management organisations.	Identification of public needs (at national scale) and natural resources. Transparency in decision-making, operations, and impact to build public trust. Environmental monitoring and accounting. Identification of public needs and subsequent private sector expertise. Public buy-in. Transparency among public and private partners.

Table A1. *Cont.*

Financing Instrument	Description	Requirements
Debt and lending	An enabling environment for debt and lending presents an avenue for fisheries and aquaculture development. As fisheries and aquaculture equipment are often expensive (and become increasingly technical with the incorporation of sustainability objectives), many stakeholders globally make use of loans to develop and expand. An enabling environment such as low interest rates on loans and alternate avenues for debt repayments, may incentivise development in other sectors as well as aquaculture and fisheries. The state of national and global economies (such as recessions) needs to be considered and how this influences the borrowing of money (where in a recession, the borrowing of money is far less likely than in an economic boom/upturn). There is room for public influence (as well as regional organisations like development banks) in this regard to reduce loan and debt repayments through industry financing (subsidies).	Awareness among the industry as to the borrowing options available (through the establishment of coordinated information and development centres) Monitoring the development of the industry.
Blue levies and stakeholder taxation	Blue levies and stakeholder taxation are similar to environmental taxation, but are not limited to disincentivising pollution. These mechanisms are rather aimed at reinvesting revenue for industry development. These levies are usually applied in different ways, at different rates and at different levels of organisation, like on importation, consumption, accommodation, service, or travel. Sectors that rely on the environments that sustain fisheries and aquaculture or on the sector itself (such as tourism, hospitality, cruise and charter, extraction, and ports and ship-building industries) could be potential targets from which the proceeds of blue levies could be directed to support fisheries and aquaculture.	Transparency Monitoring of stakeholder relationships with the environment and/or fisheries and aquaculture industry. Mechanism or institution to implement, coordinate, and reinvest proceeds according to development needs.
Payment for Ecosystem Services (PES) Schemes	PES schemes are known by five characteristics [26]: "(1) a voluntary transaction where (2) a well-defined ecosystem service (ES, or a land-use likely to secure that service) (3) is being 'bought' by a (minimum one) ES buyer (4) from a (minimum one) ES provider (5) if and only if the ES provider secures ES provision (conditionality)". PES schemes thus entail the voluntary buying and selling of ecosystem services, based on the seller protecting an ecosystem. Where PES schemes are directly linked to environmental outcomes, levies, fees or licences are not necessarily linked to environmental outcomes, but their proceeds may still be directed to benefiting fisheries and aquaculture (non-environmental benefits). Despite most PES programmes being thought of as a market-based approach, most programmes are based on compliance with government regulations [29]. However, these subsidy-PES programmes are only as good as the (government) authorities that implement them since PES requires enforcement of regulations. Subsidy based PES schemes are potentially more difficult to maintain for cash-strapped governments. A requirement for all PES schemes is accurate environmental monitoring and accounting.	
Regulated markets	Cap and trade markets require resource users to hold a purchasable right to the resource they use. It sets a limit to resource use and allocates a tradable share of the resource to an asset owner. The rights to the ecosystem or ecosystem service can then be traded (if legal). Ecosystem service can then be exploited on regulated markets (for example, in the form of biodiversity or resilience credits as the measure of ecosystem service delivery). A licence is not necessarily tradable and the issuer of a licence does not necessarily set a limit to damages to an ecosystem, but it still constitutes a transaction based on compliance.	Controlled public register of licences and rights issued. National natural resources can be divided into concession areas which can then be exploited by the private sector on a rotational basis according to who owns the legal right to do so (such as the kelp-harvesting concession areas established in South Africa). Mechanism of access to acquire rights and licences and having this available to anyone. An example is an auctioning mechanism for available national rights to resource exploitation. Enforcement and monitoring of compliance and limitations of approved permits relating to shares of the natural resource (including parties involved with subletting). Requires easy-to-use mechanism. Sophisticated and sufficient legal policy framework regarding (temporary) ownership or rights to national natural resources.
Voluntary transactions	Voluntary PES transactions can involve private and public sector actors alike. Governments, private individuals, NGOs and development organisations can all pay private actors to change practices or avoid harm to ecosystems.	Platform to identify, mediate and increase awareness of voluntary opportunities available to stakeholders. Requires monitoring of fisheries and aquaculture sectors

Table A1. *Cont.*

Financing Instrument	Description	Requirements
Biodiversity offsetting	Biodiversity offsetting is based on counterbalancing any lost biodiversity from a development project by investing in equivalent biodiversity somewhere else, thus aiming to maintain biodiversity despite economic development (or environmentally harmful extraction processes). If developers follow the mitigation hierarchy (avoidance—minimisation—restoration—offsetts), they should try to avoid negative impacts in the first place, developers should secondly consider the minimising of impacts, thereafter restoring any negative impacts stemming from the development, and finally they can use biodiversity offsets to compensate for the unavoidable biodiversity loss stemming from development projects [33]. Thus, biodiversity offsetting is only meant to counter biodiversity loss that cannot be prevented [34]. Different levels of compensation can be mandated due to the perceived value of the affected (extracted or displaced) species or environment in question. The associated biodiversity loss that is found with unsustainable fishing practices (dredging, trawling), or new aquaculture infrastructure developments, can be offset by investing a portion of the proceeds into less damaging subsectors (domestic handline fisheries, sustenance fisheries or developing restocking programs).	Baseline levels of biodiversity at the sites that provide offsets (sufficient long term data on that area, to assess historical performance or attributes, and where this is not available data would first have to be collected). Mechanism or institution to implement, monitor and coordinate biodiversity offsetting with development needs, with the private sector.
Carbon and nutrient trading credits	Coastal environments are likely to offer nutrient capture and sequestration services (such as blue carbon) in addition to the benefits they provide to fisheries and aquaculture [5]. Many of the ecosystems that facilitate the generation of carbon and other nutrient trading credits, also provide other co-benefits like nursery/feeding grounds for fish and wave attenuation which contribute to the reliance and longevity of infrastructure along coastlines. These services can be capitalised upon, and leveraged as pollutant offsets (on international and domestic markets) from which revenue can be generated to further support the protection, optimisation, and maintenance of the environments themselves, or be directed towards other areas of fisheries and aquaculture. The conservation and development of the coastal (mangrove) habitats may present an ideal opportunity to access nutrient trading markets (such as the carbon credit market) which can further finance the development of these key ecosystems.	Dependent on environmental monitoring and blue accounting methodologies. Nutrient credit market access (voluntary offset market vs international compliance markets) Finding buyers for credits (can be facilitated by third party organisations). Certification of methods that generate credits by reputable and internationally recognised organisations (increases buyer confidence). Local community involvement and buy-in (as pertains to conservation, and development impact). Legal policy for clear ownership rights of ecosystem service and/or associated credits
Natural capital as publicly traded equities	The Intrinsic Exchange group (IEG) in collaboration with the New York Stock Exchange (NYSE) are pioneering the creation of a new asset class: Natural Asset Companies (NACs). The purpose of such companies is to maximise the performance of the natural asset they are associated with, whether this be through ecosystem services provisioning, restorative/regenerative agricultural use, or hybrid cases integrating both. These companies are evaluated by the IEG, and then listed for trading on world platforms, enabling the conversion of natural assets into financial capital. The sustainable management of the environmental areas that underpin fisheries and aquaculture industries (such as fishing grounds and MPAs) such that the maximum amount/number of benefits are realised is thus incentivised by potentially global markets.	Standardisation of assessment of natural assets. Establishing a baseline of optimal ecosystem performance (need historical data). Awareness raising. Legal policy for clear ownership rights of ecosystem or ecosystem service.
Debt swaps	A debt swap can be defined as a scenario where a creditor forgives debt owed to them in exchange for a commitment by the debtor to use the outstanding service payments for a particular investment [50]. The redemption of debt can thus be conducted at a discount. The service repayments can be invested into whatever project or initiative is agreeable to both parties in the transaction, such as for fisheries and aquaculture industries or environmental and social based projects. Debt swaps can present an enticing opportunity for the governments of (SIDS) countries hoping to simultaneously facilitate development and reduce the country's historical debt. However, debt swaps are not explicitly limited to fiscal policy as any private stakeholders can engage with this mechanism assuming mutual agreement to the (legal) terms of the arrangement.	Efficient mechanism or platform for arranging debt swaps. As they are time sensitive (unresolved debt accumulating with time), such a mechanism needs to be quick and easy (this has been a problem with historical national debt swaps and needing to be ratified in parliament first, leading to reduced effectiveness). Composition of sovereign creditors need to all agree on the terms and conditions of the deal. Transparency among parties and in terms of the progress of impact (development) achieved. Involvement and buy-in of local communities for environmental development, are likely to maintain impacts achieved regardless of late repayments or other complications. Consistency in the deal from the government side, regardless of changes in political composition/structure.

Table A1. *Cont.*

Financing Instrument	Description	Requirements
Blue (and other sovereign) Bonds	Blue bonds are "a debt instrument issued by governments, development banks or others to raise capital from impact investors to finance marine and ocean-based projects that have positive environmental, economic and climate benefits" [58]. Using blue bonds as a financing mechanism supports an enabling environment for stimulating the development of a country's entire Blue Economy, by presenting financial capital to private actors wishing to make sustainable change, at low-risk to investors [60]. When considering a bond issuance, it is critical that the bond structure is fit for purpose (in this case the development of fisheries and aquaculture industries) ensures the highest degree of environmental and social impact, and that the issuer receives the lowest possible interest rates on repayments. Issuances of blue bonds are conducted based on a per-case basis and case specific environmental and economic returns, but generally the criteria for bonds to be considered "blue" require that the investment be used for oceanic or marine resource development.	
Catastrophe bonds	A trigger level (like the wind speed of a hurricane) for a specific area is determined before the phenomenon occurs. If the trigger level is surpassed, the insurer pays out to the insured party. This bond differs from insurance in that it pays out before the phenomenon has struck, whereas insurance pays out afterwards [4]. Furthermore, no payout is required if the trigger level is not surpassed, but damage may still be widespread because of the phenomenon.	Transparent environmental monitoring. Widely informed and well-established environmental trigger levels.
Environmental bonds	Environmental bonds raise capital but the return on investment (ROI) is based on the success of an environmental programme or project, as defined by pre-determined key performance indicators (KPIs). In the case of fisheries and aquaculture development, this could be achieving a maximum sustainable yield of a fish stock within a two years for example, or the protection of 20 hectares of mangroves as fish nursery grounds.	Well recorded and documented development progress (as per KPIs). Evidence of longevity/persistence of development (such that any progress does not easily get reversed upon ROI). Timelines of assessments need to be sufficiently long to allow the environment to reflect the development changes (e.g., there may be a lag period involved in a fish stock producing at sustainable max yield, if fishing of the stock has recently been suspended). Examples of specific development options within fisheries and aquaculture may be beneficial for investors to choose from.
Use-of-proceeds bonds	A use-of-proceeds bond entails the upfront promise that proceeds will be used towards blue development (not necessarily environmental development). These bonds are at risk of "environmental non-performance" where returns as benefits of the environment do not materialise, but the economic returns do [61]. This type of bond may be particularly suitable for the development of fisheries and aquaculture infrastructure (equipment, value addition practices, workspaces, etc.), given that there is no explicit environmental benefit mandated.	Given that no specific environmental benefit is mandated, it may be beneficial to stipulate any development or acquisitions from a use-of proceeds bond that involves some measure of environmental afterthought; e.g., when developing fisheries and aquaculture infrastructure, it could be designed in a (environmentally) sustainable fashion. Transparency in use of proceeds.
Blue tokens and Fintech	"Fintech" or financial technology, refers to the use of new technology to improve management and access of financial operations and processes. It involves the use of specialised software, algorithms (machine learning), and artificial intelligence to achieve the improved management of finances [15]. Blue tokens is a proposition where fintech and block chain technology are used to raise money for blue (fisheries and aquaculture) development projects [15]. An issuer could set an amount they would like to raise, for example US $10 million with an initial fixed repayment coupon. The initial price of each token could be set at US $10 (predetermined), with one million tokens being issued on a secure blue token market or platform. Any investor who has been approved through rigorous identity checks, like know your client (KYC) and anti money laundering (AML) checks, can then buy tokens and either hold them to maturity or trade them among other investors on the blue token platform. A Blue Economy credit rating agency (alluded to before) could also rate the issuance (initially and later annually) for development outcomes and financial viability, thereby giving investors maximum information to assist with their investment decision [15].	Technological infrastructure (sufficient computing equipment, stable electric supply, stable internet connection, etc). Stakeholder awareness as to what is available. Digital security. Secure block chain technology and infrastructure. Blue token platform or market. Thorough identity verification (approval). Endorsement/certification would be beneficial (such as through a Blue Economy credit rating agency).
Insurance	Insurance can create confidence for a potential project developer or investor in that it limits the risks that the project may face, potentially reducing the costs of capital investment. The role of risk management, risk pooling and risk transfer has become important for any potential development in the Caribbean, as the intensity of natural disasters like hurricanes increase [15]. Many different insurance products exist each with their own advantages and potential pitfalls. The demand of high premiums on insurance products are likely to present a barrier of entry to their use in Caribbean SIDS where finance and financing is already in short supply.	Low premiums on insurance incentivise its use in lowering risk for investors. This may be achieved with various forms of fiscal policy (i.e., government support) or regional support (such as from development banks). Awareness among project developers and industry stakeholders. Risk management to be factored into development projects.

Table A2. Linking financing instruments with financing needs in the fisheries and aquaculture sectors in Barbados, Grenada, and St. Vincent and the Grenadines (formulated from March et al., 2023 [4]). Financing instruments are ranked by their potential effectiveness.

Financing Need	Description	Potential Solutions	Financing Instrument
Intra-regional trade and domestic market development	A minimal portion of exports from the three countries is traded within the region, while the bulk of exports surpass national imports. It is crucial for these countries to maintain trade with the global market but to reduce vulnerability to external disruptions by boosting intra-Caribbean trade and limiting exports. This approach will help ensure that each country's nutritional requirements and domestic market demands are fulfilled.	There is a need to simplify the transportation of fish products across borders to promote intra-regional trade. This could be accomplished by consolidating import/export declarations and phytosanitary inspections under a single government or regional agency. Setting a zero percent preferential tariff for intra-regional trade would ensure that fish imports/exports face no restrictions. Implementing a uniform system of conformity assessment procedures for testing, inspecting, and certifying fish products for import/export across all countries would minimize confusion about trade standards and ensure that all products on the market meet legislative and food safety requirements.	1. Blue levies 2. Fintech (blockchain) 3. PPP's and SOE's 4. Debt swaps 5. Blue bonds 6. Use-of-proceeds bonds
Value addition of fish products	The essential factor for maximising profit or gains from fish products is value addition, which also generates employment and foreign currency earnings. Countries need the technology and resources to meet processing, packaging, and marketing demands for target markets. However, this technology is often costly and needs to be imported, increasing the startup costs for developing value addition in Caribbean countries. Government planning should prioritise value addition in seafood value chains by (i) encouraging private investment in seafood value addition through zero-rating imported machinery (ii) recognising the importance of training initiatives for seafood producers to equip them with necessary skills and knowledge for various stages of the value chain (iii) studying, reassessing, and potentially redefining the seafood chain to address bottlenecks and operational challenges (iv) continuing market development and diversification, and (v) establishing information centers to provide operators at various chain nodes with the necessary information for planning and investment decision-making.	The three countries can consider producing ready-to-cook and ready-cooked meals, which are increasingly popular in developed countries. This approach would yield higher prices for their fish products compared to exporting unprocessed fish to American markets or other countries. An example is what Barbados is doing with its tuna sector: making its fishing fleet more efficient and sustainable by providing it with target-selective fishing equipment (also opens itself up to an increasing amount of fast growing markets); and processing tuna before export (e.g., boxed tuna loins). Enhancing value in the tuna sector would better support local hotels and restaurants, retaining more value on the island and reducing reliance on food imports.	1. Debt and lending 2. Blue tokens and fintech 3. Use-of-proceeds bonds 4. PPPs 5. Blue levies 6. Debt swaps 7. Voluntary PES transactions 8. Insurance
Improving ecosystem services delivery	Without healthy ecosystems, fishery resources provisioning declines. The coastal and marine ecosystems around Barbados, Grenada, and St. Vincent and the Grenadines are significantly degraded, severely impacting fisheries and fish catches. Mismanaged and unsustainable fishing practices, such as non-targeted bycatch, inefficient fishing gear, and overfishing, further harm ecosystem healthrazmakThere is an immense gap in the knowledge pertaining to the state of ecosystems. An effective understanding of ecosystems is needed to measure baselines and progress in this area. Evaluating ecosystem services and anthropogenic degradation of the environment, will assist in creating market-based mechanisms to pay for such services or compensate for any damages caused.	To sustain the capacity of ecosystems related to fisheries and aquaculture in providing services, it is essential to improve the valuation of these services and enhance restoration efforts. This includes well-managed fisheries, closed seasons for the recovery of natural stocks and the environment, sustainable resource extraction with appropriate fishing gear, and an ecosystem-based approach to sustainable resource management. Continuous evaluation of ecosystem services would provide a highly integrated, multi-sector management tool, combining knowledge from ecology, biology, economics, and social sciences. This valuation would be expressed in monetary terms, making it universally understandable. An example of such a tool is the Natural Capital Project's InVEST (Integrated Valuation of Ecosystem Services and Trade-offs), which offers a suite of open-access software tools for valuing natural capital. However, substantial data is required for its effective application, and a concerted effort in data collection is recommended alongside its use.	1. PPP's and SOE's. 2. Environmental taxes. 3. Blue levies. 4. Natural Asset Companies (NACs) 5. Voluntary PES transactions 6. Blue bonds 7. Environmental bonds 8. Catastrophe bonds 9. Use-of-proceeds bonds 10. Carbon and nutrient trading credits (requires environmental accounting to already be in place)

Table A2. *Cont.*

Financing Need	Description	Potential Solutions	Financing Instrument
Increasing the role of MPAs as fisheries management tool	Marine protected areas (MPAs) and harvest control are incentive-based fisheries management tools that have proven effective over time. Their benefits extend beyond MPA boundaries, including increased biomass and abundance, habitat preservation, reduced mortality, and enhanced growth and reproduction. The effectiveness of MPAs is context-dependent, and it is crucial to implement rules that control and limit fishing around their periphery to realise their full potential. MPAs also present significant opportunities for the eco-tourism sector to benefit from the services they provide. The development of MPAs allows for collaboration between fisheries, tourism, government, the private sector, and donor agencies to acquire resources, expertise, and technical knowledge related to the Blue Economy, helping to address sector challenges. Adequate support structures and education about eco-tourism opportunities may be necessary to implement more MPAs. The culture and traditional fishing methods of fisherfolk can be leveraged to facilitate this transition to eco-tourism by sharing and monetising these experiences for tourists.	A thorough understanding of species distribution and their habitat relationships is crucial for the success of marine protected areas (MPAs), yet this is often insufficient in existing protected areas worldwide, undermining their effectiveness. Each MPA must have its own tailored management plan developed and implemented. Key factors for effective MPAs as management tools include sustainable fisheries management, economic prosperity, the MPA's location, size, and habitats, its connectivity to other MPAs, and the quality of local stakeholders' participation in its management. MPAs should serve not only conservation goals but also the improved management of existing MPAs and the creation of a network of MPAs as part of a targeted fisheries management strategy. MPAs should be designed and managed in areas that significantly contribute to fishery resources. Stakeholders in the industry can be financially incentivised to adhere to and enforce MPA regulations, but a transparent platform or mechanism should be established before this can be effectively implemented.	1. PPP's and SOE's 2. PES schemes 3. Natural Asset Companies 4. Blue levies 5. Leases, Licences, and fees 6. Debt swaps 7. Blue tokens 8. Environmental bonds 9. Catastrophe bonds
Scaling and development of aquaculture and mariculture	The aquaculture and mariculture sectors of the three countries are underdeveloped, but present a means with significant potential to create revenue. With the collective fish stocks predominantly at or above their sustainable harvesting limits, fisheries offer decreasing capacity. Using investment directed at the development of the Blue Economy, upscaling aquaculture and mariculture offers the potential to optimise the benefits received from the development of the marine environment, create sustainable, quality employment, and offer high-value commodities for both export and the domestic market. This area also offers the potential to develop further economic opportunities up- and downstream of the mariculture and aquaculture ventures themselves, creating further livelihoods. The benefits from aquaculture development, including job creation, entrepreneurship, skills development, increased food security, and potentially circular resource use, can be realised more expediently than the transition to sustainable fisheries.	Investment should be directed towards the creation of an enabling environment in which aquaculture operations can flourish, with the required support structures in place (such as veterinary services and distribution chains) to encourage further development. Among some relevant initiatives, Earth Ocean Farms in Mexico use open sea aquaculture technology to cultivate *totoaba* (endangered species) and red snapper (*Lutjanus purpureus*) in their natural environment through cages that are introduced into deep waters with ideal conditions for their growth. Essential for further development of mariculture is the harnessing of external capabilities. Connecting with practitioners experienced in aquaculture activities would provide a valuable resource for the development of mariculture in Caribbean regions. These expert practitioners could deliver key pilot projects that would provide training and capacity building, while developing strategies that prioritise national development in aquaculture and mariculture. Cultivating these connections could provide a significant investment opportunity through international development agencies, while providing a passageway to engaging in purposeful development of mariculture in the Caribbean. Aquaculture financing could happen both at the level of individual projects and at a national level. On a project level, countries that have some aquaculture can mobilise financing for securing production and environmental quality of aquaculture. This can also be promoted through financing of research-based institutions that support aquaculture developers. On a national level, financing is needed for not only creating but, just as importantly, for ensuring that public authorities have the capacity to execute national policies. In Martinique, for example, local support for aquaculture development exists and is aided by local and international (EU) funding mechanisms. Aquaculture research institutions such as 'Delegation Ifremer des Antilles Francaise' (IFREMER) can facilitate collaboration projects to further the development of aquaculture on the island and in the region on a bigger scale.	1. Debt and lending 2. Blue bonds 3. Blue tokens and fintech 4. PPP's 5. Debt swaps 6. Voluntary PES transactions 7. Insurance

Table A2. *Cont.*

Financing Need	Description	Potential Solutions	Financing Instrument
Development of aquaponics and integration into BE development plans	As with aquaculture and mariculture, integrating aquaponics into Blue Economy development strategies alongside fisheries and aquaculture provides a pathway to realise the sustainable intensification of fisheries, aquaculture, food and agriculture. Aquaponics reintroduces biological complexity into agricultural systems, closely guided by knowledge co-creation and sharing processes that aim to maximise synergies. Tackling the region's high food import bill and improving food security is increasingly being explored through aquaponics. An aquaponics industry can facilitate the rearing of fish for high-value protein concurrently with a range of vegetables and other produce, which as an import substitution measure can help reduce dependence on these foreign imports. Depending on market trends, crop production can be rapidly accelerated according to the local, tourism, and export demands. However, it is important to have access to markets that are willing to pay higher prices for superior quality produce. Costs for both construction and operating of aquaponics is fairly high, and production expenses may thus not be recovered without access to high-value markets. The aquaponics initiative may not be profitable without access to, and leverage, in the markets. A great deal of aquaponic businesses have failed—typically due to poor business planning and marketing strategies, rather than production-related issues.	Community driven (potentially PPP) projects could drive development in aquaponics throughout the Caribbean. This may contribute to ensuring the nutritional needs of locals are met despite limited available resources, as well as the potential of generating revenue for community well-being (by selling to premium markets, with sufficient scale). While financing the acquisition of aquaponics infrastructure is straightforward, facilitating access to markets is arguably one of the greatest limiting factors in the development of aquaponics. Market access and transport throughout the Caribbean region are areas towards which investment can be directed as they impact the success (via scalability and long-term sustainability) of any aquaponics venture. In this regard, synergies with the tourism and hospitality (restaurants, hotels, etc.) industry can be developed ensuring a reliable supply of premium produce for local and international tourists. Investment into aquaponics research and training institutions is also advised, as these will yield important contributions such as the profitability of (the appropriate combination of) cultured species. Such centres could also facilitate training in business planning and marketing strategies, in addition to aquaponics production. An enabling environment for aquaponics development is more likely to attract foreign investment and external expertise. A unified system of conformity assessment procedures for testing, inspecting, and certifying aquaponics products for import and export would minimise confusion over trade standards and ensure that all products meet legislative and food safety requirements.	1. PPP's 2. Debt and lending 3. Blue bonds 4. Blue tokens and fintech 5. Debt swaps 6. Voluntary PES transactions 7. Insurance
Develop and integrate aquaculture with alternative and emerging industries	To achieve scalable growth in aquaculture, it is essential to invest in strengthening existing relationships with other sectors and fostering new ones. This approach opens up numerous opportunities through alternative and emerging industries related to aquaculture. There is potential to create synergies between aquaculture and the biomedical industry, where products or byproducts from aquaculture could offer additional resources for alternative biomedical applications. This can be thought of as increasing the value addition potential/capacity of the industry as a whole, whereby development in fisheries and aquaculture thus holds implications for other sectors of the Blue Economy.	For example, tilapia skin from aquaculture farms is used to treat first and second-degree burns in northern Brazil. Once considered a waste product, this skin is rich in collagen, helps protect against infection, speeds up healing, and reduces the need for pain medication. This use of tilapia skin offers a cost-effective way to integrate the aquaculture industry with the medical field, requiring no additional development beyond existing aquaculture practices to enhance food security, livelihoods, and economic growth. Species of Rhodophyta, such as Irish Sea Moss found in the Caribbean, contain unique compounds with various health benefits, making them valuable for biotechnological applications. Seaweeds also play a significant role in agriculture by increasing crop yields as fertilisers and reducing the chemical load on soils and crops. Expanding mariculture to include seaweed extracts in food processing, nutraceuticals, pharmaceuticals, and industrial applications presents significant investment opportunities within the Blue Economy, enhancing sector connectivity and income generation. This approach also addresses the issue of Sargassum seaweed influxes in the region. It is essential to establish appropriate regulations for using these algae in consumption and as fertilisers throughout the Caribbean, especially regarding processing requirements and removing potentially harmful substances from the biomass.The integration of products from aquaculture and aquaponics with emerging industries is research and time intensive. Partnerships with other sector stakeholders may thus be beneficial for developing future mutual benefit.	1. PPPs' and SOE's 2. Blue levies 3. PES schemes 4. Blue bonds 5. Use-of-proceeds bonds 6. Blue tokens and Fintech

Table A2. *Cont.*

Financing Need	Description	Potential Solutions	Financing Instrument
Integrating fisheries and aquaculture into the wider BE	In the context of Blue Economy development at the national level, fisheries and aquaculture should be prioritised. They will remain the primary sources of animal protein and employment for the population, especially with growing efforts to advance aquaculture and aquaponics. Fisheries, as key observers of marine changes, must play a central role in preserving important habitats and rehabilitating degraded ones. This aligns with the Blue Economy approach, which integrates marine biodiversity with coastal habitats to develop solutions beneficial for both biodiversity and climate change mitigation and adaptation. Currently, there are limited coordination mechanisms and no overarching entity to drive Blue Economy development, resulting in a dominance of sectoral approaches. This hinders the ability of countries to effectively design and implement Blue Growth policies and to protect the environment and enhance ecosystem health through the Blue Economy concept. Additionally, there is increasing confusion about the role of the state in each country due to a lack of clear commitment signals. Therefore, structuring the Blue Economy should be the top priority, preceding all other interventions. There is also a lack of an integrated and forward-looking approach to marine ecosystems and spatiotemporal management tools. Neither country has fully adopted the large marine ecosystem approach (Caribbean LME), which would help monitor the evolution of coastal and marine ecosystems using ecological indicators such as biological productivity (particularly fish biomass), pollution (including plastics and chemicals), and ecosystem health. The absence of this approach results in less effective resource and ecosystem management.	The establishment of supra ministerial Blue Economy coordination units in each of the countries respectively will facilitate the integration of the fisheries and aquaculture sectors into the wider BE, by being able to manage its impact relative to other sectors. Such a unit will also be better suited to develop coordination mechanisms between BE sectors with fisheries and aquaculture industries resulting in cross-sectoral synergies and increased development capacity. Improved understanding and comprehension of fisheries and aquaculture value chains and challenges facilitates integration into the wider BE, by being able to identify synergies and opportunities for cooperation with other sectors, and the fisheries and aquaculture sectors and markets of other countries. The development of integrated and spatiotemporal management tools can be coordinated and integrated into fisheries and aquaculture, by a BE unit. A Blue Economy unit with a holistic approach will also facilitate and inform policy decision-making more accurately than individual sector representatives. Adoption and awareness raising of the large marine ecosystem approach among fisheries and aquaculture stakeholders can facilitate a more sustainable and efficient use of available natural resources. Awareness-raising can be facilitated by regional organisations, BE units, NGOs, or the state.	1. Blue levies and stakeholder taxation 2. SOE's 3. Debt swaps
Data limitation among fisheries and aquaculture and lack of policy development	Blue Economy activities and components are currently not accounted for in a unified manner. At present, data must be gathered from various sources to obtain a comprehensive view of the Blue Economy's contributions to added value and job creation. For some sectors, such as ship maintenance, data is not even recorded. Implementing a national accounting system would facilitate the tracking of annual changes in economic sectors. Similarly, ecological aspects of the Blue Economy are not accounted for, despite the valuable ecosystem services provided by coastal areas and their role in mitigating hurricane impacts. However, with the implementation of nationally determined contributions, green and blue accounting should emerge as foundational tools for evaluating specific actions related to climate change. The lack of data results in uninformed decision making and inadequate fisheries and aquaculture policy making, negatively affecting the industry.	A national organisation for Blue Economy accounting (and environmental accounting) could regulate the accounting of BE activities. This thus ensures that the data from a wide variety of sources is verified and coordinated, meaning that it can be used to inform decision-making relating to climate-change, and industry development. Policy-making needs to be informed by available data, and where it is missing, similar examples (of other countries' fisheries and aquaculture sectors) can be used as proxies (if appropriately similar). Where such an organisation is missing, an easy to use platform for recording data in fisheries and aquaculture is necessary. The design of the platform should be such that it encourages unambiguous data input and should use data already generated/collected by industry stakeholders. Incentivising stakeholders to encourage honest data reporting of fishing activities (such as through tax exemptions or non-government subsidies) may contribute to filling the data limitation.	1. PPP's and SOE's 2. Blue levies and stakeholder taxation (and exemption) 3. Fintech 4. Use-of-proceeds bonds
An enabling environment for fisheries and aquaculture investment	Banking mechanisms are inadequate, and financial markets remain underdeveloped. In this context, a transparent policy framework adhering to emerging blue finance principles (such as those from UNEP-FI) could help build investor confidence. Creating a supportive environment for sustainable financing of fisheries within the broader Blue Economy will require focused attention, particularly in relation to addressing national debt.	The recent Caribbean Blue Economic Financing Project (Caribbean BlueFin) offers a chance to strengthen the capacity of selected countries and establish an environment conducive to private sector involvement and investment in the Blue Economy.	1. Debt and lending 2. Insurance 3. Fiscal Policy 4. Debt swaps

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