National Science Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Report

Encouraging restorative economies in Aotearoa New Zealand's marine and coastal space

Cortés Acosta S, Stancu C, Brown I & Bridger T

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Report for Sustainable Seas National Science Challenges Project

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Report authors

Cortés Acosta S, Stancu C, Brown I & Bridger T

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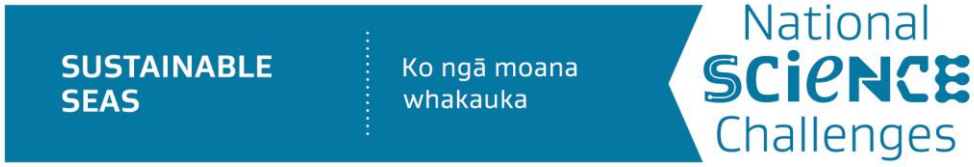
For more information on this project, visit:
https://www.sustainableseaschallenge.co.nz/our-research/restorative-marine-economies/



About Sustainable Seas Challenge

Our vision is for Aotearoa New Zealand to have healthy marine ecosystems that provide value for all New Zealanders. We have 60+ research projects that bring together around 250 scientists, social scientists, economists, and experts in mātauranga Māori and policy from across Aotearoa New Zealand. We are one of 11 National Science Challenges, funded by Ministry of Business, Innovation & Employment.

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Cover image: Auckland City. JP Yepez. Actively restored mussel bed in Mahurangi. Revive Our Gulf

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Disclaimers

Glossary of terms

Biocapacity refers to "[t]he biological capacity of ecosystems to regenerate what people demand from them. In other words, it refers to the ecosystems' capacity to produce biological materials used by people and to absorb waste material generated by humans, under current management schemes and extraction technologies. Biocapacity can change from year to year due to climate, management, and also what portions are considered useful inputs to the human economy" (Global Footprint Network, 2021).

Blue carbon refers to carbon stored in coastal and marine ecosystems.

Blue carbon ecosystems have four main dimensions that can be mapped: extent, carbon stock, rate of carbon accumulation and loss, and species composition (Blue Carbon Partnership, 2021).

Blue economy refers to marine and coastal activities that generate economic value and contribute positively to social, cultural and ecological wellbeing (The Sustainable Seas).

Blue growth is an equivalent concept to 'green growth' (FAO, 2017; OECD, 2011b) involving interconnected aspects of coastal and marine development and holistic management of complex marine social-ecological systems (Eikeset et al., 2018; EnviroStrat, 2019).

Business as usual refers to standard day-to-day business operations with no acute sense of improvement or that the availability of inputs may change.

Coastal and marine environments "can start on up to 100 kilometres inland, extend to the continental shelf, and include ocean systems with waters up to 50 meters in depth. The diverse marine ecosystems found in these environments comprise estuarine and coastal wetlands, including marshes and mangroves, seagrass beds, sand beaches and dunes, and coral and oyster reefs" (Barbier, 2017, p. 507).

Critical natural capital is part of the natural capital that performs essential and irreplaceable environmental functions (Jax, 2005) and provides particular services to society, also known as ecosystem services (Böhnke-Henrichs et al., 2013; de Groot et al., 2010) or nature's contribution to people (IPBES, 2019); that cannot be substituted by other types of built capitals (Brand, 2009; De Groot et al., 2003; Dietz & Neumayer, 2007); and are needed to generate benefits or positive outcomes for humans now and into the future.

Ecological footprint is "[a] measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices" (Global Footprint Network, 2021).

Economic activity is the combination of actions and processes that, based on inputs, results in a specific set of products or services.

Ecosystem-based management is a holistic and inclusive way to manage marine environments and the competing uses for, demands on, and ways that New Zealanders value them (Sustainable Seas National Science Challenge).

Ecosystem services are the direct and indirect contribution of ecosystems to human wellbeing (Böhnke-Henrichs et al., 2013; de Groot et al., 2010).

Environmental markets are markets that trade environmental commodities and involve multiple exchanges of credits or allowances. This definition includes markets for greenhouse

gases (GHGs), water quality or nutrient discharge allowances, water quantity and biodiversity (Greenhalgh et al., 2010). These can be compliance or voluntary markets.

- **Compliance markets (also known as mandatory or regulatory markets)** are commonly created and regulated by mandatory government regulations.
- **Voluntary markets** are typically driven by consumer preferences and are not established or enforced by governments but may be overseen and acquire authority to operate through governance arrangements put in place by NGOs or a consortium of NGOs.

Externality refers to a situation where the production or consumption of a good or service imposes benefits (or costs) on others not directly related to their production or consumption. Additionally, benefits (or costs) are not reflected in the price charged for the goods or services.

Green growth "means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our wellbeing relies. To do this it must catalyse investment and innovation, which will underpin sustained growth and give rise to new economic opportunities" (OECD, 2011b, p. 9).

Irrecoverable carbon refers to carbon that (i) can be influenced by direct and local human action, (ii) is vulnerable to loss during a land-use conversion and (iii), if lost, could not be recovered within a specified timeframe (Goldstein et al., 2020, p. 289).

Marine economy/Ocean Economy refers to all economic activity in and around the marine environment, sustainable or otherwise.

Nature-based solutions refers to “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits" (Cohen-Shacham et al., 2016, p. 4).

Natural capital refers to the stock of natural resources including geology, soils, air, water and all living organisms.

- **Living natural capital** is the renewable stocks of natural resources that are harvested for use, such as fisheries.
- **Non-living natural capital** is non-renewable stocks of natural resources harvested for use, such as minerals from the seabed.

Nature's contributions to people refers to “all the contributions that humanity obtains from nature. Ecosystem goods and services, considered separately or in bundles, are included in this category. Within other knowledge systems, nature's gifts and similar concepts refer to the benefits of nature from which people derive good quality of life. Aspects of nature that can be negative to people (detriments), such as pests, pathogens or predators, are also included in this broad category" (IPBES, 2019).

Ocean economy refers to the sum of the economic activities of ocean-based industries, assets, goods, and services of marine ecosystems (OECD, 2016). This definition does not imply sustainability of these activities. In this report, it is equivalent to the marine economy.

Ocean natural capital is the total available biophysical stock of natural resources in the ocean, for example, fish stocks, minerals and energy resources, mangrove forests, and so on (Patil et al., 2016).

Acronyms

BAU	Business as Usual
EBM	Ecosystem-Based Management
ES	Ecosystem Service
ESG	Environmental, Social and Governance
IOC	Intergovernmental Oceanographic Commission
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
NbS	Nature-based Solutions
OECD	Organisation for Economic Co-operation and Development
REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
StatsNZ	Statistics New Zealand
TCFD	Taskforce on Climate-related Financial Disclosure
TNFD	Taskforce on Nature-related Financial Disclosure
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation

CONTENTS

Executive summary

This report is a starting point in the development of knowledge, frameworks, and decision-support tools to enable restorative economies to emerge in marine and coastal spaces in Aotearoa New Zealand. It is part of a broader area of research on Blue Economy under the Sustainable Seas National Science Challenges.

Purpose

Although the notion and definition of restorative economies continue to evolve, these refer to the melding of environmental restoration and business activities. Restorative economies are practical models that foster new investments and business enterprises aiming to reverse environmental degradation and protect natural capital.

The purpose of this report is to take stock and contribute to the knowledge foundation for encouraging restorative economies in Aotearoa New Zealand.

Scope of the report and methodology

The development of this report is based on:

- A literature review of concepts, such as the blue economy, natural capital (i.e. the stock of natural resources) from the perspective of sustainability of the economy, and ecological restoration.
- A desktop review on several international and domestic examples of restorative initiatives to learn about the range of blue ecosystems covered, the scale and the scope of the initiative, key players, and funding sources.
- A discussion of potential barriers and opportunities for restorative economies in the country.

Insights

We have studied several international and domestic restorative initiatives and identified common features, including:`

- The scope of the restoration varies from small community-based solutions to large scale projects and from a single ecosystem (e.g. mangroves) to multiple ecosystems.
- Funding has been typically diverse, including private, philanthropic and governmental sources. Investors and stakeholders typically invest in nature with no financial return, using mechanisms such as grants or donations.
- Local volunteers have played a large part in the success of the restoration initiatives, particularly the larger-scale projects.
- Local communities recognise and gain benefits from the restoration initiative.
- Upscaling is possible within an ecosystem through species expansion or by restored ecosystems (e.g., mangrove, seagrass). This is because biodiversity can flourish in these areas.
- Science and research are deployed in restoration design and implementation, as well as monitoring and reporting.

A restorative economies assessment can be performed holistically by reviewing at least four attributes – social, cultural, environmental, and financial. Combining metrics with the results of an assessment is essential to identify and prioritise specific needs and opportunities for investment.

A series of barriers and opportunities were identified in the report, including:

- Public and private investment involves multiple barriers (e.g. knowledge-gaps and uncertainty of implementation). Additionally, the infancy of environmental markets and blue carbon will be a challenge (e.g. the uncertainty of implementation and information gaps).
- In regard to opportunities, we consider the current context internationally and in New Zealand, and the insights from the examples studied to identify motivations and demand for restoration and nature-based solutions (NbS) more broadly. We discuss:

  (i) the creation of NbS for New Zealand,

  (ii) enhancement of the knowledge base for NbS,

  (iii) connecting place-based solutions, and

  (iv) using public and private investment opportunities.

Further steps in developing restorative economies

This report focuses on the concept of restorative economies as part of the blue economy agenda. Further research is needed with a focus on practical ideas that contribute to the development of restorative economies by addressing key bottlenecks in knowledge, tools, and practices regarding financial and non-financial returns of ecosystem level solutions. This includes measurement and verification methodologies and protocols in coastal and marine environments. This covers natural capital valuation and accounting, and biodiversity, climate and social outcomes that are needed for the development of investment opportunities for revenue-generating and market-based solutions in Aotearoa New Zealand's context. It also requires identification and testing of attributes and metrics that underpin the value proposition of restorative economies and options to manage all capitals (natural and built) in support of human wellbeing and development.

Research and prototyping of options to foster the use of biodiversity and ecosystem-related data using digital platforms – in relation to environmental markets (carbon, nutrient and biodiversity credits) or traditional products and services (aquaculture, fisheries, energy, etc.), would also help progress the knowledge and solutions for restorative economies.

Introduction

This report is part of a series of literature reviews aimed to establish the knowledge foundations for the research project *"Restorative marine economies: Encouraging restorative economies in Aotearoa New Zealand's marine spaces".* The research project aims to develop knowledge, frameworks, and decision-support tools to enable restorative marine economies to emerge. It is part of *Theme 2: Creating Value from a Blue Economy* (phase II of the Sustainable Seas National Science Challenges).

The ocean is essential to help meet society's growing marine and coastal resources demand and the services they provide (Barbier, 2017; Costanza et al., 1997; World Bank & United Nations, 2017). However, the impact of land-driven and sea-based activities, alongside growth in the use of these resources places increasing stress on this ecosystem. In this research, we focus on the role of the ocean in national economies alongside the needs of protecting ecological and environmental coastal and marine resources.[1]

New visions of economic possibilities that identify and capture multiple benefits (rather than solely profit maximisation), are emerging (The Economist Intelligence Unit, 2015). The Dasgupta Review highlights the need to treat nature and ecosystems as natural assets (or natural capital in economic terms). It calls for investment in ecosystems to enhance the supply of their services (particularly maintenance and regulating services). This investment is seen as essential for transitioning to a sustainable economic development pathway (Dasgupta, 2021a).

Marine and coastal activities that both generate economic outputs *and* contribute to human wellbeing are also known collectively as the blue economy. In Aotearoa New Zealand for instance, moving towards a blue economy requires activities that are sustainable and resilient, minimise waste and climate change impacts, and drive and promote environmental stewardship and wellbeing (Lewis, 2021). It is also necessary to revise current practices and regulations, develop new technologies, build knowledge based on robust scientific results and indigenous knowledge, and adapt or improve performance measurements (Hewitt et al., 2018).

In Aotearoa New Zealand, there is increasing interest from iwi, communities, businesses, the sustainable finance sector and councils in initiatives that reverse environmental degradation and achieve multiple benefits – economic, environmental, social, and cultural (EnviroStrat, 2019). We refer to these initiatives as restorative economies. In the marine realm, examples of restorative economies may include multi-trophic aquaculture or specific local initiatives, such as restoration of seafloor shellfish beds, tidal wetland restoration or eco-tourism.

The overarching questions that motivate the current report are: at what point do restorative initiatives become part of the (blue) economy (i.e., are seen as an economic activity)? and what are the barriers and opportunities for restorative economies? We understand restorative economies as practical models that foster new investments and business enterprises aiming to reverse environmental degradation and protect natural capital. We make several assumptions in this regard:

- Restoration will create multiple ecosystem benefits such as habitat creation, water quality improvement, climate change mitigation and adaptation that contribute to wellbeing.

[1] See Sustainable Seas National Science Challenge (2021).

- Many of these benefits are quantifiable, some are verifiable and can be potentially monetised.
- Active investment in ecosystems and nature-based solutions will occur if we can identify, qualify, and quantify benefits.

We conduct a desktop review looking at international and Aotearoa New Zealand examples of restorative initiatives in marine and coastal environments to identify common features and trends. Through this review, we aim to learn about the range of blue ecosystems covered, the scale and the scope of initiatives, key players, and funding sources. We have learned, for example, that in most cases, funding for the documented restoration examples was initially motivated by ecological outcomes (e.g., to support objectives of coastal wetland planning) rather than by potential financial returns.

We begin with a brief overview of the concept of the blue economy to provide context for the discussion. We examine the importance of natural capital from the perspective of sustainability (weak versus strong) of the economy. This is followed by a more detailed discussion of the concept of restorative economies and how it fits within the blue economy. Later, we present international and domestic examples of restorative economies. We conclude with a section covering potential barriers and opportunities for restorative economies and recommendations for further research.

Blue economy: a new vision for restoring marine and coastal ecosystems

The ocean is a critical contributor to economic growth and helps mitigate the impacts of climate change by serving as a major heat and carbon sink, which in turn affects marine biodiversity and food security. Marine and coastal ecosystems are essential to help meet society's growing demand for food, energy, employment, medicines and transport through the services they provide (Barbier, 2017; Costanza et al., 1997; World Bank & United Nations, 2017). However, the impact of land-driven and sea-based activities, alongside growth in the use of these resources, places more stress on marine and coastal ecosystems and their ability to continue maintaining and providing these functions. Thus, the use of the ocean and its natural resources must also involve consideration of its uniqueness and vulnerability, and actions to prevent its depletion (Stuchtey et al., 2020).

In the report *The Ocean Economy in 2030*, the OECD (2016) underlines that the ocean economy encompasses ocean-based industries, such as fishing, shipping and, marine biotechnology. It includes natural assets and ecosystem services, such as fish, shipping lanes or carbon dioxide (CO_2) absorption, among others. As part of the report, the OECD makes several recommendations to enhance the sustainable development of the ocean, and the long-term growth prospect of emerging ocean-based industries, including:

- To encourage greater international cooperation in marine science and technology to promote innovation and boost the sustainable development of the ocean economy.
- To reinforce integrated ocean management.
- To enhance the statistical and methodological base, both national and international, for assessing the scale and performance of ocean-based industries, and their contribution to the overall economy.
- To build more capacity for ocean-based industries foresight.

Nevertheless, the rapid increase of economic activities that exploit the ocean and its coasts leads to concerns about the declining state of marine ecosystems (Barbier, 2017) and the impact on livelihoods. Furthermore, the impacts of climate change are escalating potential risks that could prevent capturing future opportunities of emerging ocean-based industries, even if these are designed under a blue economy basis.

The term blue economy has emerged with overlapping and distinct views, involving interconnected aspects of coastal and marine development and holistic management of complex marine social-ecological systems (Colgan, 2016; Eikeset et al., 2018; EnviroStrat, 2019). Therefore, there is still no universally accepted definition of the blue economy, despite an increased use of the term to guide investment or policy making.

Many agencies and organisations are working on developing an understanding of the blue economy concept. According to the World Bank, the blue economy "seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas" (World Bank & United Nations, 2017).

WWF (2018) has developed a set of principles for a sustainable blue economy to:

(i) help ensure that the ocean economic development contributes to true prosperity today and long into the future, and

(ii) fill a gap in shared understanding about what characterises a sustainable blue economy (see Figure 1).

For the purposes of this document, we use the term blue economy and sustainable blue economy interchangeably.

Figure 1. Principles for a sustainable blue economy. Adapted from WWF (2018)

With increasing awareness of the role of the oceans in national economies, several countries have begun to make steps to measure the ocean economy (Colgan, 2016). Australia, Scotland and Canada have developed blue economy strategies following definitions and principles that recognise their specific contexts and the core dimensions of sustainable development – environmental, social, cultural, and economic (EnviroStrat, 2019). However, further work is still needed to incorporate natural capital and marine ecosystem services into national income accounting as a means to measure and track the contribution of the blue economy.

In Aotearoa New Zealand, there is no commonly agreed definition of the blue economy. However, the Sustainable Seas National Science Challenges has proposed that the blue economy refers to marine and coastal activities that "generate economic value and contribute positively to social, cultural and ecological wellbeing" (Lewis et al., 2020). We add a spatial dimension to this definition to include estuaries and nearshore coastal zones, because numerous economic development opportunities for the blue economy are inherently associated with the land-sea interface. Therefore, in this research, we focus on the role of the ocean in national economies alongside the needs of protecting ecological and environmental coastal and marine resources.

The blue economy seeks a transition from business as usual (BAU) to an alignment of the ocean's health with new economic opportunities (World Bank & United Nations, 2017). As shown in Figure 2, this requires reducing the environmental impacts of current marine economy industries (see Evolving), pursuing emerging opportunities for circularity and zero impact (see Emerging), to creating new business value from active investment in ecosystems restoration (see Prospective) (EnviroStrat, 2019).

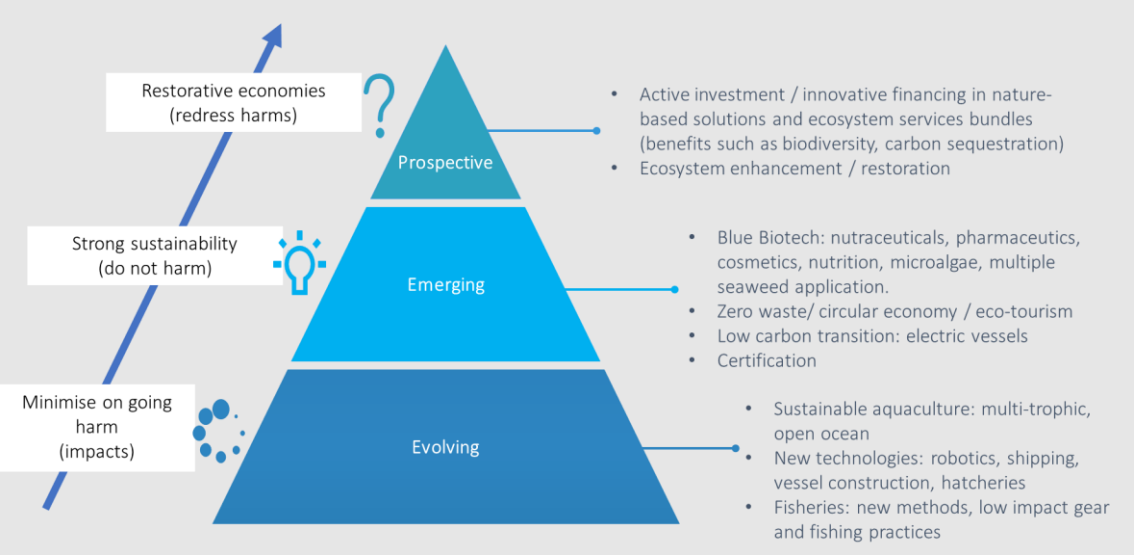

Figure 2. Blue economy spectrum. Adapted from EnviroStrat (2019).

Dasgupta (2021) argues for the conservation and restoration of ecosystems (across seascapes and landscapes), and highlights the importance of investment in natural capital:

> Conserving and restoring our natural assets will sustain and enhance their supply … Large-scale and widespread investment in Nature-based Solutions would help us to address biodiversity loss and significantly contribute to climate change mitigation and adaptation, not to mention wider economic benefits, including creating jobs. (p. 3)

The importance of natural capital

Nearly 20 years after the publication of *Blueprint for a Green Economy*, Barbier and Markandya (2012) published *A New Blueprint for a Green Economy* to revisit and update their original publication. The authors emphasise that to meet the requirements for intergenerational equity and non-declining consumption over time, each generation must pass on an undiminished stock of natural capital to the next. In this context, Barbier and Markandya (2012) argue that sustainable development has as its primary purpose:

> *the search for a path of economic progress which does not impair the welfare of future generations," which also implies "that the role of maintaining environmental quality in this process of sustainable economic progress must be ranked higher than in the past.* (p. 37)

Barbier and Markandya (2012) discuss two different approaches that have emerged from reviewing the role of the environment in sustainable development. The first, a systematic approach, which aims to maximise goals across ecological, economic, and social systems. The second, a capital approach, which translates development into economic terms when the present needs are fulfilled, without compromising future needs. The latest approach has advanced into a debate over weak and strong sustainability.

Weak sustainability	No difference between natural and built capitals: physical and human.
	As long as depleted natural capital is replaced with even more value physical and human capital, then the value of the aggregated stock will increase.
	Sustainability requires maintaining and enhancing the value of the aggregate capital stock.
Strong sustainability	Cannot view natural, physical and human capitals as a homogeneous stock.
	Cannot always substitute for natural capital, as uncertainty over current and future values of ecological goods and services, unique environments and biodiversity mean that some natural capital is essential and cannot be replaced.
	Sustainability requires maintaining and enhancing the value of the aggregate capital stock and preserving essential natural capital.

Figure 3. Comparison between weak and strong sustainability. Adapted from Barbier and Markandya (2012).

As described in Figure 3, the differences between weak and strong sustainability are not easily reconciled. The disagreement focuses on substitutability among natural and built capitals[2] (Daly, 2007; Neumayer, 2003).[3] Brand (2009) explains that the concept of "critical natural capital" arose as a way to find a balance between both sustainability positions.

Critical natural capital can be understood as the part of natural capital that:

- Performs essential and irreplaceable environmental functions (Jax, 2005) and provides particular services to society, also known as ecosystem services (Böhnke-Henrichs et al., 2013; de Groot et al., 2010) or nature's contribution to people (IPBES, 2019)[4];
- Cannot be substituted by other types of built capitals (Brand, 2009; De Groot et al., 2003; Dietz & Neumayer, 2007); and
- Are needed to generate benefits or positive outcomes for humans now and into the future.

A key consideration regarding “critical” is that human activities can also modify natural capital, affecting its ecological, socio-cultural or economic importance (Brand, 2009). Ecosystem services creating human wellbeing have different types of impacts on coastal and marine natural capital. This reciprocal relationship closes the loop and could inform management and

[2] We use “natural and built” terminology as used in the *Natural and Built Environments Bill 2021*. This bill has been proposed as the primary replacement for the Resource Management Act to protect and restore the environment, while better enabling development (Ministry for the Environment, 2021a).

[3] Although it is outside the scope of this paper to discuss what type of capitals ought to be protected and maintained to meet human needs, now and in the future, it is worth mentioning that several capitals are considered in this debate, including natural capital (e.g. marine ecosystems), cultivated natural capital (e.g. salmon farms), social capital (e.g. political institutions), human capital (e.g. skills or education) and physical capital (e.g. infrastructure) (Costanza et al., 2007).

[4] Nature's contributions to people and to ecosystem services tend to be used interchangeably, but in the literature they are not defined as having the same meaning.

conservation measures. Thus, critical might be defined by the levels of importance of the natural capital, degrees of threat to the natural capital, or irrecoverable carbon (Figure 4).

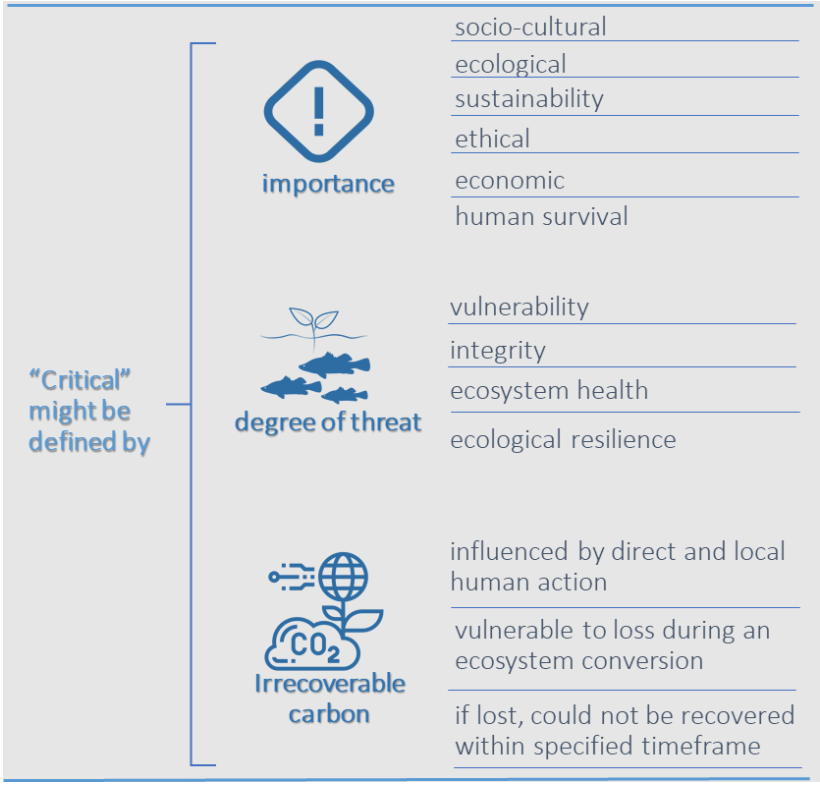

Figure 4. A conception of critical. Adapted from Brand (2009) and Goldstein et al. (2020).

Goldstein et al. (2020) present a framework for assessing 'irrecoverable carbon' describing three dimensions to be considered when prioritising actions for ecosystem stewardship or climate change mitigation:

- Manageability at the local scale: whether an ecosystem's carbon stock is affected primarily by direct human actions that either maintain (e.g. conservation), increase (e.g. restoration) or decrease (e.g. land conversion) its size.
- Magnitude of vulnerable carbon: the net change in carbon sequestered or released if the focal habitat type is altered (fragmented, expanded, degraded, restored, or converted to a different habitat type, e.g. from sandflat to seagrass meadow).
- Recoverability of ecosystem in carbon, if lost: the fraction of vulnerable carbon that could be recovered following a conversion event, assessed as a function of time and average sequestration rates.

Concept of ecological restoration

Analogous to the concept of the blue economy, ecological restoration has several definitions, resulting in additional complexities and debates. Given that commonly used concepts might reflect society's views on them and expressions of values, definitions can be arbitrary. Although it is not our goal to fully engage in this debate, we provide some examples of how restoration has been defined in the literature, since this is relevant to the proposition that restoration is required to replenish natural capital (an essential component of restorative economies, as discussed in the next section).

Bradshaw (2002), for instance, provides a comprehensive literature review on definitions and debates regarding the concept of restoration. He studies the scope of 'restoration' and whether it exclusively suggests halting the degradation of an ecosystem, or recognising the natural capital available from the ecosystem as an asset. This author concludes that the meaning of the word 'restoration' is complicated by perfectionist implications, questioning whether restorative projects can be unconditionally regarded as successful restoration. Although terrestrially focused, Bradshaw (2002) describes restoration as,

> *all those activities which seek to upgrade damaged land or to recreate land that has been destroyed and to bring it back into beneficial use, in a form in which the biological potential is restored.* (p. 7)

The National Research Council et al. (1992) defines restoration as "the return of an ecosystem to a close approximation of its condition prior to disturbance" (p. 18) recognising two levels of possible restoration. The first, repairing the ecological damage. The second, recreating both the structure and the functions of the ecosystem. Both levels are incorporated into the meaning of the term restoration. The National Research Council et al. (1992) states,

> *Merely recreating the form without the functions, or the functions in an artificial configuration bearing little resemblance to a natural resource, does not constitute restoration. The goal is to emulate a natural, functioning self-regulating system that is integrated with the ecological landscape in which it occurs.* (p. 18)

Martin (2017) states that one of the most accepted definitions was published in 2004 in *The SER International Primer on Ecological Restoration*, "The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (p. 3).

Restoration of the ocean and its coasts, however, has been defined in the UN Environment Programme & FAO (2021) as "reducing the pressure on those ecosystems so they can recover, both naturally and by re-seeding or transplanting key species. It also means understanding how to make both ecosystems and communities more resilient in the face of global change".

More recently, Dickson et al. (2021) discuss various approaches that contribute to conserving and repairing damaged ecosystems. They propose nine guiding principles for the UN Decade on Ecosystem Restoration (see Figure 5) and emphasise that,

> *This [ecosystem restoration] may involve active restoration or the removal of drivers of degradation to 'passively' promote natural regeneration. Whatever the approach, restoration requires time, resources, knowledge, enabling policies and governance if it is to contribute to human wellbeing, economic development, climate stability and biodiversity conservation.* (p. 30)

For the purpose of this research, we use the definition proposed by the UN Environment Programme & FAO (2021), and consider restoration to involve all measures focused on reducing and removing drivers of ecosystem degradation; this includes measures for recreating ecosystems.

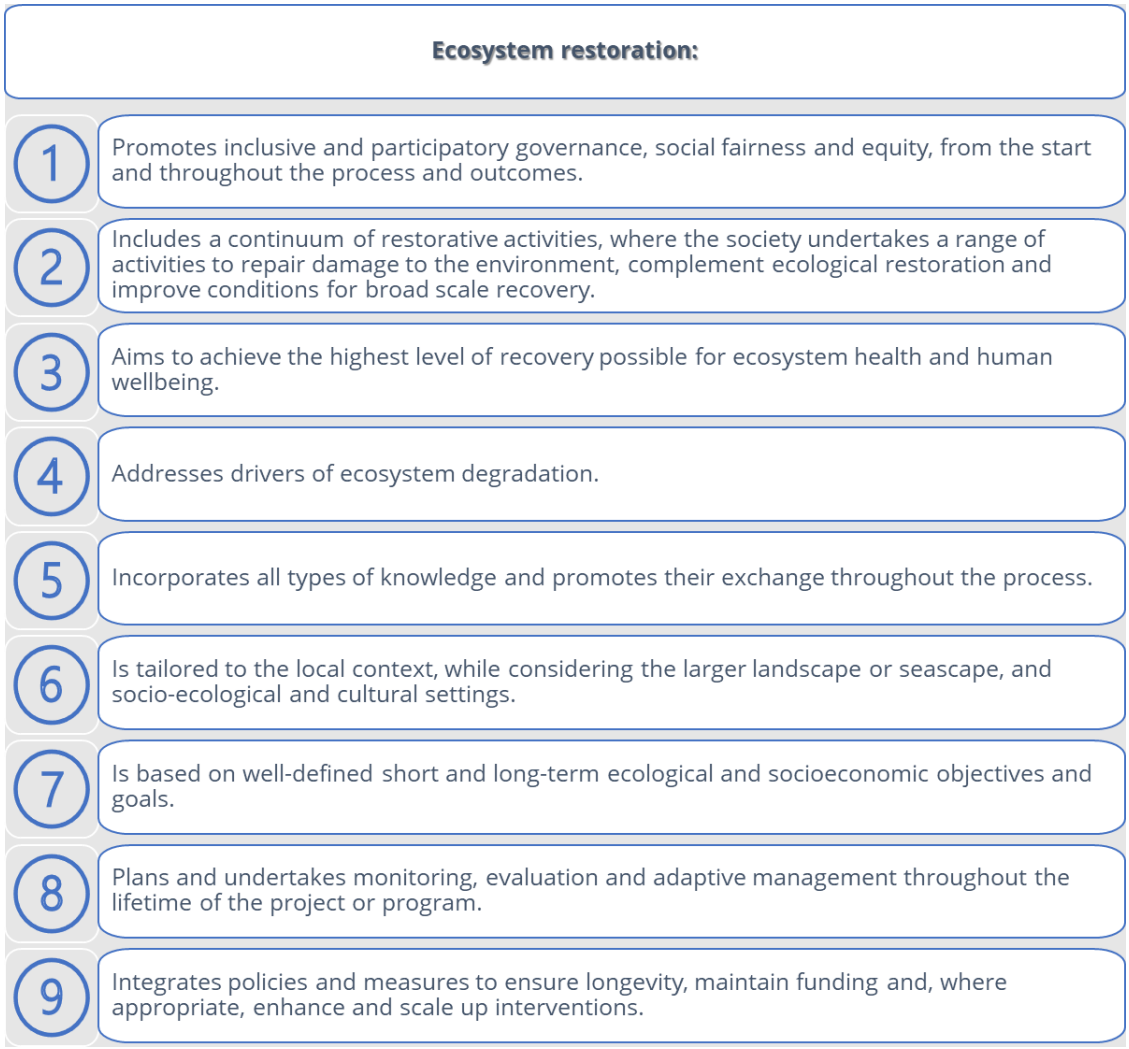

Figure 5. Ecosystem restoration principles. Adapted from Dickson et al. (2021, p. 33) and Gann (2017).

Towards restorative economies

In general terms, restorative economies are practical models that aim to reverse environmental degradation and build natural capital by fostering new investments and business enterprises. These models actively seek to enhance the biodiversity and health of degraded ecosystems instead of ignoring degradation or contributing to it (Hawken, 2010; Hewitt et al., 2018). Although the notion and definition of restorative economies continues to evolve, the term refers to the melding of environmental restoration and business activities. In *The Ecology of Commerce: A Declaration of Sustainability*, Hawken (2010) argues that:

> *A restorative economy tries to create a market in which every transaction feeds the integrity of the commons, as opposed to what we know today, when consumption causes degradation and harm.* (p. 100)

Hawken uses two concepts– commons and externalities, which have been the centre of debate, especially in economics literature since the 1950s.[5] The concept of commons has been used interchangeably with free or open-access resources, however, it is not a synonym for common-property resources.[6] In this regard, Elinor Ostrom's research provides several examples in which resources held in common have been used effectively, if not efficiently (Ostrom, 1990, 1999; Ostrom et al., 1999; Ostrom & Hess, 2007). By contrast, open-access resources have hardly ever been used effectively.

Externalities are also discussed in *The Dasgupta Review* from the perspective of market difficulties in adequately recording the use of nature's goods and services and assigning them a price, as well as the underlying challenge of defining property rights to goods and services that are mobile (i.e. much of nature consists of 'fugitive resources'). Moreover, the harms caused to nature are non-excludable, that is, it is not possible for people to pick and choose who is affected (Dasgupta, 2021a).

Externalities can be positive of course, in which case, it is often not feasible for anyone to make a profit from them. An extreme form of positive externalities is provided by public goods – goods and services that are neither rivalrous nor excludable. Open-access resources are thus a mirror image of public goods (Dasgupta, 2021a).

In the case of our analysis, it is likely that restorative economies occur in common-pool resources (CPRs) given that the ocean is, broadly speaking, a public good. Following Ostrom (1990), CPRs denote natural or human-made "resource systems" (e.g. an aquaculture farm) that generate flows of usable "resource units" (e.g. seaweed per hectare or blue carbon units) over time. Given that CPRs are characterised by rivalry and difficulty of exclusion (Ostrom & Hess, 2007), it may be necessary to consider alternative layers of property rights in order to overcome resource degradation (Agrawal, 2001; Schlager & Ostrom, 1992) and to incentivise investment.

A theoretical example: the relationship between natural capital, consumption, and restoration

Let us imagine a particular natural capital stock consumption rate, such as the number of a specific fish species in one year in a fishery. Note that in this context, consumption is associated with the use of a natural capital stock either for human purposes or other factors that negatively affect it (e.g. changes in the temperature of the water or the acidity of the ocean). Figure 6 shows three different consumption levels (C1, C2, C3) and their potential effect on the yield from a fishery. Note that X represents the biomass (e.g. fish stock) and F(X) represents the instantaneous growth of the biomass (e.g. the reproduction or growth rate of the fish).[7]

A consumption rate of C_1 extinguishes the fish stock because C_1 is always greater than the growth or reproduction rate of the fish. A consumption rate of C_2 leads to the maximum yield

[5] In 1954, Gordon initiated a discussion of the potential externalities involving common-pool problems on marine fisheries, affirming that "everybody's property is nobody's property" (p. 135). Soon After, Hardin (1968) introduced the concept of the "tragedy of the commons" by using as an example of overgrazing as a result of "pasture open to all". However, Hardin's observations neglected to consider that some resources held in common are not open to all.

[6] For further discussion see for example Frischmann et al. (2019).

[7] We assume that F(X) follows a parabolic pattern of growth given that on the increasing part of the curve, resources (e.g. prey, shelter) are plentiful and instantaneous biomass growth increase rises as population size grows. On the decelerating part of the curve, population size is expanding towards the point where the environment can no longer support it and mating pairs do not have enough resources to reproduce beyond replacement.

(X_{MY}) from the fishery. A consumption rate of C_3 is equal to the growth in fish stock at two different stock levels, X' and X". Yield X' represents an unstable state. If biomass dips below X' with a consumption rate of C_3 or higher, the stock will collapse to zero or will be extinguished. However, for all levels of biomass greater than X', a consumption rate of C_3 will result in a stable equilibrium at the much higher biomass of X". Thus, where consumption is C_3, only X" is a stable equilibrium.

The critical natural capital from the fishery would be subject to levels of consumption, importance, the degree of threat, or the need for prioritising actions for its stewardship or climate change mitigation.

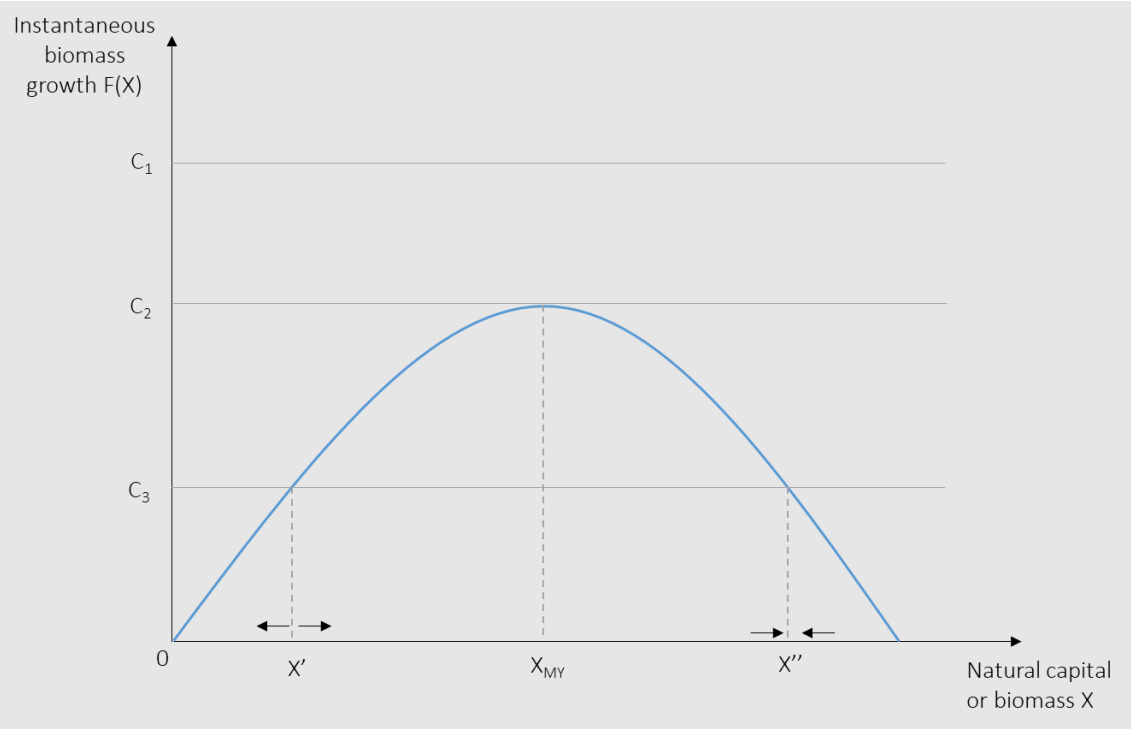

Figure 6. Instantaneous biomass growth and natural capital – an example. Adapted from Hartwick and Olewiler (1997).

Figure 7 shows a relationship between natural capital stock, consumption rate, and restoration. We assume that the consumption rate is constant in time and located somewhere between C_2 and C_3 (as represented in Figure 6). Panel A represents a situation in which natural capital has been exploited or over consumed. The dotted line represents a switch to restorative economies. In panel B, the depletion of natural capital is avoided because the consumption rate decreases, while the scale of ecological restoration increases over time.

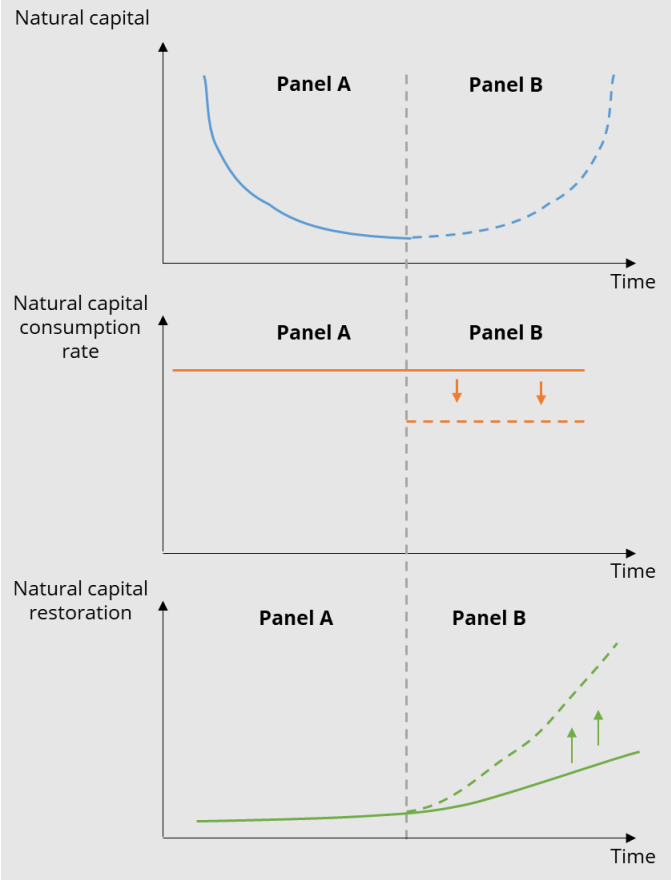

Figure 7. A relationship between natural capital, consumption, and restoration – an example.

From theory to practice

To provoke the discussion regarding the importance of recognising natural capital to the economy, we look at the ecological footprint and the biocapacity of Aotearoa New Zealand (Global Footprint Network, 2021). Although the ecological footprint does not refer specifically to the contribution of coastal and marine ecosystems, it is one of the environmental measures that captures natural assets and ecosystem services at a national level.

As shown in Figure 8, in 1961, New Zealand biocapacity was 18.6 global hectares (gha) per person, and the ecological footprint[8] was 4.8 gha per person, representing a biocapacity reserve of 13.8 gha per person.[9] By contrast, in 2017, although the ecological footprint remains almost the same (4.7 gha per person), the biocapacity declined to 9.2 gha per person as a result of consumption, representing a biocapacity reserve of 4.8 gha per person.

[8] As explained by the Global Footprint Network, global hectares are the accounting unit for the ecological footprint, because trade is global, an individual or country's footprint includes land or sea from all over the world. A global hectare is a biologically productive hectare with world average biological productivity for a given year.

[9] Biocapacity reserve is the subtraction between biocapacity and ecological footprint.

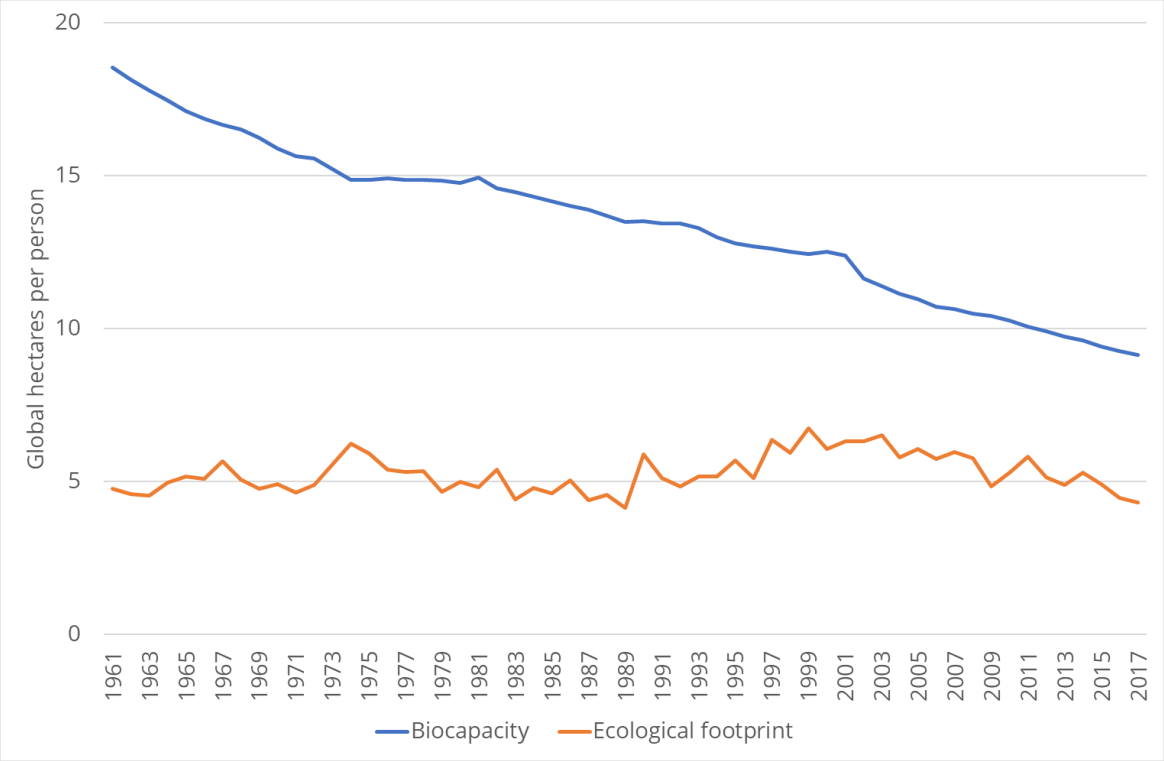

Figure 8. The ecological footprint and the biocapacity for Aotearoa New Zealand (1961 – 2017) (Global Footprint Network, 2021), accessed on 16 June 2021.

In the case of the blue economy, Yeoman et al. (2019) provide the first estimate for Aotearoa New Zealand– $7.4 billion (around 3% of gross domestic product (GDP)), comprising those related sectors that directly rely on the maritime area. They also estimate that the blue economy generates nearly 70,000 direct jobs, equivalent to 3.3% of total employment in the country. In comparison, Stats NZ (2019) estimates that, in the year ended March 2017, the marine economy contributed $3.8 billion directly to New Zealand's economy (around 1.4% of GDP) and a further $3.2 billon indirectly, bringing the total value of the marine economy to $7.0 billion (approximately 2.6% of GDP).

However, Yeoman et al. (2019) argue that the Sustainable Seas National Science Challenge's blue economy definition is aspirational from a measurement point of view. Although the authors employ the term blue economy to capture this aspiration, the statistics used are related to the current sectors of the marine economy activity.[10]

As an accounting issue, neither of the two estimates capture the value of natural capital and services (unless it is monetised, as in the case of fisheries), or the revenue generated from restoration (environmental expenditure) related to the maintenance of marine and coastal ecosystems.[11]

A restorative economies assessment can be performed holistically by reviewing at least four attributes – social, cultural, environmental, and financial (see Figure 9). Combining metrics

[10] The sectors of the blue economy used by Yeoman et al. (2019) are offshore minerals (14%), commercial fisheries (15%), coastal tourism (41%), infrastructure and transport (21%) and government and services (9%). The marine economy considered by StatsNZ comprises marine services, fisheries and aquaculture, offshore minerals, and shipping.

[11] UNEP Finance Initiative (2021) recently recommended a list of activities to exclude from financing, due to their damaging impact on the ocean. The exclusion list is divided across five sectors and indicates critical actions or behaviours: seafood (wild-caught fisheries and aquaculture), ports, maritime transport, marine renewable energy, coastal and marine tourism.

with the results of an assessment is essential to identify and prioritise specific needs and investable opportunities. For example, an assessment can analyse the current conditions in the marine and coastal economy, determine the drivers for change and trends, identify opportunities and risks to economic diversification and environmental impacts, and consider societal and cultural outcomes (EnviroStrat, 2019).

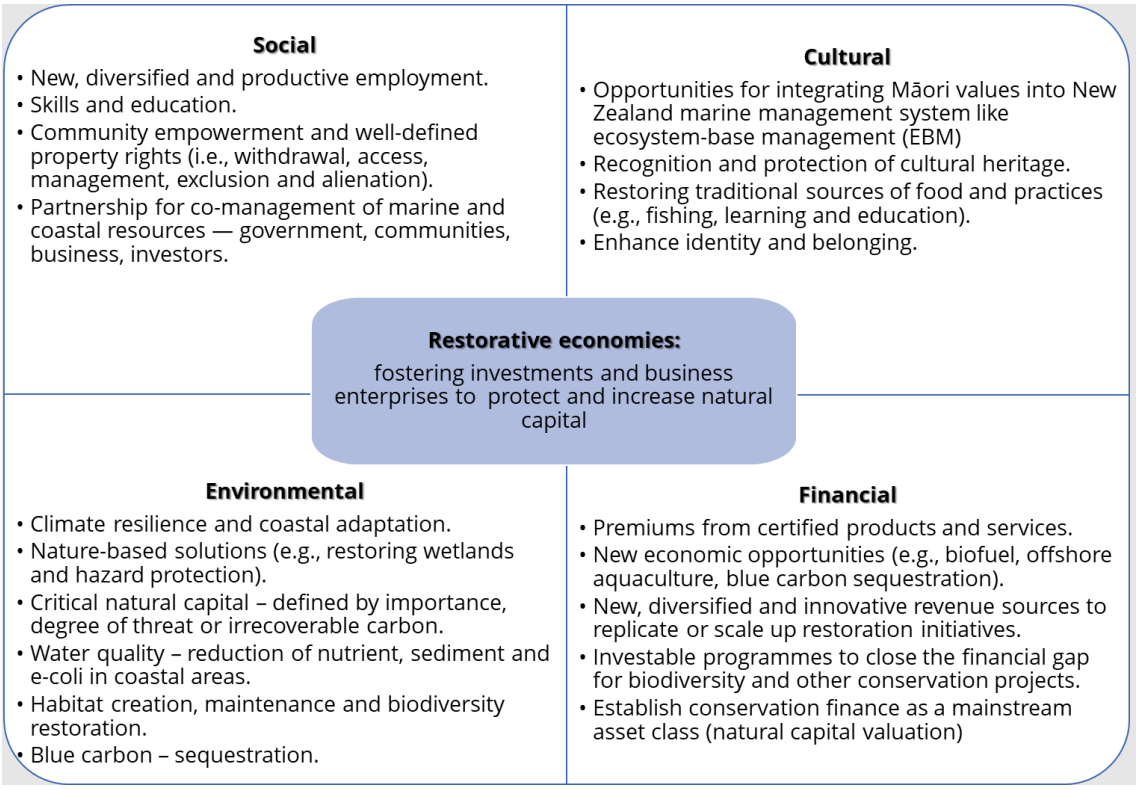

Figure 9. A value proposition of restorative economies.

The four attributes presented in Figure 9 are based on a multicriteria approach, rather than the four capitals from the Living Standards Framework – for further discussion, see Ausseil et al. (2021). We differentiate between social and cultural attributes to highlight the range of values and aspirations of Māori and local communities that influence the complexities associated with governing and managing coastal and marine areas – for further discussion, see Maxwell et al. (2020).

In the following section, we present a number of examples of restorative initiatives that have evolved into a business model, "a conceptual structure which specifies the purpose and goals of a business and the ongoing plans to fulfil these" (Stephenson et al., 2018, p. 5).

Examples of restorative initiatives

We conduct a desktop review looking at international and Aotearoa New Zealand examples of restorative initiatives and projects in blue (marine and coastal) environments, to identify common features and trends. Through this review, we aimed to learn about the range of blue ecosystems covered, the scale and scope of the initiatives, key stakeholders and funding sources.

As shown in Table 1, the international examples centre around prominent ecosystems in coastal and marine areas that store carbon, such as mangroves, salt marshes and seagrasses. By contrast, the Aotearoa New Zealand examples are niche ecosystems, such as mussel reefs and estuaries. A detailed description of these examples is provided in Appendix 1 and Appendix 2.

The information available on specific marine restoration projects is scattered and frequently not easily accessible.[12] Some of the examples we studied are better documented than others. The mangrove restoration project in Senegal, for example, has an impact analysis (Livelihoods Funds, 2020). Other examples are more recent or have fewer available resources to allow for further study, such as the Northumberland Strait Saltwater Marsh restoration project.

Table 1: Restoration examples

Examples	Ecosystem restoration	Location
International	Seagrass	Australia – South Australia
		USA – The Volgenau Virginia Coast Reserve
	Mangrove	Pakistan (Sindh) Indus Delta – The Delta Blue Carbon Project
		Kenya – Vanga Bay
		Colombia – Bay of Cispatá Project
		Senegal – Casamanae and Sine-Saloum Regions
	Salt marsh	USA – West Fourchon Marsh Creation and Nourishment
		Canada – Northumberland Straight Project
Aotearoa New Zealand	Seaweed	Hauraki Gulf & BOP – GreenWave NZ
	Mussel reef	Hauraki Gulf – Revive our Gulf
		Whakatane – Ohiwa
	Coastal wetland	Canterbury – Te Waihora
		Bay of Plenty – Maketū Estuary
		Kaipara – Kaipara Harbour

Common features observed from the examples reviewed

Through the above examples (Table 1), we have identified common features of restorative initiatives, including:

- The scope of the restoration varies from small community-based solutions to large scale projects and from a single ecosystem (e.g. mangroves) to multiple ecosystems.
- Investors (public, private or philanthropic) and stakeholders typically invest in nature with no financial return, using mechanisms like grants or donations; the GreenWave NZ project is an exception.[13]
- Local volunteers have played a significant part in the success of the restoration initiatives, particularly the larger-scale projects (e.g. Virginia and Senegal). However, the Pakistan Delta

[12] An example of published literature reviews is that of Bayraktarov et al. (2020), who elucidate why scientists engage in marine and coastal restoration. Aronson et al. (2010) also assess whether restoration scientists and practitioners use their projects to demonstrate socio-economic benefits.

[13] Based on company insights, the information is confidential at this point.

Blue project local community was paid to plant and Te Waihora engaged professional groups for large planting events.

- Local communities recognise and gain benefit from the restoration initiative. In Senegal, for example, where fishing and agriculture jobs are prevalent, local community members could appreciate the project's benefits in terms of increased production and new job opportunities.
- Upscaling is possible within an ecosystem through a focus on species expansion or restored ecosystems (e.g. mangrove, seagrass).
- Funding has been typically diverse, including private, philanthropic and governmental sources.[14]
- Science and research are deployed in restoration design and implementation, as well as in monitoring and reporting.
- Aside from GreenWave NZ, funding for the restoration initiatives documented has been initially motivated by ecological outcomes (e.g. support objectives of coastal wetland planting), rather than seeking financial returns. In the case of GreenWave NZ, the model was established to create a sustainable seaweed supply chain.

Key players, such as project leaders, community groups and collaborators, can indicate the potential for scaling the restoration activity. The larger and more complex the project is, the more individuals and groups are involved.

Although the literature has highlighted the importance of **local communities** and **indigenous** groups in restorative initiatives (Dickson et al., 2021; Keenleyside et al., 2012), their role differs in the restoration examples studied. In the case of Revive our Gulf,[15] the project mission clearly states: "to work in partnership with mana whenua and community to restore the mussel reefs of the Hauraki Gulf". For GreenWave, Māori are represented in governance roles, as well as being farm pilot participants.

Science has played an essential role in the restoration examples studied, with scientists playing significant roles in research and development of all restoration projects, sometimes acting as champions. Additionally, measurement and reporting play a key role as all cases focus on the measurability of the ecosystem and the effectiveness of restoration.

Scaling-up restoration projects to meet international commitments has involved many different players from diverse backgrounds. This can be seen in international models where the projects have been used as a tool to meet national commitments to the Paris Agreement (only in developed countries). In addition, highlighted examples are projects that have up-scaled from the restoration of one ecosystem to more. In the Virginia Bays seagrass restoration, for example, the project evolved into allowing the restoration of scallops in the bays. This can be seen to be connected with the restored base ecosystem (mangrove, seagrass), in which biodiversity has been able to flourish. A further example can be seen in the Senegal mangrove restoration project, which also revived rice paddies for local farmers.

[14] In this sense, Bayraktarov et al. (2020) found that marine restoration projects have been largely funded by governmental grants with some investment from private donations, non-governmental organisations, and volunteer commitment.

[15] For more information, visit www. Revive Our Gulf – Restoring the mussel reefs of the Hauraki Gulf / Tīkapa Moana / Te Moananui a-Toi.

Below, we further discuss four examples: The Volgenau Virginia Coast Reserve (Example 1), GreenWave NZ (Example 2), Revive our Gulf (Example 3), Ōhiwa harbour (Example 4) and Maketū Estuary (Example 5).

The Volgenau Virginia Coast Reserve, USA

Example 1. Virginia Bays, United States (Seagrass)

2008 – current

Key Drivers:

Reviving a seagrass habitat to historic levels and learning how restoring seagrasses affects an ecosystem.

Project Lead and Collaborators

Environmental scientists at the University of Virginia, the Virginia Institute of Marine Science and the Nature Conservancy.

Scope:

Off the Eastern Shore of Virginia in the United States is the Volgenau Virginia Coast Reserve. In this location 3,612 ha of seagrass has or currently is being restored. The project began in 2008 as part of a 20+ year restoration plan. So far, around 74.5 million seeds in 536 individual restoration plots have been planted. 56 % (2,028 ha) of this is in South Bay with the remaining 44 % (1,584 ha) spread among the three bays: Cobb, Spider Crab and Hog Island Bay (Orth et al., 2020).

Funding:

- Government. the Army Corps of Engineers, The Virginia Coastal Zone Management Program, the Virginia Marine Resources Commission's Recreational Fishing License Fund and NOAA, National Science Foundation.
- Private.
- Philanthropic funding. The Keith Campbell Foundation.

Economic Benefits:

- Job Creation.
- In the future, returns may be seen economically in species such as bay scallops, oysters, and fish that may positively impact the fisheries industry.
- Carbon market potential - an application has been made through Verra to become a certified project under the Verified Carbon Standard (VCS).

Co-benefits:

- As the location is a marine reserve, the tourism industry may also benefit.
- Increase in biodiversity.
- Climate change resilience.

Source: Based on Lusk (2021)

A timeline portraying the level of change from complete degradation to restoration in a century is provided in Figure 10. It shows how projects can be up-scaled following research and development by scientists with the addition of collaborators and funding.

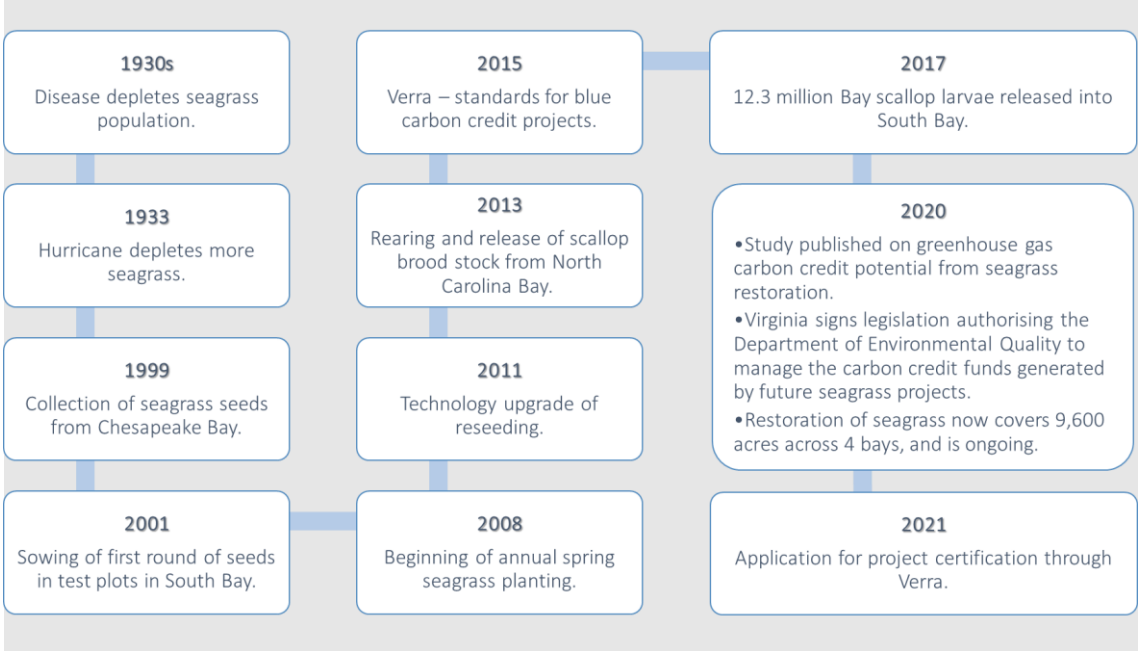

Figure 10. Virginia Bays Restoration Timeline. Based on Lusk (2021).

GreenWave, Aotearoa NZ

Example 2. GreenWave, Aotearoa NZ (Seaweed)

2019 – ongoing

Scope:

This model was established to create a sustainable seaweed supply chain (hatcheries R&D, farming, processing) for Aotearoa NZ, catalysing a high value, low impact seaweed sector; providing environmental benefits; improving mauri of coastal waters, and enhancing the resilience of coastal communities.

The initiative began in 2019. A pilot has been established for three years. Locations of seaweed farms will vary from Hauraki Gulf and Bay of Plenty.

Project Lead and Collaborators:

EnviroStrat in partnership with GreenWave (USA), collaborating with the University of Waikato, Premium Seas Ltd and AgriSea.

Iwi involvement and governance: marine farm pilot participants, Advisory Board participants, Executive Chair.

Funding:

- Grant funding: The Tindall Foundation, Foundation North, Bay Trust and Ports of Auckland.
- Government: Ministry for Primary Industries and Auckland Council Healthy Waters.
- Impact investment: Toniic members and EnviroStrat.

Economic Benefits:

- Potential for productive jobs in the seaweed sector.
- Enhanced resilience post-COVID through creation of new seaweed farming jobs in regional coastal communities.
- Potential for new tradable market (blue carbon and nutrient credits, which will improve agricultural land through application to soil).

Co-benefits:

- Social impact and economic resilience in regional communities.
- Biodiversity and water quality improvement.
- Climate change resilience. Improve mauri of coastal ecosystems.

Outcomes

Organic bio-stimulants and animal nutrition products from seaweed. Systemic stimulus of productive and resilient sector for NZ through seaweed sector supply chain creation.

Source: Based on EnviroStrat (2020)

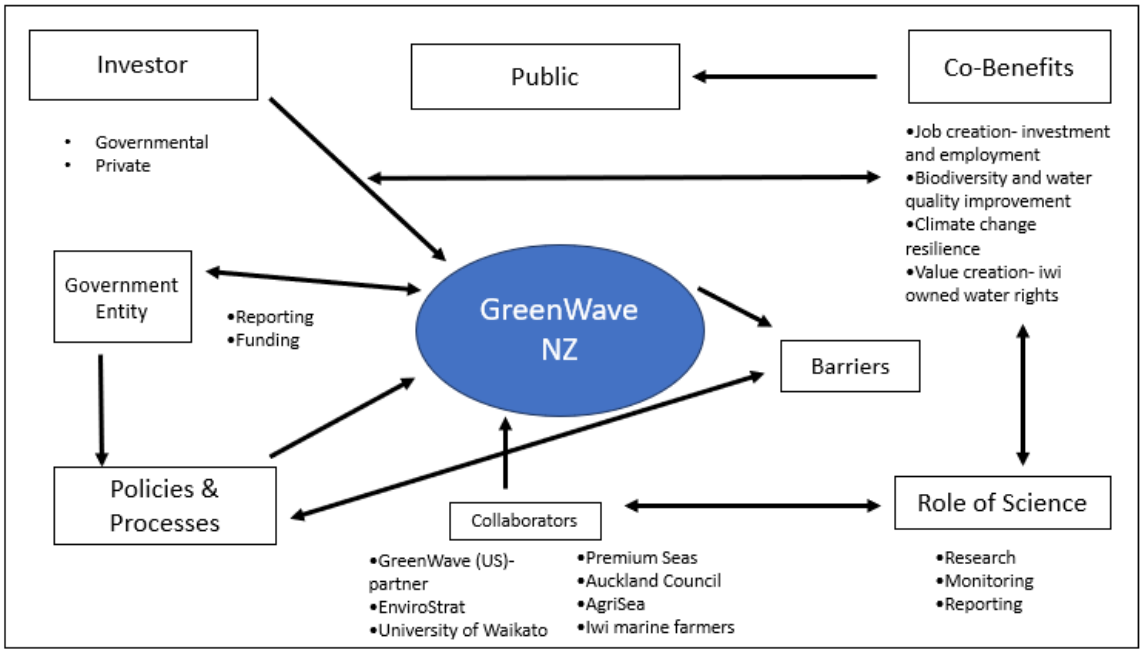

Figure 11. Project model – GreenWave NZ. Based on EnviroStrat (2020).

Revive our Gulf, Aotearoa NZ

Example 3. Revive Our Gulf, Aotearoa NZ (Mussel Reef)

2012 – current

Scope:

The vision of the initiative is to "have a Hauraki Gulf enhanced with restored seabed mussel reefs, healthy ecosystems, and a natural biodiversity of marine life". The aim of this project is the restoration of mussel reefs.

The entity was established in 2012 and is ongoing. At four locations, 150 tonnes of mussels filter 390m litres of water each day.

Project Lead and Collaborators:

The Nature Conservancy, Auckland Council, University of Auckland, Auckland Foundation, Hauraki Gulf Forum, OBC Auckland and iwi and hapū across the Gulf, including partnering with Ngāti Whātua at Okahu Bay.

Funding:

- Private- Corporate sponsors.
- Philanthropic funding and donations,
- Government.

Economic Benefits:

- Job creation.

Co-benefits:

- Boosting biodiversity.
- Increasing biomass.
- Providing food for other species.
- Filtering water.

Source: Based on Revive our Gulf (2021)

Ōhiwa Harbour, Aotearoa NZ

Example 4. Ōhiwa Harbour, Aotearoa NZ - Awhi Mai Awhi Atu (Shellfish)

2020 – 2023

Scope:

The driver of the project is to re-establish mussel reefs in Ōhiwa Harbour. Research has identified that starfish may be the main predators of shellfish in the harbour. Therefore, the vision of the model is to enact a kaitiakitanga-based approach to ecosystem-based management (EBM), combining Mātauranga Māori (Māori knowledge systems), western science and local kaitiakitanga (active guardianship) to better understand degradation, assist recovery, and generate common management approaches and responses for the culturally and ecologically important shellfish in the soft bottomed Ōhiwa harbour.

Project Lead and Collaborators:

Co-developed with iwi of Ōhiwa Harbour, NIWA and the University of Waikato.

Project key researchers, MUSA Environmental, Eco Research Associates Ltd. Co-developed with Bay of Plenty Regional Council, Kaumātua, Te Rūnanga o Ngāti Awa, and the Ōhiwa Harbour Implementation Forum (OHIF).

Funding:

Government. Sustainable Seas Project.

Philanthropic funding and donations.

Economic Benefits:

Mussel production for food (enhancing a bio-circular economy).

Co-benefits:

Environmental water improvement such as denitrification.

Improvement of taonga in the harbour,

Decrease in plastic pollution in the harbour through the use of natural biodegradable mussel culture ropes,

Improved kaitiakitanga, restoration of estuarine mauri.

Source: Sustainable Seas (2020)

Maketū, Aotearoa NZ

Example 5. Maketū Estuary, Aotearoa NZ - Estuary

2017 – 2020

Scope:

Restore Kaituna River's freshwater flows into the estuary. Re-create wetlands around the estuary margin, to help filter nutrients and create breeding areas for birds and fish, among other benefits. So far, the project has re-diverted an additional 15% of the Kaituna River's flow back into Ongatoro/Maketū Estuary.

Project Lead and Collaborators:

Bay of Plenty Regional Council led with several contractors, notably WSP, Stratum NZ and J Swap Contractors.

Funding:

Governmental funding.

Economic Benefits:

- Job creation.
- Increase in kaimoana.

Co-benefits:

- Increase the mauri of the estuary and lower river.
- Aid the relationship between tangata whenua and water.
- Increase kaimoana.
- Maximise ecological benefits (e.g. habitat creation, decrease flood risk, restore balance of fresh water and salinity).
- Increase in recreational purposes.

Source: Bay of Plenty Regional Council (2014)

Barriers and opportunities for restorative economies

Barriers for restorative marine economies

This section discusses barriers to build restorative marine economies. We start by focusing on general barriers to restorative economies and green growth, followed by a focus on Aotearoa New Zealand's context as informed by the marine restoration examples covered in this report.[16]

Given the public and regulatory pressure to reduce environmental impacts and the recognition of the dependence on coastal and marine environments of the society, the premise is that restorative (coastal and marine) economies will be widely implemented. This, however, is not the case: global risk assessments increasingly highlight biodiversity loss and climate change as significant risks to economies and wellbeing (IPBES, 2019). The COVID-19 crisis is a consequence of (un-managed) risks from destruction of nature and over-exploitation, as well as lack of investment in natural assets (Stern et al., 2020). Interventions for economic recovery need to avoid further degradation of natural systems or relaxation of environmental regulation and faster resource exploitation through people-to-work programmes (Stern et al., 2020).

As one of the public goods, seascapes and oceans (marine natural capital) are especially vulnerable due to drivers of degradation from on-land as well as the sea, with only 13% of the world's ocean as marine wilderness (Jones et al., 2018). After the global financial crisis of 2008, the OECD (2011a) investigated fundamental constraints to green growth[17] such as government failures, market failures, and market imperfection. These constraints vary depending on economic returns, socio-economic context, and existing environmental policy settings.[18] A similar rationale can be applied for constraints to restorative economies, in which low economic returns and low appropriability of these returns (i.e., sharing of returns by the society) (see Figure 12) represent key barriers.

[16] It is broadly accepted that understanding restoration in terrestrial ecosystems is more advanced in terms of knowledge, tools and research compared to marine restoration.

[17] The focus on green growth investment was driven by the context at the time; the global economy was recovering from the financial crisis of 2008. Green growth was promoted as a platform for recovery.

[18] Hausmann et al. (2008) developed a framework for growth diagnosis to identify whether low domestic investment and entrepreneurship levels relate to (i) low returns to economic activity and (ii) high cost of finance. The OECD (2011a) applied this framework to the green growth context.

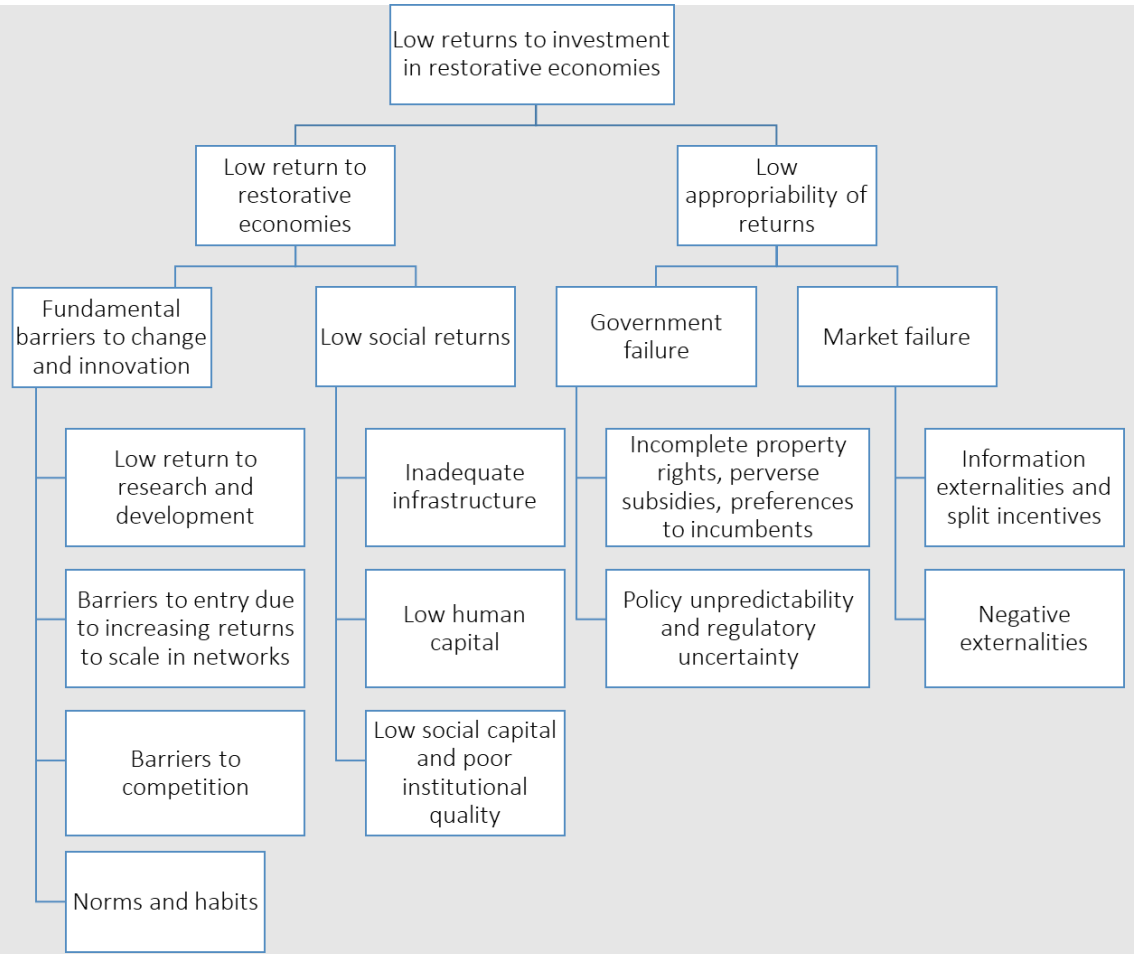

Figure 12. Barriers for restorative economies. Adapted from OECD (2011a).

The Dasgupta Review provides a nuanced analysis of barriers by positioning the economics of nature and biodiversity as an asset management problem. In this perspective, the inefficient management of nature and biodiversity leads to the loss of ecosystem services on which economies and people depend. Institutional failure resulting in the depletion of natural capital and unaccounted for externalities is the overarching reason for this. Furthermore, because the accounting prices for nature are not incorporated into market prices (since much of nature can be open access or public goods), society invests more in-built capital like infrastructure or finance even though they have a lower rate of return than nature.[19]

The Dasgupta Review suggests two options to enhance asset management (in a combined portfolio of natural capital and other capitals); reverse the depletion of natural capital and maintain biodiversity. To pursue such solutions, a wide range of interventions are proposed, starting with changing economic measures (measuring wealth that accounts for natural capital), accounting and valuing natural capital, different governance of ecosystems and a system of payments for ecosystems, or a financial system that channels investments into natural capital protection and restoration. Additionally, the need for pooling knowledge and perspectives from different sources and at different scales is identified as critical to "allow for

[19] When long term global yield is used as a proxy, estimates in the report show the rate of return for biosphere is approximately four times greater than that of produced capital (19% vs 5%) (Dasgupta, 2020). For further discussion regarding global value of ecosystem services see also Costanza et al. (1997, 2014).

collaborative planning, participation and coordination" (Dasgupta, 2021b, p. 4) that sustainable management of ecosystems requires.

Insights into constraints to restorative economies can also be drawn from barriers to adopting emissions mitigation practices in agriculture. Jaffe (2017), for example, proposes a typology to identify factors other than expected profitability, that can affect a resource manager's (in the research example, the farmer's) decisions on adoption of investment, technologies or practices. The adoption of these (i) reduces the environmental impact of an enterprise, and (ii) does not reduce the profitability of the enterprise, measured in conventional financial terms.

Table 2 summarises potential barriers for public or private sector investment in restorative economies by directly applying the typology from Jaffe (2017).

Table 2. Potential barriers for restorative economies

Name	Description of Situations
1. Efficient or arguably efficient barriers	The simple financial profitability test fails to measure the true economic impact on self-interested decision makers correctly.
2. Information barriers	Restorative marine economies do not emerge because of imperfect availability of information.
3. Market structure or institutional barriers	Market or institutional failures inhibit the implementation of restorative marine economies.
4. Externalities	Decision-makers do not bear the costs or benefits of their actions.
5. Regulatory or policy	Restorative marine economies do not emerge because of existing or potential constraints from public policy or the law.
6. Risk and uncertainty	(i) rational calculations of the financial consequences of risk and (ii) cognitive inabilities to process uncertainty inhibit the implementation of restorative economies.
7. Behavioural	Cognitive biases push economic agents away from rational profit maximisation predictably or systematically.

Source: Adapted from Jaffe (2017).

Focusing specifically on marine ecosystems, Stewart-Sinclair et al. (2020) researched barriers to restoration through meta-analysis, workshops and case study examples. The barriers were grouped into environmental, technical, social, economic, and political domains (Table 3). For the economic domain, challenges included long term financing, insurance, and risk management of restoration projects with potential solutions involving the use of financial instruments like bonds or REDD+,[20] or valuation and payments for ecosystem services. Integration of cultural values and community participation were also identified as prerequisites for successful restoration.[21] The research suggests that marine restoration can be informed by the insights from terrestrial restoration regarding scaling up (larger scale, multiple benefits, solution demonstration).

[20] Reducing emissions from deforestation and forest degradation (REDD+) is a mechanism that creates a financial value for the carbon stored in forest. For further information see UN-REDD Programme (2021).

[21] Demand for value for "public money", which requires buy-in from rate/taxpayers into the values being achieved, can also act as a barrier to restorative economies.

Table 3. Barriers to marine and coastal restoration

Domain	Factors (barriers)	
Environment	Land conversion Over-exploitation Hydrological modification	Water quality Pest damage Climate change
Technical	Capacity and knowledge	Site selection
Social	Rights and responsibilities Cultural values	Community engagement Public perception
Economic	Financing	Insurance and risk management
Political	Land tenure and trade-offs	Policy and governance

Source: Adapted from Stewart-Sinclair et al. (2020).

The role of markets, and specifically environmental markets, is also examined in literature and captured in typologies (Jaffe, 2017; OECD, 2011b) as potential barriers (or enablers) for ecosystem solutions.

Blue carbon is of particular interest because of the advanced development of carbon markets (availability of rules and standards, and investment capital) and the potential of marine ecosystems (e.g. salt marshes) and species (e.g. seagrass and kelp forest) to act as carbon sinks (Hoegh-Guldberg et al., 2019; Macreadie et al., 2017).

Blue carbon is not yet included in New Zealand's carbon inventory. In the most recent report, *Ināia tonu nei: a Low Emissions Future for Aotearoa*, the Climate Change Commission recommends that further scientific research is needed before blue carbon can be considered in the carbon budgets and targets of Aotearoa New Zealand. Currently, the only domestic carbon credits in the country are forestry-based.

Blue carbon restoration projects can generate carbon credits that may be attractive to organisations with environmental, social and governance (ESG) commitments that include becoming carbon neutral (World Economic Forum, 2020). While there is increasing knowledge about the measurement of carbon sequestration in marine ecosystems (Douglas & Lohrer, forthcoming), the potential of marine restorative initiatives to access revenue from carbon sequestration depends on several factors. These include the demand for such credits, the ability to measure and verify the sequestration achieved following specific methodologies, and standard requirements like additionality (Murray & Vegh, 2012) or permanency, in mangroves (Alongi, 2008), in seagrasses (Short & Wyllie-Echeverria, 1996) and in salt marshes (Gedan et al., 2009).

Factors such as uncertainty and long-time horizons to achieve ecosystem restoration outcomes can also impact the ability of projects to access capital for development (both in terms of expenditures and operations) (Bell-James, 2016; Fritsch, 2020; National Science Challenges, 2020).

Following the experience with land tenure and carbon rights in terrestrial ecosystems, we anticipate that a lack of defined property rights in marine ecosystems and their services (e.g. carbon sequestration) may also present barriers to restoring commonly held ocean ecosystems (USAID, 2012). In this context, the revenue rights (e.g. carbon credit) on which restoration depends must be defined.

Analysis of constraints to finance of the blue economy also offer insights about the potential issues that need to be addressed from an investor perspective (Fritsch, 2020). Examples of constraints that investors note include: ability to, and availability of, well-developed investment propositions that consider all capitals (natural, financial, social, etc.); ability to measure natural capital and account for ocean risks in investment portfolios; appropriate deal structures and exit strategies; and adequate government support and policy frameworks to support blue economy investment markets (e.g. standards for green or blue bonds) (Drew et al., 2020; Fritsch, 2020; Mudaliar et al., 2018).

Lastly, Laffoley et al. (2021) suggest that a more effective narrative is required in the post-COVID context to truly reflect the vital connection between people and the ocean, and unlock initiatives and actions to protect it with immediate urgency. It is proposed that such narrative is informed by the 'One Health' or whole system approach, and makes explicit the need of joint action for climate change.

Opportunities for restorative economies: leveraging the climate and biodiversity agenda

To understand opportunities for restorative economies in marine and coastal ecosystems, we consider the current context internationally and in Aoteraroa New Zealand, and the insights from the examples presented in this report to identify motivations and demand for restoration and nature-based solutions (NbS) more broadly. We look at ecosystem restoration and restorative economies as the nexus between climate change and biodiversity solutions (Dickson et al., 2021; Perry & Karousakis, 2020).

As described earlier in the report, interest in restorative economies (and the blue economy more broadly) is driven by a combination of regulatory pressure (including international commitments such as those under the Paris Climate Agreement) and the need to address environmental, social and governance (ESG) considerations. This, in turn, is driving change in the practices and risk management approaches of marine economic sectors and the financial industry (also referred to as sustainable finance) (UNEP Finance Initiative, 2021b).

Globally, the 2020- 2030 decade is critical for adding climate change impacts and reversing biodiversity loss, two deeply connected challenges for humanity (Dasgupta, 2021a; IPBES, 2019; Pörtner et al., 2021). Decisions by the UN Convention on Biodiversity Conference (COP 15) and the UN Climate Change Conference (COP 26) are expected to give further support and impetus for progress towards the UN Sustainable Development Goals (UN SDGs).

The United Nations General Assembly has declared 2021- 2030 the "UN Decade on Ecological Restoration" and coastal restoration is part of the suite of nature-based solutions required to address these challenges (Cohen-Shacham et al., 2016). 2021- 2030 is also the UN Decade of Ocean Science with the specific goal to "help to build a shared information system, based on trustworthy, science-based data, from all parts of the world's ocean", as highlighted by Peter Haugan past chair of the Intergovernmental Oceanographic Commission (IOC).

Further indication of the importance of the ocean and the blue economy, is the establishment of a high-level policy panel for a Sustainable Ocean Economy (Ocean Panel) in 2018 to "catalyse and scale bold, pragmatic solutions across policy, governance, technology and finance to ultimately develop an action agenda for transitioning to a sustainable ocean economy".

However, despite the increasing global profile of the ocean and the blue economy, more initiatives and solutions are needed, both at policy and finance levels (Perry & Karousakis, 2020; Rogers & Aburto-Oropeza, 2020). Actions regarding *UN SDG 14 Life under Water* remain poor and underfunded (Perry & Karousakis, 2020), and targets such as expanding areas of coastal and marine protection[22] are trailing behind (Laffoley et al., 2021; WWF, 2020). The estimated finance needs for the post-2020 era are between US$151 to $895 billion annually (CBD, 2020), which is significantly larger than estimated commitments of US$78-91 billion (Perry & Karousakis, 2020) or $121.5 billion annually[23] (Seidl, A., et al., 2020).[24]

While in practice climate change and biodiversity are often addressed separately, there is strong focus and increasing understanding by the scientific community and policy makers that these two global challenges need to be addressed together (Pörtner et al., 2021). Opportunities for increasing biodiversity and quality of life from climate change mitigation and adaptation actions (e.g. carbon sequestration from large-scale afforestation or mangrove restoration) were explored by the joint scientific committees of IPBES and IPCC. The summary report makes the case for joint action and proposes a focus on transformative change and resilience pathways to achieve climate and biodiversity goals while also delivering human development (Pörtner et al., 2021).

Opportunities for progressing restorative economies are enabled by private sector initiatives such as the Task Force on Climate-related Financial Disclosure (TFCFD)[25] and the Portfolio Decarbonisation Coalition[26] which are encouraging institutional investors to assess, mitigate and disclose their climate related risks across a wide range of sectors. Similarly to TCFD, the Task Force on Nature-related Financial Disclosure (TNFD) was recently established with the aim to create a global framework for companies and investors to disclose and act on nature-related risks (TNFD, 2021). It is expected that TNFD will help support a nature-friendly transition just as TCFD is supporting a low-carbon transition through guiding organisations on how to report on climate-related physical and transition risks in a standardised way.

Interest in solutions to societal challenges like climate change, biodiversity and food security has informed the work led by the International Union for Conservation of Nature (IUCN) to develop a Global Standard for Nature-based Solutions (NbS).[27] The standard defines NbS as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits" and establishes criteria and indicators for NbS that governments, business and stakeholder organisations can use in the design and implementation of NbS.

Mitigating the economic and social impact of the COVID-19 pandemic might also provide opportunities for more sustainable and restorative economies under the banner "build back better". For this to happen, a greater focus on investments in NbS (and related measurements

[22] This refers to the Aichi Biodiversity Targets agreed in 2010 under the UN Convention on Biological Diversity. For further information see Aichi Biodiversity Targets (cbd.int).

[23] This estimate covers public biodiversity investments only.

[24] There are different estimates available and the two referenced in this report are the most recent. The OECD estimate for global biodiversity finance of US$ 78-91 billion per year is based on averages for 2015-2017, with over 80% of it representing public domestic expenditure.

[25] For further information see TCFD (2021).

[26] For further information see UNEPFI (2021).

[27] For more information, see www.iucn.org/theme/nature-based-solutions/resources/iucn-global-standard-nbs. Accessed on June 28.

and targets) is required in the COVID-19 recovery packages to balance the focus on climate-positive outcomes and take a more holistic approach to solutions (Beyer et al., 2021).

Nature-based solutions (NbS) for Aotearoa New Zealand

In Aotearoa New Zealand, the first assessment of the Climate Change Risk for Aotearoa New Zealand, lists risks to coastal ecosystems (intertidal areas, dunes, wetlands) as the highest risk for the environmental domain, followed by risks to indigenous ecosystems (Ministry for the Environment, 2020). Because coastal ecosystems are linked to economic and social systems, productive sectors like fisheries and aquaculture are also considered at risk. A national adaptation plan to climate change is expected to be launched by the government in 2022. However, regions and communities throughout the country are already grappling with sea level rise and coastal ecosystem change (Hendtlass et al., 2020).[28] Many local authorities have already completed coastal hazard assessments and reviews of coastal plans provide opportunities for taking into account hazards like sea level rise, address on-land pollution and establish further protection for indigenous biodiversity and high value seascape, and marine space use.

Because of the advancement in the policy, legal and market frameworks, climate change mitigation also offers opportunity for restorative economies. In its final advice to the government regarding the emissions reduction plan for the 2022-2025 period, the Climate Commission recommends that more science and research is required to understand the role of voluntary markets in meeting carbon targets and how much blue carbon is stored or released by New Zealand's marine ecosystems (He Pou a Rangi the Climate Change Commission, 2021). While blue carbon is not currently included in the national inventory and international carbon accounting frameworks, the interest in blue carbon and other NbS is already high.

Regarding the biodiversity agenda for New Zealand, the Department of Conservation released *Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy* in 2020 as a vision and framework for action to protect ecosystems and biodiversity across the country.[29] The strategy recognises the interdependencies between the economy, climate change and nature protection, and sets out a range of objectives through to 2050 to prevent further biodiversity loss and to restore ecosystems. Te Mana o te Taiao identifies the need for resources and funding to be secured to implement the strategy and adequately support iwi and Māori organisations, businesses and communities.

These national policy frameworks and strategies are complemented by private sector initiatives and strategies responding to climate change and other environmental, social and governance factors. One such initiative is the Aotearoa Circle, a partnership of public and private sector leaders working together to reverse the decline of New Zealand's natural resources and to support long-term investment in natural resources.[30] Their review, "Exploring plausible futures for aquaculture and fisheries in New Zealand" (Aotearoa Circle, 2020) highlights the importance of building adaptative capacity and pro-actively managing risks and opportunities from low carbon transition and climate risks in the next decade.

[28] In New Zealand, several initiatives have been developed to look at a wide range of issues around the coast and climate adaptation and resilience. Some examples of these initiatives are Wharekawa Coast 2120 (see https://wharekawacoast2120.hauraki-dc.govt.nz/about/) or the sea level rise data viewers for the Wellington Region (see https://mapping.gw.govt.nz/News11_Sea_Level_Rise.htm).

[29] For more information, see Te Mana o te Taiao - Aotearoa New Zealand Biodiversity Strategy 2020 (doc.govt.nz). Accessed on June 28.

[30] For more information, visit The Aotearoa Circle.

Considering all of the above, we outline restorative economy opportunities centred around three themes: enhancing the knowledge base for NbS, connecting place-based solutions, and leveraging public and private investment. These opportunities are not prioritised but rather represent building blocks for progressing restorative economies at scale. Figure 13 shows a model of restorative economies where a range of potential initiatives are considered. Jointly, these initiatives will support the ecosystem's recovery.

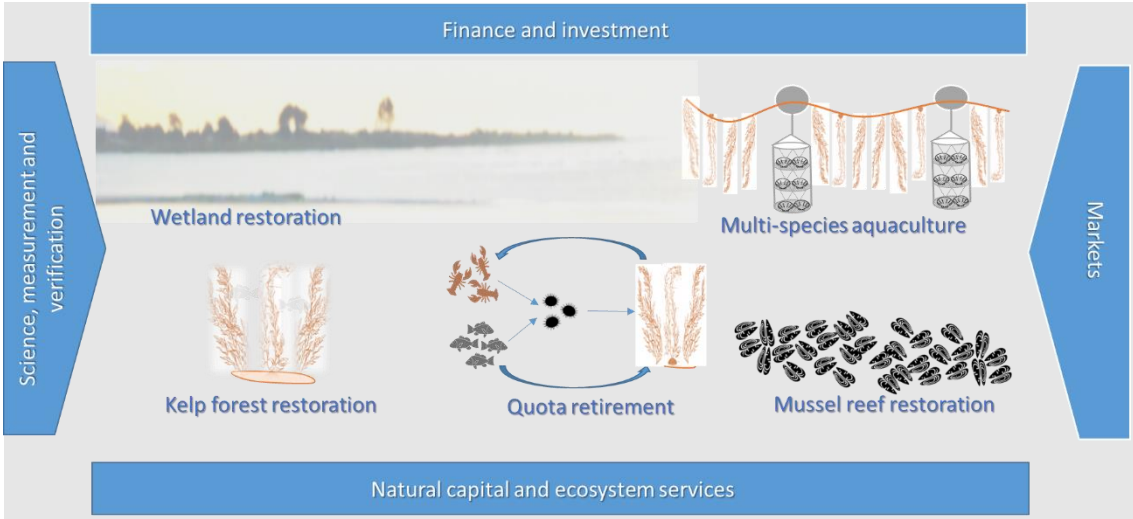

Figure 13. A model of restorative economies combining seascapes and terrestrial restoration initiatives.

Enhancing the knowledge base for NbS

Knowledge about the blue economy and restorative economies, in particular, is still limited in the government and private sectors,[31] especially due to the challenge of integrating the economy with the environment. Opportunities for enhancing this knowledge are present at different levels (national, regional, local). They require the combination of bio-physical and socio-economic knowledge with the express goal to integrate and find a balance between the environment and economic activities.

- The value proposition of the restorative economies is not yet established. A measurement on the size and impact of restorative economies is required as part of a sustainable blue economy at the national level. This measurement could be done by further expanding the use of the UN System of Economic Environmental Accounts, specifically the development of the satellite accounts for the ocean, following the Ocean Accounts methodology, currently being promoted globally.
- Further progress on natural capital accounting (both stocks and flows) is also required. This accounting may also include scope (impacts and dependencies) as well as application (national vs regional or district level).
- Economic valuation of marine ecosystem services (i.e. converting biophysical data on the marine environment to a monetary metric) is linked to the opportunity above to measure the success of marine and coastal restorative economies. An economic valuation aims to

[31] This was one of the insights from the Conference *Turning the Tide* hosted by the Department of Conservation and WWF on 15 June 2021.

raise awareness and to put ecosystems and their services on a more equal footing with economic data and decision-making.

- Blue carbon accounting methodologies (storage and release) for coastal and marine ecosystems are emerging and being tested globally. Mapping, identifying, and testing methodologies relevant to the Aotearoa New Zealand context is in line with recommendations from the Climate Change Commission and a potential area of interest for the private sector and government,[32] due to interest in carbon neutrality. It will also respond to one of the short-term objectives (by 2025) of Te Mana o te Taiao to better understand the carbon storage potential from the restoration of indigenous ecosystems (including wetlands, and coastal and marine ecosystems i.e. blue carbon) to contribute to New Zealand's emissions reduction goals. The scope of work should consider opportunities for co-benefits like nutrient mitigation (from on-land activities), and the habitat and climate resilience benefits of coastal and marine ecosystems.

In terms of applying and prototyping the knowledge generated (as per above) or already available but not deployed in Aoteaora New Zealand's context, tangible opportunities include:

- Testing the NbS standard in a decision-making context at the regional level or within a specific investment decision. This could be done, for example, in conjunction with the development of coastal development plans by regional councils[33] or as part of input into the development of the national climate adaptation plan currently in development.[34] This is aligned with, and will contribute to, the Te Mana o te Taiao objective that by 2050, "biodiversity provides nature-based solutions to climate change and is resilient to its effects" (Objective 13).

- Trialling the Ocean Accounts methodology in conjunction and coordination with Stats NZ's marine economy reporting. Application of the Ocean Accounts methodology could be explored for example, within the context of the government's response to, and implementation of The Sea Change – Tai Timu Tai Pari Hauraki Gulf Marine Spatial Plan.

- Using natural capital accounting and valuation to inform investment propositions in the blue economy and to articulate options for scaling up voluntary blue carbon and co-benefits markets.

Connecting place-based community solutions

Examples from the literature review and the restorative economy explored in this report illustrate that there is a wide range of restoration initiatives taking place, at different scales and locations within coastal and marine ecosystems in Aotearoa New Zealand. Place-based restoration is a common and highly effective approach in restoration and particularly relevant to indigenous practices (Le Heron et al., 2020; Robson et al., 2009) but also of potential interest to the private sector who want to contribute to solutions in the community where they operate.

Often, initiatives start as localised actions driven by local communities' desire to halt ecosystem degradation and deliver benefits for the community, such as food provisioning or

[32] For more information, visit https://www.mbie.govt.nz/dmsdocument/15041-carbon-neutral-government-programme-report-back-and-further-implementation-decisions-proactiverelease-pdf; accessed on 17 June 2021.

[33] The New Zealand Coastal Policy Statement (NZCPS) guides councils in their daily management of the coastal environment. For more information see Department of Conservation, 2010; Ministry for the Environment, 2021b.

[34] For more information, visit First national climate change risk assessment for New Zealand | Ministry for the Environment. The first national adaptation plan is expected to be published in August 2022.

improved water quality. In other cases, interest in carbon sequestration might be driven largely by externals, but the community would perceive revenues through carbon credits alongside other benefits, as in the example of mangrove restoration (Earth Security, 2020). Connecting place-based interventions and solutions combines ecosystem, economic and community goals, including:

- Achieving scale in restoration through consolidating supply initiatives to provide a sustained and diverse (critical) flow of benefits (e.g. carbon sequestration, species recovery and buffer from storms), through combining different place-based restoration efforts with different costs and revenue streams (e.g. quota retirement, shell-fish restoration and multi-species aquaculture).
- Sharing resources, transferring, and replicating solutions to accelerate the transition to nature and climate-positive solutions.
- Recognising the benefits delivered by community-driven projects beyond the restoration site (e.g. a rahui that helps with habitat and species recovery beyond the specific site).
- Combining restoration interventions with different benefits / rates of return (economic, social, cultural) that jointly are more attractive for investment through a portfolio approach. This includes combining productive terrestrial landscapes (catchments) with seascapes as a means of aggregating investment and impact.

There are many opportunities for connecting place-based community solutions under the banner of an impact framework or long-term restoration vision. Examples include:

- The Sea Change – Tai Timu Tai Pari Hauraki Gulf Marine Spatial Plan, supporting progress towards the implementation.[35]
- Te Waihora (Canterbury) or Waituna (Southland) lagoons and the tributary catchments impacting the lagoon ecosystems.
- Regional (tidal) wetlands restoration initiatives (or re-flooding / re-establishing tidal flow) across Aotearoa New Zealand (Dymond et al., 2021).

Leveraging public and private investment

The finance and investment needs for New Zealand's biodiversity and restoration goals have not yet been established, however it is widely accepted that there is a significant gap between what is available and actual needs. *Te Mana o te Taiao* calls for identification of the finance needs and investment provision to help progress its short and long-term objectives.

The government's investment and budget allocation – including its COVID-19 recovery package (particularly Jobs for Nature) – offers an opportunity to leverage such investment to stimulate the allocation of finance by the private sector towards solutions that address both climate and nature conservation in Aotearoa New Zealand's coastal and marine environments. Particular opportunities are driven by interest in:

- Models for blended finance between the government, public and philanthropy where the impact and return on investment (financial and non-financial) is shared between public and private interests. Public procurement (e.g. COVID-19 grants under Jobs for Nature), can be leveraged to increase finance from the private sector and as a result, increasing the impact.

[35] For more information, visit Ministry for Primary Industries (2021, July 22).

- Interest in voluntary markets for carbon and biodiversity credits or allowances (no net-loss solutions) by New Zealand public and private sectors (linked to restoration activities in terrestrial and marine environments).
- Developing business and investment value propositions and metrics that are informed by natural capital accounting and assessment of dependency on coastal and marine ecosystem flows of business and industry activities (e.g. the business case for investing in spawning habitat protection or multi-species aquaculture).
- Enhancing economic analysis regarding the role of the blue economy and its contributions on the national and regional economies.

Broader considerations regarding finance for biodiversity include the need for more granular analysis regarding financial flows and expenditure allocated to promote the conservation of coastal and marine ecosystems, and specifically biodiversity.

Where to go from here in developing restorative economies

This document focuses on the concept of restorative economies as part of the blue economy agenda. The opportunities outlined above are dependent on the availability of science, knowledge and research in support of viable solutions and connections with end-users. Further research could focus on practical ideas that contribute to the development of restorative economies by addressing key bottlenecks in knowledge, tools and practices regarding financial and non-financial returns of ecosystem level solutions. Possibilities for future research include:

- Measurement and verification methodologies and protocols in coastal and marine environments (combining biodiversity, climate and social outcomes – multi-benefits) that are needed for the development of revenue-generating and market-based solutions in Aotearoa New Zealand's context. This includes:
  - » Understanding the cost-effectiveness of restoration (cost vs outcome) in coastal and marine ecosystems.
  - » Understanding the aspect of rights to ecosystem services (blue carbon sequestration, flood control, nutrient cycling) from interventions in common resource ecosystems (salt marshes, seagrasses) and the ability/right to trade such services when not linked to the underlying ecosystem asset.
  - » Supporting biodiversity and ecosystem services assessment, valuation and disclosure, including considering the need for integrity, robustness and / or independent and expert-driven assessments.
  - » Testing selected methodologies for carbon sequestration and co-benefits.
- Integrate and align biodiversity and ecosystem services considerations in public (government) and private sector decision-making at different levels (national vs regional, value/product chain vs organisational footprint). This includes:
  - » Solutions for valuing biodiversity and restoration benefits (total economic cost, externalities), and acknowledging that some ecosystem services/benefits, whilst valuable, cannot and should not be monetised.
  - » Interest in a new unit of trade (NZ bio-unit) that bundles a wide range of ecosystem services from marine and coastal ecosystems.

- (Linked to above) Identify attributes and metrics that underpin the value proposition of restorative economies and options to manage all capitals (natural and built) in support of human wellbeing and development. This should consider linkages with, and potential expansion of, the dashboard indicators in the Living Standard Framework and its domains like cultural identity or natural capital needs (Ausseil et al., 2021; The Treasury, 2019; van Zyl & Au, 2018).
- Explore how to expand relevant solutions and knowledge from terrestrial-based primary industries in relation to climate risks to biodiversity and conservation, and opportunities to marine economies.
- Explore options to foster improvement in biodiversity and ecosystem-related data using digital platforms, in relation to environmental markets (carbon, nutrient and biodiversity credits) or traditional products and services (aquaculture, fisheries, energy, etc.).
- Explore models for cross-sectoral solutions and value networks innovation as options to scale up restorative economies.

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Appendix

Appendix 1. Restorative economies – International examples

Please see table below.

Appendix 2. Restorative economies – National examples

Please see table below.

Appendix 1. Restorative economies – International examples

Name	Ecosystem	Location	Project Size	Project scope	Project Leads	Collaborator	Volunteers	Funding	Time Frame	Economic Benefits	Co-benefits	Carbon Credit Standard	References
The Volgenau Virginia Coast Reserve	Seagrass	Virginia Eastern Bays (USA)	3,612 ha	Restoration of seagrass to historic levels.	Environmental scientists at the University of Virginia, the Virginia Institute of Marine Science and the Nature Conservancy.	N/A	Yes.	Government, philanthropic and private. NOAA, Army Corps of Engineers, Virginia Coastal Zone Management Program the Virginia Marine Resources Commission's Recreational Fishing License Fund, National Science Foundation, Keith Campbell Foundation for the Environment and various other public and private funders.	Start: 2008. Timeframe of 20+ years	Tourism. Souranding fisheries.	N/A	Applied through VERRA-processing.	Lusk, B. (2021). Marine habitat restoration at VVCR: Putting science to work in our coastal bays. [The Nature Conservancy]. *Stories in Virginia* . https://www.nature.org/en-us/about-us/where-we-work/united-states/virginia/stories-in-virginia/vcr-marine-restoration/
Delta Blue Carbon Project	Mangroves	Districts of Thatta and Sujawal in the Indus Delta Area, Sindh Province, Pakistan	350,000 ha	Restoration of degraded lands through large-scale reforestation.	Indus Delta REDD. CEO & Founder: Nadeem Khan.	Technical Adviser: Silvestrum Climate Associates (USA). Strategic Adviser: Pollination. Project Partners: Government of Sindth. Industry Standards: The Climate, Community & Biodiversity Alliance (CCBA).	Yes.	Philanthropic and private.	Start date: 2013. Timeframe: N/A.	All planting is done in partnership with local communities in the project zone, creating hundreds of jobs. Furthermore, a ward and watch system is put in place post planting, which is formalised through Mangrove Stewardship Agreements (MSAs) with different community groups, from which they derive further income. The project directly supports the livelihoods of 60 villages around the perimeter of the project zone. These communities represent 4,911 households and ca. 43,000 individuals.	Biodiversity co-benefits are being achieved through greater protection of the ecosystem and by maintaining natural habitats and the ecological integrity of the Indus Delta. socio-economic livelihoods of coastal villagers who collect shellfish and crabs.	VERRA	Indus Delta Capital. (2019). *The Delta Blue Carbon: Project details* . Delta Blue Carbon. https://deltabluecarbon.com/project-details/
Vanga Blue Forests Project	Mangroves	Kenya, Vanga Bay	460 ha	Provide long-term incentives for mangrove protection and restoration through community involvement and benefit.	Association for Coastal Ecosystem Services (ACES).	UN Environment Programme, the Kenya Forest Service, the Kenya Marine and Fisheries Research Institute and partners.	Yes	Government, philanthropic and private. Carbon credits through the voluntary carbon market.	Start date: 2020. Timeframe: N/A.	Support the livelihoods of over 8,000 people in fishing communities in the area through community development initiatives.	Sustainability goals: 1. No Poverty 4. Quality Education 5. Gender Equality 6. Clean Water and Sanitation 13. Climate Action 14. Life Below Water 15. Life on Land 16. Peace, Justice and Strong Institutions.	Plan Vivo	Plan Vivo Organisation. (2020). *Vanga – Kenya* . Plan Vivo: Current Projects. https://www.planvivo.org/vanga Kairo, J., & Mangora, M. (2020). *Guidelines on Mangrove Ecosystem Restoration for the Western Indian Ocean Region—Western Indian Ocean Ecosystem Guidelines and Toolkits* . United Nations Environment. https://wedocs.unep.org/handle/20.500.11822/33253
Bay of Cispata on Colombia	Mangroves	Bay of Cispata on Colombia	11,000 ha	Project aim is "to use the carbon value generated through the conservation and restoration of the Cispata mangroves to contribute to a long-term sustainable financing strategy for the region".	Conservation International.	Apple, Conservation International's regional partners – INVEMAR Research Institute and CVS (Coporación autónoma regional del Valle del Sinú) and various local partners.	N/A	Philanthropic. Financed by Apple through verified carbon credits under the voluntary carbon standard market.	Start: 2015. Indefinite timeline.	Aim to use the carbon value generated through the conservation and restoration of the Cispata mangroves to contribute to a long-term sustainable financing strategy for the region.	For the 12,000 people who depend on the mangroves for food, firewood and livelihoods, the sale of carbon offsets will provide a degree of financial security as well as the initial funding needed to develop a sustainable ecotourism program and improve fishing practices in the region. Local wildlife will be protected, and a healthier mangrove forest will provide more secure employment, not to mention food security, water purification and better coastal protection against storm surges.	VERRA	Lanham, K. (2019). *A Critical Investment in Blue Carbon* . The Mangrove Alliance. http://www.mangrovealliance.org/apple-and-conservation-international-team-up-to-value-blue-carbon/
Senegal	Mangroves	Regions of Casamanae and Sine-Saloum, Senegal	10,000 ha	This project will restore the shrinking mangrove forests and as a result, protect vital arable land since mangroves serve as effective filtration systems that prevent the influx of saline water which renders soil unfit for agriculture.	The Livelihoods Carbon Fund and the NGO Océanium.	Ramsar Convention, IUCN, FFEM.	Yes	Private and philanthropic. Livelihoods Carbon Fund. Investment is in the Livelihoods Carbon Fund; companies then receive carbon credits. Donations.	Start: 2011. Scheduled for 20+ years.	Job creation through planting of mangrove. Fishermen now have more substantial catches, allowing them to sell their catches allowing for improved food security and increased income for the surrounding villages.	Biodiversity increase. Coast protection.	UNFCCC	Livelihoods. (2019). *10 years- 10 lessons we learned from the Livelihoods-Senegal mangrove restoration program – Livelihoods Funds* . https://livelihoods.eu/10-years-10-lessons-learnedfrom-the-livelihoods-senegal-mangrove-restoration-program/ Livelihoods Funds. (2020). *Senegal: The largest mangrove restoration programme in the world* . Livelihoods Funds. https://livelihoods.eu/portfolio/oceanium-senegal/
New Life for out Coastal Environment	Seagrass	Largs Bay and Hove, Adelaide, South Australia	10 ha	Stabilise seabed. Help marine life. Part of a larger coastal restoration plan.	South Australian Government.	South Australian Research Development Institute.	N/A	Government. $1 million from South Australian Government.	Research and funding began: 2015. Restoration starts 2021. Timeframe: Indefinite.	Fisheries industry.	Biodiversity. Coastal stability against climate change (storm events).	N/A	Tanner, J., & Theil, M. (2020). *Adelaide seagrass rehabilitation project: 2017-2019* (SARDI Publication F2009/000210-3; SARDI Research Report Series No. 1025). South Australian Research and Development Institute (Aquatic Science). https://www.landscape.sa.gov.au/hf/coast-and-marine/coast-and-marine-ecosystems/seagrass-project
West Fourchon Marsh Creation & Nourishment (TE-0134)	Salt Marsh	West of Port Fourchon, between Bayou Lafourche and Timbalier Bay, Louisiana	250 ha	Support the objectives of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) by creating marsh and black mangrove habitat and nourishing existing marsh.	NOAA. National Oceanic and Atmospheric Administration.	N/A	N/A	Government. Approved Funds: $29.5 Mil. Federal Sponsor: National Marine Fisheries Service. Local Sponsor: Coastal Protection and Restoration Authority.	Start: 2015. Timeframe of 20+ years.	Improvement to the use of ports and surrounding fisheries.	Long-term benefits to wildlife.	N/A	NOAA. (2020). *West Fourchon Marsh Creation & Nourishment Project* . https://www.habitat.noaa.gov/pdf/westfourchon_te_134_draft_ea.pdf
Northumberl and Strait Saltwater Marsh Restoration	Salt Marsh	Northumberland Strait area of Nova Scotia, Canada	15 ha	This project will restore tidal wetland in the Northumberland Strait area of Nova Scotia and build community capacity to identify, protect, and restore this habitat. In addition to the direct benefits to the ecosystems where restoration work is completed, this project will develop and/or contribute to existing guidance documents and shareable, open-access data resources to build the capacity of other groups who want to complete similar work.	Clean Foundation.	ESRI Canada and Clean Leadership Program	Yes.	Government and philanthropic. Department of Fisheries and Oceans Canada's Coastal Restoration Fund. Fund allocation: $2,408,947.	Start: 2018: Time frame: for 5 years.	N/A	N/A	N/A	Clean Foundation. (2020). *Northumberland Strait Coastal Restoration Project- Tidal Crossing Assessments – Pictou County* . Clean Foundation. https://cleanfoundation.ca/wp-content/uploads/2020/05/TidalCrossingAssessments_Pictou.pdf

Appendix 2. Restorative economies – National examples

Name	Ecosystem	Location	Project Size	Scope	Project Leads	Collaborator	Iwi Involvement y/n	Funding	Time Frame	Standard	Co-Benefits	Reference
GreenWave	Seaweed	Huaraki Gulf	Huaraki Gulf.	This project will create a sustainable seaweed supply chain (hatcheries (R&D), farming, processing) for NZ, catalysing a high value, low impact seaweed sector, provide environmental benefits, improve mauri of coastal waters, and enhance the resilience of coastal communities.	GreenWave (USA) and EnviroStrat.	University of Waikato, Seaweed Innovation, Auckland Council, AgriSea.	Collaboration with Ngati Pukenga for programme management.	Private, governmental and philanthropic. The Tindall Foundation, Ministry for Primary Industries (MPI), Foundation North and Bay Trust.	2019, project to be indefinite.	N/A	Creation of new seaweed farming jobs in regional coastal communities. Potential for highly skilled jobs in nutrition, bio-stimulants, polymers. Flow through to housing and social support in marginal regional communities. Biodiversity and water quality improvement. Climate change resilience. Improve mauri of coastal ecosystems.	EnviroStrat. (2020). *GreenWave NZ Commercial Scale Regenerative Seaweed Farming Pilot* (p. 1-9).
Revive our Gulf	Mussel Reef	Huaraki Gulf	Hauraki Gulf.	"Mussel reefs once dominated the Hauraki Gulf. Bringing them back is key to improving its mauri, or life sustaining capacity."	Revive our Gulf.	Auckland Council, The Nature Conservancy, The University of Auckland, Auckland Foundation, Hauraku Gulf Forum, OBC Auckland.	In partnership with.	Private and philanthropic. "The Mussel Reef Restoration Trust, the charitable trust behind the Revive Our Gulf project, has partnered with Tāmaki Makaurau's community foundation, the Auckland Foundation, for local fundraising. All our individual donations are managed through the Auckland Foundation's Revive Our Gulf Fund".	Established 2012. Ongoing indefinitely.	N/A	Environmental benefits consisting of boosting biodiversity and biomass, providing food for other species, and filtering water.	Revive our Gulf. (2021). *About us – Revive Our Gulf* . Revive Our Gulf. https://www.reviveourgulf.org.nz/about-us/
Kaipara Moana Remediation (KMR) programme	Coastal-wetland and marine area	Kaipara Harbour	Harbour wide.	The remediation programme will reduce the amount of sediment (eroded soil) being deposited into Kaipara Moana. This is a fundamental first step to halt the degradation of the harbour. In doing so the programme will support a more productive, environmentally sustainable and high-value use of the land within the Kaipara catchment.	The programme is led by a 12-member joint committee, made up of six Kaipara Uri representatives and six council representatives (three each from Northland Regional Council and Auckland Council).	Ngā Maunga Whakahī o Kaipara Development Trust, Te Rūnanga o Ngā Whātua and Te Uri o Hau Settlement Trust (together they take the name 'Kaipara Uri') Northland Regional Council, Auckland Council.	Co-lead.	Governmental- Ministry for Environment Jobs for Nature. Co-funding provided by councils, landowners, industry and others.	Established 2020. Ongoing,	N/A	Job creation- an estimated 300. Habitat creation through wetland restoration. Pollution decrease an increase in water quality through fencing and riparian planting for waterways.	Kaipara Moana Remediation Programme. (2021, May 6). Ministry for the Environment. https://environment.govt.nz/what-government-is-doing/areas-of-work/freshwater/kaipara-moana-remediation-programme/
Awhi Mai Awhi Atu and the Ōhiwa Harbour Strategy	Mussel Reef	Ohiwa	Harbour wide: 26km2.	Iwi kai had dissapeared and all round haarbour health (mussels) increase in starfish who are predidators.	Iwi lead and intitated.	Project Key Researchers- University of Waikato, NIWA, Eco Research Associated Ltd, MUSA Environmental. Other partners- Bay of Plenty Regional Council, Kaumātua, Te Ūpokorehe, Te Rūnanga o Ngāti Awa, Ōhiwa Harbour Implementation Forum (OHIF).	Maori management matarunga, eg. flax natural fibre lines for mussels.	Governmental. The Sustainable Seas.	Project 2020-2023. (after 20 years of research and development.	N/A	Allowing a focus on taonga and mana for iwi.	Sustainable Seas. (2020). *Awhi Mai Awhi Atu: Enacting a kaitiakitanga-based approach to EBM* . Sustainable Seas National Science Challenge. https://www.sustainableseaschallenge.co.nz/our-research/awhi-mai-awhi-atu/
Maketū Estuary enhancement	Estuary	Te Awa o Ngātoroirangi/Maketu Estuary	Re-divert an additional 15% (for a total of 20%) of the Kaituna River's flow back into Ongatoro/Maketū Estuary (the estuary).	Restore Kaituna River's freshwater flows into the estuary. Recreate wetlands around the estuary margin, to help filter nutrients and create breeding areas for birds and fish among other benefits.	Bay of Plenty Regional Council.	Key support- WSP, Stratum NZ as surveyors, J Swap Contractors, and several others.	Engagement throughout the project.	Governmental.	2017-2020	N/A	Maximise the ecological and cultural benefits (particularly wetlands and kaimoana) while limiting the economic cost and adverse environmental effects to acceptable levels. Increase mauri of the estuary and lower river, and therefore aid tangata whenua relationships with the area.	Bay of Plenty Regional Council. (2014). Kaituna River Re-diversion and Wetland Creation Project Assessment of environmental effects – Summary (p. 11). Bay of Plenty Regional Council. https://cdn.boprc.govt.nz/media/322268/kaituna-river-re-diversion-and-wetland-creation-
Whakaora Te Waihora programme	Coastal Wetland	Te Waihora / Lake Ellesmere, Canterbury.	Te Waihora and surrounding farmland.	The vision for Whakaora Te Waihora is "To restore and rejuvenate the mauri and ecosystem of Te Waihora and its catchment".	Ngāi Tahu and Environment Canterbury.	Environment Canterbury and NIWA.	In partnership with.	Governmental, private and philanthropic. Funded by Environment Canterbury, the Government's Freshwater Improvement Fund, and NIWA.	2020-2023	N/A	Biodiversity and water quality.	Te Waihora Co-Governance. (2021). *Te Waihora- Current Projects* . Te Waihora. https://tewaihora.org/current-projects/