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Coral Reef Restoration Enterprises

Strategy and drivers and barriers of businesses focusing on coral reef restoration as their core activity

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Abstract

Coral reefs are essential for providing ecosystem services to humans, including coastal protection, nutrition, and income opportunities for coastal communities. However, coral reefs worldwide have suffered severe damage due to anthropogenic factors, leading to their rapid degradation. Thus, next to preventative actions, coral reef restoration efforts are necessary to avoid complete degradation. In response, businesses have emerged that focus on coral reef restoration as their core business activity. Given that this is a new phenomenon, research on such businesses, Coral Reef Restoration Enterprises (CRRE), is scarce. Therefore, this thesis aims to address this research gap by investigating their business models, value capture strategies, and internal and external drivers and barriers. For this, interviews with representatives of CRRE as well as with relevant market actors and a complementary desktop research were conducted and analysed using a qualitative content analysis. The findings reveal that CRRE have identified multiple value capture strategies supported by a diverse set of value propositions in the economic, environmental, and social domain. As a result, this thesis presents a framework to describe and analyse their business model. The research also identified various internal and external factors that either aid or inhibit their work. Internally, CRRE particularly benefit from shared values within the company and are inhibited by lacking skills of workers. Externally, they mostly face barriers, especially in the political and economic domains. However, the findings also suggest that these domains have the potential to be drivers if they are adapted to the needs of these businesses. Overall, the findings of this research offer valuable strategic insights for practitioners in the field of coral reef restoration who aim for profitability, and insights for policymakers who can support these businesses by improving the policy landscape, establishing standardised biodiversity valuation systems, and providing financial support.

Keywords: Coral reef restoration enterprise (CRRE), Nature-based enterprise (NBE), Coral business, Profitable coral reef restoration, Sustainable business model.

Executive Summary

Problem definition

Coral reefs around the world are rapidly degrading due to climate change and other anthropogenic impacts. The Intergovernmental Panel on Climate Change (IPCC) reports that even if global warming is restricted to 1.5 degrees, nearly 90 percent of coral reefs are expected to disappear (Bindi et al., 2018). In addition to their intrinsic value to nature, coral reefs provide ecosystem services to humans. These include coastal protection through wave dissipation, nutrition through fish biodiversity, and an aesthetic value leading to a recreational value for coastal communities and tourism. Through their ecosystem services, they also provide economic value through tourism, commercial fisheries, coastal development, and extractive activities for medicinal use (International Coral Reef Initiative & UNEP, 2018; Spurgeon, 2001).

With many coral reefs already being severely damaged, restoration efforts are needed to prevent further degradation of coral reefs. While so far coral reef restoration has historically been the responsibility of the public sector, the private sector has responded to the growing need for restoration with Coral Reef Restoration Enterprises (CRRE). These are businesses whose strategy is to focus on profitable coral reef restoration as their core activity. Research on this emerging phenomenon has been scarce, particularly on the strategies for making coral reef restoration profitable and the factors influencing those CRRE.

Aim and research questions

The aim of this master thesis is to examine current business activities of coral reef restoration enterprises by analysing their business model, the strategies they have developed to capture value, and the drivers and barriers they face. This will on one hand inform the strategy and decision-making of these coral reef restoration businesses. On the other hand, it is also intended to inform policymakers about the development of coral reef businesses, so that they can take this into consideration when planning coral reef restoration policies. Finally, the ultimate goal is to support coral reef restoration efforts by overcoming two of the main barriers: financing, and improving the efficiency of the restoration activities. Therefore, the following research questions have been chosen to guide this research:

RQ1a: What are the underlying business models of coral reef restoration enterprises?

RQ1b: What are different strategies for coral reef restoration enterprises to capture value?

RQ2: What are drivers and barriers for coral reef restoration enterprises?

Research design, materials, and methods

A qualitative approach was chosen to answer the two research questions. This was chosen because the emergence of coral reef restoration enterprises is a relatively new phenomenon that has not been explored in this way before. A qualitative approach is particularly suited to studying little-known phenomena and allows for creativity in the data analysis to identify new patterns (Patton, 2002; Tracy, 2010). Data collection methods included interviews with representatives of CRRE and additional interviews with other relevant market actors in the coral reef restoration sector, as well as a desktop review to triangulate results. An initial literature review informed the interviews through a business model canvas framework for RQ1 and a framework for internal as well as one for external drivers and barriers for RQ2. The

interview method chosen for the research was in-depth semi-structured qualitative interviews. This data was supplemented by a desktop review of relevant newspaper articles, secondary interviews, and homepages of CRRE. All data was analysed through a mixed deductive-inductive content analysis using the NVivo 12 tool, ultimately answering the two research questions.

Main findings

For **RQ1**, the findings include a business model framework for CRRE (see Figure I). CRRE have developed different solutions to the question of how to make coral reef restoration profitable. As the strategies vary widely, the business model framework outlines different configuration options that a CRRE can choose for its business model. The configuration options show the possible mix-and-match combinations available to CRRE in the market.

	Attribute	Configuration options								
Value proposition	Economic	Improved restoration efficiency	Attractiveness	Impact communication	Improved monitoring	Risk reduction				
	Environmental	Restoration	New reefs	Low environmental impact	Likeness to nature	Coastline protection				
	Social	Individual contribution	Aesthetic value	Education	Support of local community					
Stakeholder	Key partners	Tourism industry	Government	Insurance companies	Restoration projects	Scientific community	NGOs	Suppliers	Local community	Fishing industry	Other industries
	Customer segment	Tourism industry	Government	Insurance companies	Restoration projects	Real estate	Polluters	Consumer	Other industries		
	Key beneficiaries	Tourism industry	Government	Insurance companies	Restoration projects	Real estate	Local community	Consumer	Fishing industry		
Value facilitation	Key activities	Restoration	Dive shop	Education	Communication					
	Key resources	Ocean-based	Land-based	Substrate						
	Governance	Subscription model	"Home" reef							
	Cost structure	Material for restoration	Boat & equipment	Staff	Travel costs	Shipping of structures				
Value capture	Revenue streams	Restoration service	Education	Planting experience	Diving	Consulting				
		Touristic tours	Maintenance and monitoring	Merchandise	Coastal protection infrastructure					
	Other	Donations	Government funding	Incubator/accelerator programmes	Biodiversity credits	Cryptocurrency				
	Cost reductions	Administrative volunteers	Scientific volunteers	Restoration volunteers						

Figure I: CRRE Business Model Framework. Source: Author.

In terms of both value proposition and value capture, CRRE have adopted different strategies. Concerning the value proposition, each CRRE tried to diversify its portfolio in terms of the value it could offer to potential customers. With the exception of the individual consumer, each CRRE matched at least one economic value proposition with each of its customers, which could be a relevant step in achieving customer willingness-to-pay: offering an economic value that ensures that customers have an economic incentive to pay for the restoration service. An example of this is a strategy of larger scale CRRE, which combined improved restoration efficiency and the resulting positive environmental impacts with impact communication, so that private sector customers could use it for their sustainability reporting. Of all of the different value propositions, improved restoration efficiency was the most important one. Here, CRRE aimed to improve either the speed of restoration, the success in terms of coral survival, the resilience of the corals to climate change, or price efficiency. Given that climate change is leading to increased degradation of coral reefs, demand for rapid, efficient, large-scale, and adapted coral reef restoration is expected to increase. Capturing value through the restoration itself has been the key strategy of CRRE. Most have identified customers who are

willing to pay for the restoration service. Nevertheless, CRRE have demonstrated that they are engaged in many more value capture strategies than just generating funds through the restoration itself and they reported that diversification was key to ensuring financial stability. Also, when it comes to sustaining the ongoing costs of coral reef restoration, some CRRE have developed a three-year subscription model in which customers in the beginning of the contract agree to pay the ongoing subscription fee.

Stakeholders have been described as highly important and highly intertwined for CRRE, with key partners, customers, and key beneficiaries overlapping in many cases. The interviews revealed that most stakeholders overlap in at least two, if not all three of the categories. In particular, key beneficiaries proved to be highly relevant to CRRE's strategy, as they were either also customers or key partners, or both. Stakeholders that overlapped in all three categories were the tourism industry, governments, insurance companies, and other coral restoration projects. Arguably, these overlapping stakeholders can also be summarised as the key stakeholders for CRRE.

The findings for **RQ2** included the identification of relevant drivers and barriers for CRRE. For internal influencing factors, drivers and barriers were identified in both the structural and the cultural domains. The most important influencing factors according to the interviewees are summarised in Figure II. In terms of structural attributes, the majority of barriers related to the skillset of the workforce, while the drivers were more diverse, including business strategy, investment in research and development, and the brand image of the CRRE. Regarding cultural attributes, there were more drivers identified than barriers, and the drivers were also identified as particularly helpful.

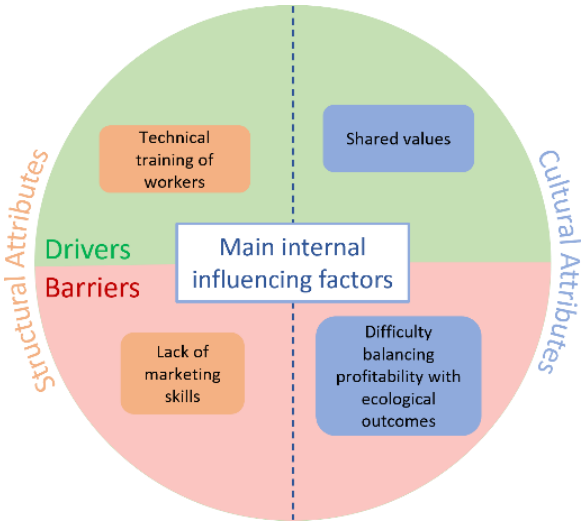


Figure II: Most important internal influencing factors as outlined by interviewees. Source: Author.

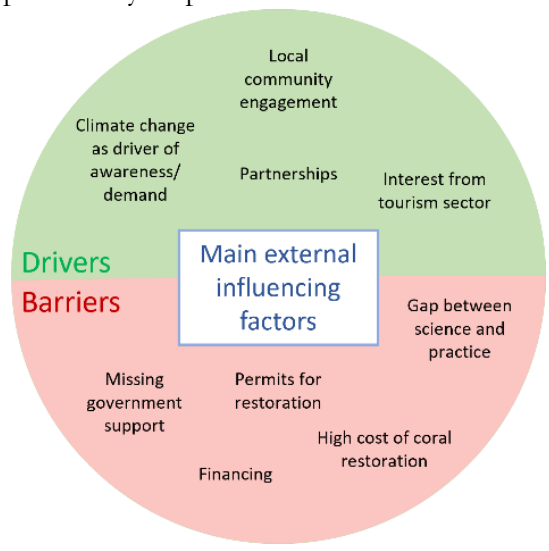


Figure III: Most important external influencing factors as outlined by interviewees. Source: Author.

In contrast to the internal factors, the external factors are predominantly barriers, and participants also reported receiving little support in their activities. The most important barriers from the perspective of the interviewees are summarised in Figure III. For the analysis, the identified drivers and barriers were organised according to the PESTEL framework. The economic domain was found to have the most potential to provide drivers and barriers for CRRE. This was closely followed by the political and the social domains. The findings outline the difficulties that CRRE face in their external environment, but also point to drivers that CRRE can actively work on, such as partnerships.

Conclusions and recommendations

This thesis provides insights into CRRE's commercialisation strategies, their business model, and the relevant drivers and barriers that influence their work. The findings show that CRRE engage in multiple strategies to deliver value to its customers and capture value to make coral reef restoration profitable. For one, the diversified value propositions of CRRE target key beneficiaries to convert them into paying customers. In most cases, the value proposition includes economic values that are relevant to all customers except the individual consumer. In order to capture value, CRRE have identified diversified revenue streams. In addition to their revenue streams, CRRE have also identified additional value capture opportunities through other measures such as donations and government funding as well as cost reductions through the use of volunteers. These additional value capture options are possible because of their commitment to NBS and their positive impact on biodiversity and the environment.

The findings on internal factors have shown that there is a potential for CRRE to capitalise on their internal drivers, as these were reported to be helpful in their efforts. Furthermore, the internal barriers outline what a CRRE can work on to improve its business strategy. While the findings on internal factors resulted in a majority of drivers that outline how a CRRE can positively influence themselves, the findings on external influences resulted mainly in barriers that show how the current external environment for CRRE tends to inhibit their work. It was also shown that external factors can be both drivers and barriers. This shows that there is a potential and a need for policymakers to intervene and support CRRE through improved policies such as a standardised approach to biodiversity valuation, additional funding opportunities, and improved distribution of restoration permits.

In summary, specific implications and recommendations for CRRE are:

- Include a diversified portfolio of value propositions
- Offer an economic benefit next to environmental and social benefits to all costumers other than the individual consumer
- Improve restoration efficiency as it is a key value proposition
- Identify key beneficiaries and involve them either as customers, as key partners, or both
- Diversify value capture strategies
- Focus on improving internal drivers, as those can be influenced, and invest in skilled employees, especially those with business strategy and marketing skills
- Employ an atmosphere of shared values within the business

Finally, recommendations for future research have emerged from this thesis. These include the possibility of expanding on this research. As it has faced limitations due to its global scope, future research is needed with a focus on one geographical area. This will make the findings more specific and contextualised. In addition to expanding the research by limiting the scope, the research can also be expanded by repeating it at a later stage. Currently, the majority of CRRE have only been established within the last four years. By repeating the study at a later stage, the CRRE had the opportunity to establish themselves more sustainably, to solidify their strategies, and to conclude long-term learnings.

Table of Contents

ACKNOWLEDGEMENTS ..... **I**

ABSTRACT ..... **II**

EXECUTIVE SUMMARY ..... **III**

LIST OF FIGURES ..... **VIII**

LIST OF TABLES ..... **IX**

ABBREVIATIONS ..... **IX**

1 INTRODUCTION **1**

1.1 PROBLEM DEFINITION 2
1.2 AIM AND RESEARCH QUESTIONS 3
1.3 SCOPE AND DELIMITATIONS 3
1.4 ETHICAL CONSIDERATIONS 4
1.5 AUDIENCE 5
1.6 DISPOSITION 5

2 CURRENT KNOWLEDGE RELATED TO CORAL REEF RESTORATION AS A NATURE-BASED ENTERPRISE **7**

2.1 APPROACHES TO CORAL REEF RESTORATION 7
2.2 THE LINK BETWEEN NBS AND BUSINESSES 9
2.3 NATURE-BASED ENTERPRISES 10
2.4 RESTORATION OR ENVIRONMENTAL STEWARDSHIP AS A BUSINESS 11
2.5 CORAL REEF RESTORATION AS A BUSINESS 13
2.6 DRIVERS AND BARRIERS OF NATURE-BASED ENTERPRISES 15
2.7 SUMMARY 19

3 CONCEPTUAL FRAMEWORKS OF RELEVANCE TO CORAL REEF RESTORATION ENTERPRISES **20**

3.1 BUSINESS MODEL FRAMEWORKS 20
3.1.1 Nature-Based Solutions Business Model Canvas 20
3.1.2 Own proposition: Nature-Based Enterprise Business Model Canvas 22
3.2 FRAMEWORKS FOR FACTORS THAT INFLUENCE SUSTAINABILITY STRATEGIES 23
3.2.1 Internal organisational capabilities 23
3.2.2 External drivers and barriers for business strategy 23

4 RESEARCH DESIGN, MATERIALS, AND METHODS **25**

4.1 RESEARCH DESIGN 25
4.2 DATA COLLECTION 26
4.2.1 Literature review 26
4.2.2 Interviews 27
4.2.3 Desktop review 29
4.3 DATA ANALYSIS 30

5 FINDINGS/RESULTS & ANALYSIS **32**

5.1 BUSINESS MODELS OF CORAL REEF RESTORATION ENTERPRISES 32
5.1.1 Value proposition 33
5.1.2 Stakeholders 37
5.1.3 Value facilitation 41
5.1.4 Value capture 44
5.2 INFLUENCING INTERNAL AND EXTERNAL FACTORS 47

5.2.1 Internal factors ... *47*
5.2.2 External factors ... *50*

6 DISCUSSION ... **56**

6.1 DISCUSSION OF RESULTS IN RELATION TO WHAT IS KNOWN ... 56
6.1.1 Underlying business models and value capture strategies (RQ1) ... *56*
6.1.2 Drivers and barriers for CRRE (RQ2) ... *59*
6.2 OVERALL REFLECTIONS ON CRRE ... 61
6.3 LIMITATIONS ... 65

7 CONCLUSION ... **67**

7.1 PRACTICAL IMPLICATIONS AND RECOMMENDATIONS ... 68
7.2 RECOMMENDATIONS FOR FUTURE RESEARCH ... 69

BIBLIOGRAPHY ... **70**

APPENDIX ... **77**

APPENDIX A: LIST OF WEBPAGES USED FOR THE DOCUMENT REVIEW ... 77

List of Figures

Figure 1-1: Global distribution of tropical coral reefs with relevant regions approximately marked on map. Source: Adapted from Jackson et al. (2020). ... 2

Figure 2-1: Proactive versus reactive actions in coral reef restoration. Source: Adapted from Escovar-Fadul et al. (2022). ... 8

Figure 2-2: Financing needs for an NBS. Source: Mayor et al. (2021). ... 9

Figure 2-3: How to categorise coral reef restoration enterprises in the broader concept of sustainable business models. Source: Author. ... 10

Figure 3-1: The Nature-Based Solutions Business Model Canvas. Source: Connecting Nature (2019). ... 21

Figure 3-2: The Nature-Based Enterprise Business Model Canvas. Source: Own elaboration with influences from Osterwalder & Pigneur (2010) and Connecting Nature (2019). ... 22

Figure 3-3: Internal organisational capabilities. Source: Adapted from Stubbs and Cocklin (2008). ... 23

Figure 4-1: Research design. Source: Author. ... 25

Figure 5-1: Venn diagram of customer segment, key partners, and key beneficiaries. Source: Author. ... 37

Figure 5-2: Key internal influencing factors. The boxes with a red border indicate factors which have been identified as particularly important by respondents. Source: own elaboration with influences from Stubbs and Cocklin (2008). ... 47

Figure 5-3: Key external influencing factors. The writings in red bold indicate those influencing factors which were identified as especially important by respondents. Source: own elaboration with influences from McQuaid et al. (2021) ... 51

List of Tables

Table 2-1: Methods of coral reef restoration. Source: Adapted from Boström-Einarsson et al. (2020)..... 8

Table 2-2: Types of organisations delivering nature-based solutions. Source: Kooijman et al. (2021)..... 11

Table 2-3: Examples of NBEs engaging in restoration or environmental stewardship. Source: Author. 11

Table 2-4: Summary of internal drivers and barriers for NBEs from the literature review. Source: Author. 16

Table 2-5: Summary of external drivers and barriers for NBEs from the literature review. Source: Author. 16

Table 3-1: PESTEL Framework. Source: de Bruin (2016). 24

Table 4-1: List of interviewees. Source: Author. 28

Table 4-2: Overview of content analysis. Source: Author. 30

Table 4-3: Themes of the literature review matrix. Source: Author. 30

Table 4-4: Initial coding structure for the content analysis of RQ1 and RQ2. The cursive words show the sub-codes to the non-cursive words. Source: Author. 31

Table 5-1: CRRE Business Model Framework. Source: Author..... 32

Abbreviations

AI	Artificial intelligence
BMC	Business model canvas
CRRE	Coral Reef Restoration Enterprise
ESG	Environmental, social, and governance
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MAP	Marine-protected area
NBE	Nature-based enterprise
NBS	Nature-based solutions
NBE-BMC	Nature-based enterprise business model canvas
NBS-BMC	Nature-based solutions business model canvas
NGO	Non-governmental organisation

OECD	Organization for Economic Cooperation and Development
SBM	Sustainable business model
UN	United Nations
USD	United States dollar

1 Introduction

Climate change has impacts across ecosystems, countries, and ultimately also impacts business strategy. Coral reefs are a vulnerable marine ecosystem that is highly threatened by many anthropogenic impacts, the most important of which is climate change. While coral reefs are significantly impacted by human activities, they also provide significant benefits to humans in the form of ecosystem services. Coral reefs are important for coastal protection, as they can reduce wave strength by up to 97 percent, thereby reducing coastal erosion and providing coastal communities with a buffer against potential damage from storms or strong waves (Brathwaite et al., 2022; Escovar-Fadul et al., 2022). In addition to coastal protection, coral reefs also provide sustenance through fish biodiversity, and corals provide aesthetic and therefore recreational value to local communities and tourism (Gattuso et al., 2014).

Coral reefs also offer economic value in their provision of ecosystem services. Figure 1-1 shows a map of the global distribution of tropical coral reefs, showing the areas of the world directly benefiting from corals. Coral rich areas are highly dependent on the economic value provided by coral reefs. The main industries that benefit from the economic value provided by coral reefs are tourism, commercial fisheries, and coastal development (International Coral Reef Initiative & UNEP, 2018). For these three sectors, the value derived from coral reefs is estimated to be approximately 6.2 billion USD per year for the Mesoamerican region[1] and 13.9 billion USD per annum for the Coral Triangle[2] region (International Coral Reef Initiative & UNEP, 2018). "Reef-associated tourism alone generates more than 7.9 billion USD annually from more than 11 million visitors" in the Caribbean region[3] (Escovar-Fadul et al., 2022, p. 5). Specifically for flood risk reduction, the value of coral reefs is estimated to be over 1.8 billion USD per year in the United States alone (Quigley et al., 2022). Additionally, the pharmaceutical sector also relies on extractive activities in coral reefs for medicinal use (Spurgeon, 2001). Given the vulnerability of coral reefs and the multiple benefits they provide to multiple stakeholders, their conservation and restoration is critical.

Over half of the world's coral reefs are at either a medium or high risk of degradation (Gattuso et al., 2014). According to a special report by the Intergovernmental Panel on Climate Change (IPCC), around 90 percent of coral reefs are expected to disappear even in a scenario where global warming is limited to 1.5 degrees (Bindi et al., 2018). One of the impacts of climate change is the warming of the oceans which among other unprecedented impacts on marine ecosystems, leads to mass bleaching events of coral reefs. Bleaching means that part of the coral tissue, which is essential for the energy supply of corals, is broken down, resulting in large parts of coral reefs being irreparably damaged (Gattuso et al., 2014). Furthermore, rising sea levels due to climate change effectively "drown" corals in their current locations (Brathwaite et al., 2022). In addition, other anthropogenic activities such as agricultural run-off leading to ocean acidification and destructive fishing practices put coral reefs under stress. Coral reefs are one of the ecosystems most at risk of disappearing due to climate change (Quigley et al., 2022).

[1] The Mesoamerican economic region is located in the Americas, ranging from the south of North America over Central America to the north of South America and encompasses following countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, (the southern provinces of) Mexico, Nicaragua, and Panama (OECD Territorial Reviews, 2006).

[2] The Coral Triangle is a marine area in the western Pacific Ocean. Adjacent countries include Indonesia, Malaysia, the Philippines, Brunei, and Papua New Guinea, and the region is known for its rich marine biodiversity (Carpenter et al., 2011).

[3] The Caribbean region is a semi enclosed basin of the western Atlantic Ocean that is located east to the Mesoamerican region and includes 26 countries, such as Cuba, Dominican Republic, Haiti and Jamaica, and 19 dependent territories of France, the Netherlands, the United Kingdom, and the United States (Miloslavich et al., 2010).

Even if carbon emissions were to cease completely now, current reef systems are said to be unable to withstand already increased ocean temperatures and thus adaptation of corals and restoration measures are needed if coral reefs are to survive (Gibbs, 2021).

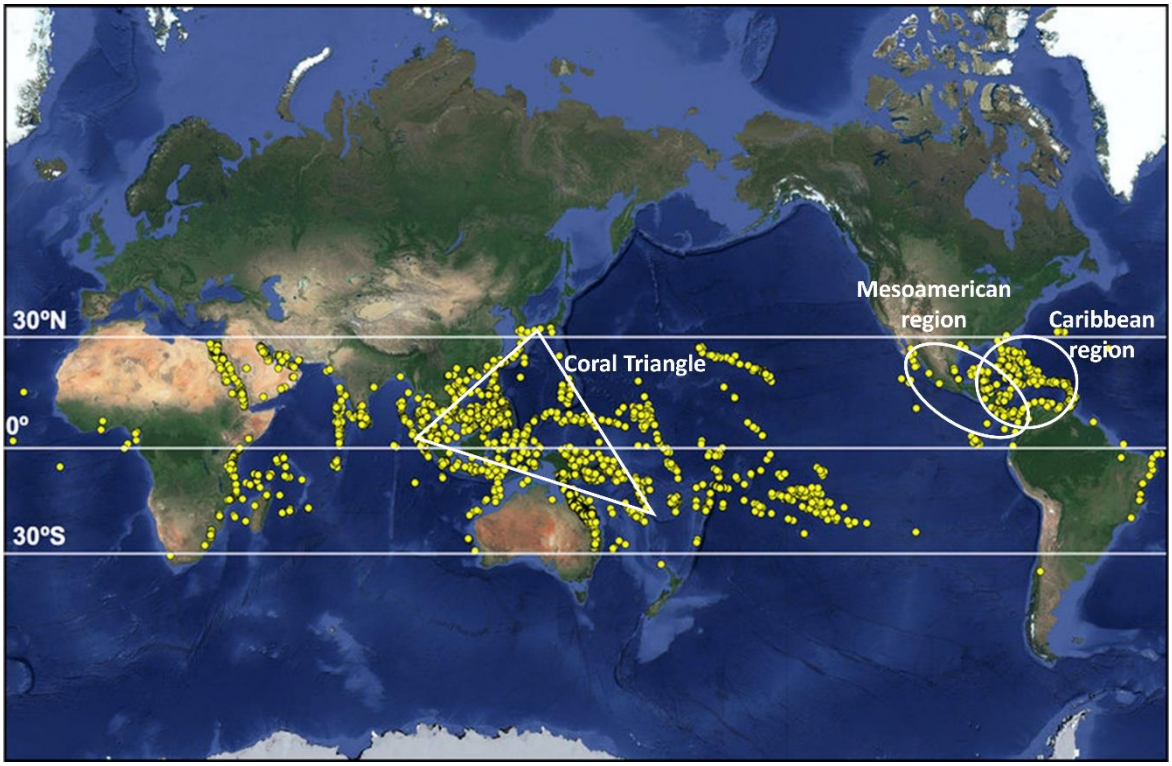


Figure 1-1: Global distribution of tropical coral reefs with relevant regions approximately marked on map. Source: Adapted from Jackson et al. (2020).

1.1 Problem definition

The current scale of restoration projects is too small to achieve the required restoration target (Gibbs, 2021). Preventive measures, such as climate change mitigation and fisheries management, help to reduce stress on coral reefs and are an important means of protecting coral reefs. However, as many of the world's coral reefs are already severely damaged and bleaching events are expected to continue, preventive measures must be accompanied by restoration efforts to prevent the complete degradation of coral reefs (Gattuso et al., 2014; International Coral Reef Initiative & UNEP, 2018). When it comes to coral reef restoration, one of the main problems is securing funding for the restoration activities and coordinating restoration efforts (Bayraktarov et al., 2020; Okubo & Onuma, 2015). Currently, coral reef restoration activities are mainly driven by the public sector (Kooijman et al., 2021). However, the private sector could overcome funding barriers through new value capture strategies, as well as expertise barriers through research and development for a coordinated restoration effort, and thus could represent a major advance in the field of coral reef restoration (McQuaid et al., 2021). As of now, some companies are attempting to bridge this gap and commercialise coral reef restoration, for example through pay-to-restore schemes or by offering improved restoration practices.

There is a gap in research on the economic viability of businesses working to restore natural systems, particularly coral reefs, as well as a gap in the research on business strategies to make coral reef restoration a profitable venture. From an economic perspective, Mohr and Metcalf (2018) point out that even though there is a global restoration economy of about 1 trillion

USD annually, little research is done on the business side of restoration (Mohr & Metcalf, 2018). Using qualitative analysis, they examined businesses involved in the restoration of a river. Replicating their study for coral reef restoration, rather than river restoration, may provide additional insights into the role of businesses in restoration. McQuaid et al. (2021) studied drivers and barriers of enterprises with nature as their core and suggests that it would be valuable to extend their research to a specific market. In addition, there is also a call from coral reef restoration research to focus on the commercialisation, such as Okubo and Onuma (2015), who mention that future research in the area of commercialisation of transplantation could provide valuable inputs to make coral reef restoration financially independent. Finally, Quigley et al. (2022) outline the importance of making coral reef restoration profitable in order to secure funding.

The relatively recent development of businesses engaging in coral reef restoration as their core economic activity – hereafter referred to as Coral Reef Restoration Enterprises (CRRE) – and the research gap outlined above indicate that research into the profitability strategies of coral reef restoration, as well as the drivers and barriers to CRRE, can provide valuable insights for current practitioners, not only those attempting to commercialise it, but also non-governmental organisations (NGOs) seeking to improve their strategy or policymakers seeking to support this new development.

1.2 Aim and Research Questions

The aim of this master thesis is to examine current business activities of coral reef restoration enterprises by analysing their business model, the strategies they have developed to capture value, and the drivers and barriers they face. This will on one hand inform the strategy and decision-making of these coral reef restoration businesses. On the other hand, it is also intended to inform policymakers about the development of coral reef businesses, so that they can take this into consideration when planning coral reef restoration policies. Finally, the ultimate goal is to support coral reef restoration efforts by overcoming two of the main barriers: financing, and improving the efficiency of the restoration activities.

The following research questions support the research of current commercialisation efforts in the coral reef restoration market and thus account for the activities that are already happening. These research questions are to gain insights into relevant aspects of coral reef businesses:

RQ1a: What are the underlying business models of coral reef restoration enterprises?

RQ1b: What are different strategies for coral reef restoration enterprises to capture value?

RQ2: What are drivers and barriers for coral reef restoration enterprises?

1.3 Scope and Delimitations

This study focuses on the analysis of CRRE enterprises, i.e., enterprises that engage in coral reef restoration as a profitable core business activity. As coral reef support can manifest itself in a number of ways, CRRE are defined as those businesses that engage in reactive coral reef restoration activities directed at helping already damaged reefs (see Figure 2-1). Thus, the institutions interviewed and analysed in this study will mainly focus on reactive rather than

proactive (preventative) actions, but there is a possibility that institutions may also be involved in proactive actions or in actions that could fall into both categories.

Additionally, in terms of the types of organisations studied, this thesis focuses on CRRE that aim to be profitable, as opposed to NGOs. When it comes to profitability, there are three types of organisations. The three types are non-profit, not-for-profit, and for-profit. For-profit means that the organisation has their activities centred around profit-making. Non-profit and not-for-profit organisations do not distribute their profits but reinvest them in their activities or in activities that benefit the general public. The difference between the two types is that non-profits rely on grants and philanthropy, while not-for-profits are financially self-sustainable (Hinton & Maclurcan, 2017). Therefore, non-profit coral reef restoration is not within the scope of this thesis, as it does not qualify as a CRRE, whereas not-for-profits generate their own revenue but have actively chosen not to make a profit but rather to reinvest it for the good cause, thus still being profitable in an economic sense. Thus, this thesis will focus on analysing for-profit coral reef restoration enterprises, but will also accept not-for-profit enterprises, as they are financially self-sustaining. Non-profits are outside of the scope of this thesis and will only be interviewed to aid the analysis of for-profit enterprises.

As there are not yet many coral reef restoration businesses in the market yet and those that do exist are scattered across nations, the scope is global not limited by geographical scope. This may of course limit the comparability of the analysed enterprises, but a smaller scope would result in too little data being available for collection. In addition to interviewing CRRE, this thesis will also include international institutions and NGOs in the scope, as long as their experience is consistent with the scope of reactive actions outlined in the first paragraph. This should not affect the comparability of the data, as the interviews with NGOs and international organisations are complementary to the interviews with CRRE in order to triangulate the information from CRRE.

Through semi-structured interviews with practitioners in the coral reef restoration sector, this thesis will identify business models, value capture strategies, and drivers and barriers relevant to CRRE. This will be supported by the prior literature review to triangulate the findings and will be discussed as an outcome.

1.4 Ethical considerations

This research is not supported or funded by any external organisation and there is no other entity that could unduly influence the nature of this analysis, or the conclusions drawn from it. There are no conflicts of interest in this research.

However, as this research is in close contact with practitioners, there are other ethical considerations that need to be taken into account when conducting this research, particularly in relation to the ethical responsibility to the research subjects who are the practitioners. The practitioners that will be interviewed were all voluntary participants that chose to be a part of this research. Prior to taking part, they were informed about the content of the research. They were also informed that they could choose to withdraw their consent at any time during the course of the research without any repercussions.

While this research did not seek to collect sensitive data about the organisations that participants represent, such as technological details about their products/processes or critical financial information, it did seek general information, such as their value proposition and revenue streams, that may be relevant to their competitiveness in the marketplace or that may influence the public's perception of the companies. Each participant had influence over the

specificity and depth of information they chose to disclose. The interviews were conducted anonymously, and any information disclosed by the participants was voluntary. Each participant had the opportunity, during or after the interview, to comment on things they have said and to exclude them from the data collection.

Finally, all sensitive information from interviews and pre/post communication were stored on a password-protected hard drive. Sensitive information will include participants' personal data and documentation of the interviews, which will be encrypted so that it cannot be directly traced back to a particular participant. These were stored in separate locations on a hard drive.

1.5 Audience

As this thesis analyses the business models and strategies of CRRE, the main target audience of this thesis is practitioners in the field of coral reef restoration with a specific focus on CRRE. The analysis and subsequent discussion of value capture strategies and drivers and barriers will provide insights into potential strategies for these businesses and could improve their decision-making. While RQ1 will help practitioners to analyse their internal business strategies and potentially identify opportunities for practitioners, RQ2 will support decision making by using the knowledge of drivers and barriers to their advantage.

In addition to CRRE, this work is also aimed at NGOs and international organisations working on coral reef restoration. Any attempt to work on nature-based solutions (NBS) usually requires the involvement of many stakeholders and collaboration is key. Therefore, an understanding of CRRE, the problems they face and the solutions they have produced is crucial for NGOs and international organisations who wish to work with CRRE on a project.

Next to practitioners in the coral reef restoration market, this thesis also aims to inform policy makers about CRRE. As the policy environment is crucial for an organisation involved in the implementation of NBS, this is likely to be no different for CRRE. If policymakers are aware of the development of CRRE, and the drivers and barriers that exist, they can use this knowledge to better design policies that support such enterprises and ultimately coral reef restoration.

Finally, this research is conducted as a master thesis for the Master of Science at the International Institute for Industrial Environmental Economics (IIIEE) at Lund University, thus this thesis will be written with them as an audience in mind. As research about CRRE is scarce, this thesis is also aimed at any researcher interested in studying CRRE. Furthermore, it also is directed at researchers studying NBEs, as this thesis expands current research in this field.

1.6 Disposition

Section 1 introduced to the researched topic by defining the problem and outlining the research aim and questions. Additionally, the scope of this research was stated, ethical considerations raised, and the intended audience of this research outlined.

Section 2 is based on a literature review and addresses relevant knowledge related to coral reef restoration as a profitable business. For this, the link between NBS and businesses is explored, the concept of nature-based enterprises (NBEs) is outlined, and examples of restoration or environmental stewardship as a business are explored. This leads to the review of literature analysing coral reef restoration as a business as well as drivers and barriers for NBEs.

Section 3 outlines conceptual frameworks that build the analytical basis for this thesis. This includes different business model frameworks as well as the framework of internal organisational capabilities for internal influencing factors and the PESTEL framework for the analysis of external influencing factors.

Section 4 explores the research design of this thesis including the chosen data collection methods and how the data was analysed. It will also explain why the methods of interviews and a desktop review was chosen, and how the individual steps of the research were conducted.

Section 5 presents the results of this research. For one, it presents a business model framework for CRRE as a result from the interviews and the desktop review. Additionally, it also outlines the identified influencing internal and external factors of CRRE.

Section 6 discusses the findings from section 5. Firstly, by comparing the results in relation to what is already known and then by expressing overall reflections that are of relevance to CRRE. The limitations to this research are also reflected on in this section.

Section 7 concludes the main findings of this research, provides practical implications for practitioners, and recommends future research opportunities.

2 Current knowledge related to coral reef restoration as a nature-based enterprise

To understand the emergence of businesses attempting to make coral reef restoration their profitable core business, one should go back and understand the development of businesses that started focusing on nature-related activities or even the notion that a business does not only have responsibilities towards their shareholders, but also a wider responsibility towards their stakeholders and the general public. The traditional reasoning of a business can be described by the shareholder doctrine, explained by Milton Friedman. Here, a company's entire responsibility was to maximise the profits of their shareholders (Friedman, 1970). However, the business world has evolved towards a new perspective, where business responsibility has shifted from shareholder profits towards a more holistic approach including a triple bottom line, meaning to "consider a wide range of stakeholder interests, including environment and society" (Bocken et al., 2014, p. 1). With this development, the focus of a company switches to areas more beneficial to society, such as, among others, coral reef restoration. Notably, the phenomenon of businesses focusing on coral reef restoration as their core business is comparably new. To understand this new development, this literature review focused on businesses that generally implement nature-based solutions as their core business, examples of how businesses attempt to commercialise restoration practices in other ecosystems, what relevant drivers and barriers such businesses face, and how this could translate to a coral reef restoration business. Before diving into these themes, the next section first provides background information into the practices of coral reef restoration that are of relevance to having a holistic understanding of CRRE.

2.1 Approaches to coral reef restoration

In the area of coral reef ecosystems, several actions can be taken to safeguard them. Figure 2-1 illustrates actions that can be taken for coral reef enhancements and sorts them under proactive and reactive actions. Proactive actions include "actions aimed at protecting reefs and enabling recovery" (Escovar-Fadul et al., 2022, p. 21). Such actions can include climate change mitigation as well as waste and water management. Next to proactive actions, coral reef support also includes reactive actions, meaning "actions aimed at repairing ecosystem function and assisting the recovery of a degraded reef system" (Escovar-Fadul et al., 2022, p. 21). However, as the figure also illustrates, proactive and reactive actions are not always clearly divided. The CRRE defined for this thesis engage in reactive measures, those mainly being coral reef restoration and substrate manipulation, but in some cases might also include predator and invasive species control, disease management, and larval propagation.

Prominent restoration methods include direct transplantation of corals, coral gardening, larval enhancement, and substratum enhancement methods (see Table 2-1). The most common method is coral gardening (Boström-Einarsson et al., 2020). This is the case due to the comparable ease of the method. One picks up so-called fragments of opportunity[4] and transplants them into a nursery first, where they are kept safe during their most vulnerable stage. As fragments of opportunity are cheap and the nursery can be established at the restoration site underwater, this method is comparably cheap and easy to manage. The other prominent method is substrate enhancement, which includes either the construction of artificial structures for the transplantation of corals or the stabilisation of substrate. Finally,

[4] Fragments of opportunity are coral fragments that have detached from the parent colony due to natural causes (such as them breaking due to storms or turtles feeding on them) or non-natural causes which were, however, not initiated by the restoring entity (such as anchors of boats destroying corals) (McLeod et al., 2022)

larval enhancement methods were shown to be less prominent due to their novelty, complexity, and comparably high costs (Abrina & Bennett, 2021). Nevertheless, the method was argued to be crucial for upscaling current restoration efforts and adapting corals to changing environmental factors (Abrina & Bennett, 2021; Boström-Einarsson et al., 2020).

Table 2-1: Methods of coral reef restoration. Source: Adapted from Boström-Einarsson et al. (2020).

Type	Method	Definition
Asexual propagation	Direct transplantation	Directly transplanting coral fragments without a nursery phase
	Coral gardening	Transplanting coral fragments with an intermediary nursery phase to safeguard their growth in the most vulnerable stage
Sexual propagation	Larval enhancement	The use of sexually reproduced coral larvae for release or planting at a restoration site
Substratum enhancement	Substratum addition	Installation of artificial reef structures (such as frames or blocks) for coral reef restoration purposes
	Substratum stabilisation	Stabilising of natural substratum at the site

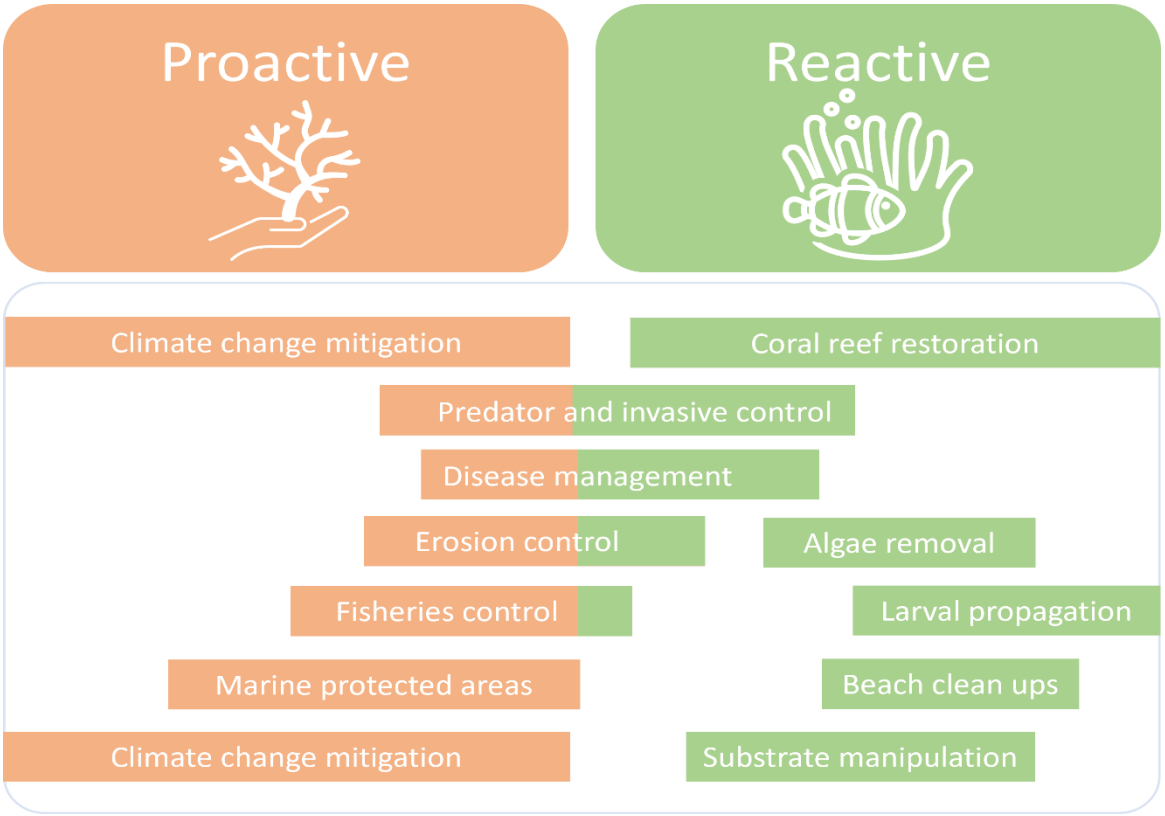


Figure 2-1: Proactive versus reactive actions in coral reef restoration. Source: Adapted from Escovar-Fadul et al. (2022).

2.2 The link between NBS and businesses

The International Union for Conservation of Nature (IUCN) has defined nature-based solutions as "actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al., 2016, p. 2). NBS shifts the understanding from nature simply being a cost-factor to actually being the solution, as it benefits us as a society and thus provide solutions to sustainability challenges (Mayor, Toxopeus, et al., 2021). An example of an NBS is the restoration of reefs instead of replacing them through grey infrastructure in the ocean to increase wave dissipation and thus coastal protection. With multiple environmental challenges such as climate change and biodiversity loss, there is a need for solutions that tackle those problems with the least negative impact on ecosystems. NBS have the potential to be a nature-friendly solution, offering multiple benefits to multiple stakeholders and thus having the potential to offer cost-efficient solutions to complex environmental problems (Mayor, Toxopeus, et al., 2021).

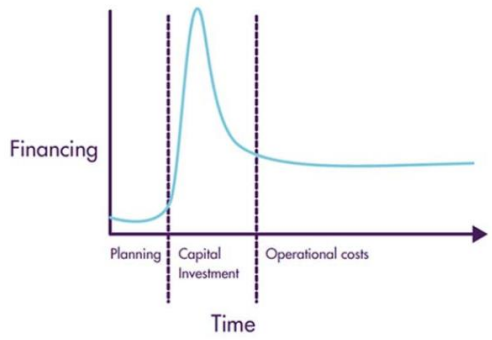


Figure 2-2: Financing needs for an NBS. Source: Mayor et al. (2021).

Environmental challenges do not only lead to risks for society as a whole, but also businesses face risks due to climate change and biodiversity loss, which is why businesses focus on environmental risk mitigation (Pattberg, 2012). This means that businesses can also benefit from NBS to decrease risks associated to their business activities, such as weather-related risks in the food industry or ocean warming related risks in the fishing industry.

When engaging in NBS as a company, the financial structure differs. First, NBS usually require high initial capital investment. Furthermore, comparing NBS to so called "grey" (non-nature-related solutions) infrastructure, it is notable that most grey infrastructure depreciates over time, which is traditionally accounted for by businesses, whereas in the case of NBS, most infrastructure appreciates over time, while ongoing investments are needed to sustain the operational costs (Mayor, Toxopeus, et al., 2021). These needed ongoing investments result in the need for companies to continuously generate revenue throughout an NBS project and beyond in order to sustain the ongoing costs needed (Mayor, Toxopeus, et al., 2021). The financial needs of a NBS are illustrated in Figure 2-2. This difference means that any company attempting to make NBS their core business, has to shift their business model towards a sustained revenue which funds the NBS alternative, but it also means that there lies great long-term value in NBS in contrast to traditional alternatives. However, the reality still is that values which create marketable products have a higher potential to be profitable for a company than values which offer more public benefits, which is the case for many NBS (Toxopeus & Polzin, 2017). So, to successfully implement NBS as a business, it is crucial to define a clear business case and secure funding and long-term revenue, as NBS oftentimes require larger initial investments and long-term maintenance costs (Somarakis et al., 2019).

Coral reef restoration qualifies as a NBS considering that the restoration adds to biodiversity through coral biodiversity improvements and resulting fish biodiversity through habitat restoration. Furthermore, the restoration of coral reefs also lead to improving well-being for humans through so called ecosystem services by increased food security, coastal protection, and recreational benefits (Gattuso et al., 2014).

2.3 Nature-based enterprises

When looking into general business literature focused on the implementation of nature-based solutions, the papers written by Kooijman et al. (2021) and McQuaid et al. (2021) emerge as key literature. They conducted relevant analyses regarding sustainable business models and focused it specifically on nature-based solutions in the context of businesses.

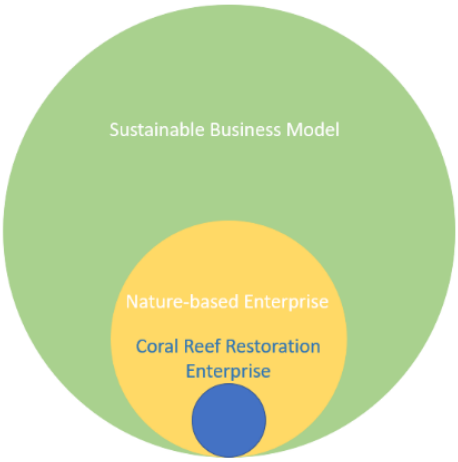


Figure 2-3: How to categorise coral reef restoration enterprises in the broader concept of sustainable business models. Source: Author.

A traditional business model can be defined as the underlying architecture of a company's structure and how it uses resources to capture economic value (Teece, 2010). This traditional view was expanded by Bocken et al. (2014), who describes the concept of a sustainable business model (SBM). The first time where the concept of business models in combination with NBS was explored was through the European Commission in 2014-2020, where they advanced research on NBS as part of the Horizon 2020 programme and as a result the need to research business models for NBS was identified (Mayor, Toxopeus, et al., 2021).

While SBMs include a responsibility towards society and the environment (Bocken et al., 2014), Kooijman et al. (2021) put forward a sub-concept for SBMs that concentrate on nature-based solutions as their core activity. They name them nature-based enterprises (NBE) and in addition to incorporating a triple bottom line, NBEs aim at supporting the delivery of different ecosystem services and are beneficial for biodiversity (Kooijman et al., 2021). Nature and nature-based solutions are at the core of their business activities.

To qualify as a NBE, an organisation delivering NBS has to fulfil certain criteria (shown in Table 2-2) (Kooijman et al., 2021). On one hand there is the distinction between organisations which engage in economic activity, meaning the selling of goods or services at a given price on a given market, or the lack of economic activity, which would be the case for organisations implementing NBS with external funding without actually selling the implementation, so for example NGOs engaging in restoration. Furthermore, there is the question of how the organisations engage with nature. It differs between organisations offering nature-based products and services, meaning that the organisation which offer these products or services do not engage with nature as the core of their activities, such as for example a forestry enterprise which as part of their management engage in conservation, but do not do this as their main business, and organisations who have nature as the core of their activities, meaning they engage with NBS as their core activity (Kooijman et al., 2021). In order to qualify as a NBE, the organisation has to both engage in economic activity by selling products or services, and nature has to be at the core of their organisation, meaning that their main strategy is about NBS (see nature-based enterprise in Table 2-2). The categories of nature-based economic activities NBEs engage were outlined by Kooijman et al. (2021) and include direct activities, such as ecosystem creation, restoration, and management, or indirect activities, such as advisory or financial services.

Table 2-2: Types of organisations delivering nature-based solutions. Source: Kooijman et al. (2021).

	Nature is at the core of activities	**Nature is not at the core of activities**
Economic activity	Nature-based enterprise	Enterprises delivering nature-based products and services
No economic activity	Nature-based organisation	Organisations delivering nature-based products and services

From a business model perspective, value proposition, value capture, and value delivery are fundamental for an NBE (Mayor, Toxopeus, et al., 2021). This holds especially true considering that the value proposition differs from traditional businesses by including multiple values for the economic, social, and environmental domain which do not necessarily all manifest for the intended customer, but also for other not directly involved beneficiaries (Connecting Nature, 2019). Out of that reason comes the importance of value capture and value delivery for an NBE. This is because value delivery has a potential to be complex in nature due to the complexity of NBS and capturing economic value is essential for an NBE, but might not be as clear as in a traditional business model (Egusquiza et al., 2021).

Both Kooijman et al. (2021) and McQuaid et al. (2021) have done defining work in establishing and analysing a sub-concept of SBM which is the NBE. This research is highly relevant when it comes to the analysis of coral reef restoration as a business, considering that ecosystem restoration is one of the by Kooijman et al. (2021) defined economic activities of a NBE.

2.4 Restoration or environmental stewardship as a business

While the concept of NBE is new, this does not mean that such enterprises are new. On the contrary, enterprises focusing on nature as their core business have been establishing over the past decades and Kooijman et al. (2021) even presented some NBEs in their paper. For this section, the literature review focused on finding examples of NBEs in the specific sub-categories of restoration or nature stewardship that would be most comparable to coral reef restoration to better understand how this could translate to cases of coral reef restoration as an NBE. Five examples will be presented in this section, three of them being a restoration NBE and two of them focused on nature stewardship instead. A summary of the presented examples can be viewed in Table 2-3.

Table 2-3: Examples of NBEs engaging in restoration or environmental stewardship. Source: Author.

Author	**Location**	**Type**	**Description**	**Value Capture**
Mohr and Metcalf (2018)	United States	Restoration	Restoration of the Clark Fork River in Montana.	Value capture through the restoration practice itself.
Mekuria et al. (2020)	Ethiopia	Restoration	Forest exclosures for restoration.	Beekeeping Harvesting fodder Cultivating high-value plant species
Applegate et al. (2022)	Indonesia	Restoration	Peatland restoration with a core restoration area and a buffer zone.	Agroforestry Aquaculture Honey
Spenceley and Goodwin (2007)	South Africa	Environmental Stewardship	Private nature reserves run by private tourism enterprises.	Lodging Safaris
Anyonge-Bashir and Udoto (2012)	Kenya	Environmental Stewardship	Establishment of private wildlife sanctuaries	Lodging Safaris

The first example is about businesses engaging in a river restoration project analysed by Mohr and Metcalf (2018). The Clark Fork River is the largest river by volume in Montana, in the United States, and had been contaminated by over 100 years of mining activity, which needed to be restored. This project included multiple stakeholders such as consultancies, businesses, and state agencies. The businesses involved in the restoration practice mainly included engineering for the implementation and some businesses focused on the design of the restoration project. While it was not entirely clear from the text if these businesses fulfil the requirements to be a NBE considering that the businesses analysed were kept confidential, there were still some aspects in the text that pointed towards them being NBEs, such as their engagement with restoration and one part mentioning that "many of [the interviewed business representatives] had been trained as ecologists (or in other environmental sciences) and not as business people, and so the profitability side of their business was often a hoped-for by-product of their projects" (Mohr & Metcalf, 2018, p. 384). In this case, restoration was the core activity of these businesses. According to the author, they effectively aided in the restoration in a profitable manner and had powerful impacts on ecological and social outcomes.

Another example includes restoration in so called exclosures in Ethiopia, areas of forest that will be excluded from woodcutting and other damaging activities to restore them (Mekuria et al., 2020). Here, short-term revenue streams from those exclosures were identified to establish NBEs run by members of the local community that would support the restoration process. These revenue streams included beekeeping, harvesting fodder for livestock fattening, and cultivating high-value plant species, such as moringa. As a result, the exclosures provided the space and conditions for higher quality and quantity of feed that could be foraged and improved water quality within the exclosure as well as for nearby cattle. In addition, community awareness of the exclosures increased and the community began to become more actively involved in the natural resource management and restoration of these. This example shows that while NBS usually leads to long-term benefits, it is crucial to identify short-term revenue streams to aid in the restoration process, to cover the ongoing costs, and to gain the support of the local community, ultimately leading to improved livelihoods.

Peatland restoration in Indonesia is another example where NBEs by the local community improved engagement of the local community and support of the restoration activities (Applegate et al., 2022). Here, the restoration site was organised into a core restoration area in the middle, then a buffer zone around the restoration area where locals established their businesses mainly based mainly on agroforestry, aquaculture, or honey, and then the outer ring included general sustainable production. While the restoration was not their core activity, revenues through agroforestry supported the restoration activities. In this example, the authors argue that a restoration must always offer tangible economic benefits.

In South Africa, three private nature reserves were run by private nature-based tourism enterprises (Spenceley & Goodwin, 2007). These tourism enterprises used their privately owned land to establish nature reserves, where they would safeguard wildlife, while earning revenue through lodging and safaris for tourists. For one, the cases safeguarded wildlife and their habitat, but these cases also reported to be especially beneficial for lifting locals above the poverty line by offering new possibilities of livelihoods through increased employment. One of the three cases has helped to double the proportion of locals living above the poverty line. Furthermore, many of these NBE invested money in environmental education of the locals, which also reduced negative interactions with the environment.

Another example of stewardship of wildlife is from Kenya, where most wildlife lived outside of protected areas (Anyonge-Bashir & Udoto, 2012). There, most locals had a negative perception about wildlife and saw wildlife on their territory as a nuisance rather than a benefit. Through the promotion of the economic benefits that private wildlife sanctuaries could bring, one million hectare of land was converted into private wildlife sanctuaries which qualify as NBEs. While this case reports a success through an improved nature conservancy, they also report difficulties of implementation due to the lack of marketing and management skills by locals who established those NBE.

To summarise the outlined examples, all cases included very small to small enterprises and in many of the cases the establishment of those NBEs was supported by the government. Furthermore, oftentimes the community either established the NBE or were included through education programmes or better employment possibilities. All cases reported environmental benefits as well as economic benefits. The establishment of NBEs has also been reported to contribute to local job creation. Finally, the importance of finding and establishing short-term revenue streams was strongly advocated in all of the cases, which seems that to establish a successful NBE, value capture strategies need to be identified that offer short-term revenue and that support or do not negatively interfere with the restoration or stewardship activities. No case of a coral reef restoration NBE was identified in academic literature.

2.5 Coral reef restoration as a business

One of the main problems of coral reef restoration is the fact that it is underfunded, but also that the current practices are not achieving their restoration targets (Bayraktarov et al., 2020; Rinkevich, 2015). NBEs have the potential to achieve better funding while also being innovative (McQuaid et al., 2021). While some literature has mentioned the potential of the private sector in coral reef restoration to achieve funding and improved restoration management practices (Bayraktarov et al., 2020; Okubo & Onuma, 2015; Rinkevich, 2015), there has not been an analysis focused on this, but rather suggestions on how the private sector could intervene. Okubo and Onuma (2015) have researched the potential of tourist divers to aid in the transplantation process, which could be led by dive shops and would thus be private sector. Bayraktarov et al. (2020) has looked at selected cases of coral reef restoration and concluded that partnerships of the projects, which were mainly led by NGOs, with the private sector as well as community engagement made the cases successful.

When it comes to commercialization possibilities, some suggestions were made in the literature. As mentioned in the paragraph before, Okubo and Onuma (2015) suggested that an NBE could incorporate tourist divers to do the planting process and thus sell the experience to individual consumers. Another way to include value capture through tourism is by establishing a private marine-protected area (MAP), which includes lodging for the tourists and activities such as dives to see the reef (Riedmiller, 2012). In addition, Rinkevich (2015) and Quigley at al. (2022) suggested that a company restoring coral reefs could sell biodiversity offsetting to other companies that try to lower their biodiversity footprint. Finally, other literature listed aspects to focus on as an institution that attempts this, such as the need for technological advancements in terms of adaptation of the coral to global warming, or the scale and type of coral restoration which depends on funding (Abrina & Bennett, 2021; Rinkevich, 2015). Generally, the literature has mostly focused on how technological advancements in coral reef restoration are needed. As there is a rising need for efficient coral reef restoration, this could be a window of opportunity through a growing market and thus another way for a CRRE to capture value (Gibbs, 2021). Suggestions on the technological improvements that would be needed included rubble stabilisation or enhancement of the substrate where corals grow, environmental surveillance and monitoring, such as reef health for ongoing operations of

restored reefs, and new resilient varieties of corals, especially concerning heat resistance due to rising ocean temperatures (Gibbs, 2021; Quigley et al., 2022).

Suggested potential customers for this value capture varied. Due to the United Nations (UN) decade of ecosystem restoration, there is a global drive for coral reef restoration which opens up new funding from governmental actors (Quigley et al., 2022). Additionally, there is also the possibility to include the tourism sector in the search for a customer. Escovar-Fadul et al. (2022) found in a survey that more people want to travel sustainably after the COVID19 pandemic. The increased demand for sustainable tourism offers opportunities for CRRE, as they can offer touristic experiences. Finally, literature also argues that there are certain actors that are most influenced by declining reef health which due to their dependence have the need for restoration, making them possible customers (Escovar-Fadul et al., 2022). A most obvious customer would be large hotel areas located right by and dependent on a beach (Brathwaite et al., 2022). Thus, the literature provides two primary areas where paying customers can emerge, those being governmental actors, such as coastal municipalities or national level actors, or the tourism industry, such as hotels or tourist divers. No literature mentioned the fishing industry or the pharma industry as potential customers, even though they also (partly) depend on healthy coral reefs for their extraction.

The costs of restoration activities that would need to be covered by an NBE include administration and analysis, collection, and transplantation (or hatchery work, larval enclosures production and larval enhancement depending on the type of coral restoration) (Abrina & Bennett, 2021). Some projects have shown to have a median cost of 93.000 USD per year with a median duration of three years, however the costs depend highly on the case (Bayraktarov et al., 2020). This means that a company attempting to do coral reef restoration might have difficulties calculating the cost of operation in advance. While earlier literature pointed out that coral reef restoration is the most expensive ecosystem restoration and is not economically viable (De Groot et al., 2013), newer literature argues against this and a cost-benefit analysis was conducted showing that coral reef restoration is in fact economically viable and there is a business opportunity to engage in it (Stewart-Sinclair et al., 2021).

If we compare the value capture strategies and potential customers suggested in the literature for coral reef restoration with the value capture strategies of the NBE examples outlined in Section 2.4 (see Table 2-3), there are some similarities. NBEs involved in the river restoration in the United States generated revenue through the restoration itself. When translated to a CRRE, this would be the case if governments, industry, or the tourism industry would pay a CRRE for their restoration service. Another way of capturing value suggested by the literature was to get tourism to pay for the restoration service through for example restoration divers or in the case of lodging in the private MAP (Okubo & Onuma, 2015; Riedmiller, 2012). This compares to the two environmental stewardship cases identified in the literature, which both generated revenue through lodging and nature-related activities for the tourists (Anyonge-Bashir & Udoto, 2012; Spenceley & Goodwin, 2007). A difference is that two restoration examples had extractive revenue streams, such as agroforestry or aquaculture (Applegate et al., 2022; Mekuria et al., 2020). No literature has mentioned comparable revenue streams for CRRE even though, for example, the pharma industry extracts resources from the reef (Spurgeon, 2001). In conclusion there are comparably many similarities between value capture strategies of non-coral related NBEs active in restoration or stewardship of different ecosystems. As coral reef restoration would be a restoration of another ecosystem, the value capture strategies of other NBEs could be similar to value capture strategies of CRRE.

Finally, Gibbs (2021) argues that a socio-technical transition is taking place in the coral reef restoration sector and that the sector will become globally established, driven by technological advances in coral reef restoration. Considering that the phenomenon of CRRE is comparably new, there is a potential that this development has already started with CRRE establishing recently and the UN decade of restoration further increasing the demand for coral reef restoration.

2.6 Drivers and barriers of nature-based enterprises

There are many influencing factors under which a company needs to navigate if they want to succeed in a market. Those influencing factors are either from an internal or external environment (McQuaid et al., 2021). While the internal environment is related to the entrepreneurial behaviour of a firm and thus is determined by aspects of the business model such as their technology or value delivery, the external environment is related to everything which is outside of the control of the company, such as the political environment or the market. The internal environment can be adapted for succeeding in the market and the external environment presents the conditions under which a company must survive and thrive. Both the internal and external environment can offer drivers and barriers that influence the development of an NBE.

Drivers and barriers in the context of NBE are little researched. In fact, with Kooijman et al. (2021) having argued for the concept of NBE only in 2021, no research besides the continued research by McQuaid et al. (2021) has so far referred to this concept with the current definition. The research of McQuaid et al. (2021) has focused on researching external drivers and barriers for NBEs. In addition to the drivers and barriers identified by McQuaid et al. (2021), a literature review focused on drivers and barriers for other businesses engaging in ecosystem restoration, nature stewardship, and for drivers and barriers for coral reef restoration regardless of their profitability. If drivers and barriers were mentioned in a context of an organisation which could be labelled as a NBE according to Kooijman et al. (2021) or if they were mentioned for restoration or specifically coral reef restoration, they were included and are outlined in this section.

The internal drivers and barriers that were identified in the literature are summarised in Table 2-4. One internal driver outlined by Mekuria et al. (2020) was if companies invested in continuous training of the people responsible for the restoration. And once workers are trained, they pointed out that follow-ups were needed to ensure sustainable learnings from the initial training. Another driver mentioned by Knowlton et al. (2021) specifically for coral reef restoration enterprises outlined the need for NBEs to invest in research and development of technological innovations. Ideally, CRRE need to invest into innovations to increase scalability of the restoration process or quicken the growth of corals. Furthermore, Knowlton et al. (2021) also point out that there is already scientific evidence for the potential of such innovations.

Internal barriers for NBEs usually revolved around the skill set of the workers within the enterprise. Anyonge-Bashir and Udoto (2012) explained that one key barrier in their wildlife sanctuaries was the lacking management and marketing expertise. However, their business model builds on employing local communities for the management of the wildlife sanctuaries and might thus not be translatable to CRRE. Still, Escovar-Fadul et al. (2022) reported lacking skills within coral reef restoration, which would support the notion that this barrier is also relevant for a CRRE. Additionally, Somarakis et al. (2019) pointed out that the knowledge transfer within organisations focusing on NBS is oftentimes uncoordinated, which could also be based on the fact that NBS are usually complex in nature. Another barrier for NBEs is the difficulty of balancing profitability with meeting ecological goals (Mohr & Metcalf, 2018).

Finally, one of the main barriers identified by Mohr and Metcalf (2018) was the risk aversion persisting in NBEs, which usually led to overweighted losses and underweighted gains. This impedes their ability of investing in innovation, which is one of the main drivers outlined above. NBEs reported a fear of failure and large losses which might be due to the nature of the restoration projects that are usually long-term projects with larger initial capital investments (Mohr & Metcalf, 2018). While this fear leads to less innovation within NBEs and an attitude of preferring status-quo processes, innovation is strongly outlined as a necessary driver for NBEs and thus high risk aversion is a barrier to NBEs (Knowlton et al., 2021; Mohr & Metcalf, 2018).

Table 2-4: Summary of internal drivers and barriers for NBEs from the literature review. Source: Author.

Driver	Barrier
° Training of workers ° Investment in R&D	° Lacking management and marketing skills ° Lacking technical skills ° Difficulty of knowledge transfer ° Difficulty of balancing profitability with meeting ecological goals ° Risk aversion

While internal factors where little researched, there was more literature outlining external factors. The majority of the authors reviewed for the external factors focused their research on businesses focusing on NBS, although some focused specifically on restoration (Mekuria et al., 2020; Mohr & Metcalf, 2018). Others focused more specifically on factors for coral reef restoration, but did not specifically outline these from a business perspective (Escovar-Fadul et al., 2022; Knowlton et al., 2021). All identified external drivers and barriers are summarised in Table 2-5.

Table 2-5: Summary of external drivers and barriers for NBEs from the literature review. Source: Author.

Factor	Driver	Barrier
Political	° Increased NBS awareness [6] ° NBS policy support [6]	° Inconsistent public policies support [6] ° Lack of in-depth understanding [6] ° Missing government support [2]
Economic/ Market	° Support instruments [6] ° Industry networks and collaborations [6, 7, 9] ° Partnerships across different sectors [9] ° High awareness and interest from the tourism sector [2] ° Education and skills [6] ° Availability of funding instruments [6] ° Cost savings for NBS in comparison to grey infrastructure [9]	° Financing [5, 6] ° Profits are often long-term and rather savings than actual profits [1, 5] ° Missing awareness of NBS in private sector [5, 9] ° NBS benefits scattered between different stakeholder [5] ° Lack of capacities of workers [2] ° Lack of trained local workers [12]
Social	° High media/public interest [6] ° Collaboration with academia [4, 8] ° Engagement of local communities in the business [7]	° Disparities in awareness across NBE market sectors [6] ° Negative attitude of local communities [12] ° Gap between science and practice [8]
Techno-logical	° Smart technologies [6] ° Technological advancements leading to adaptation to changing environmental conditions [4, 8]	° Evidence of NBS effectiveness [6] ° Measuring impact of NBS [5, 6]

	° Innovation to drive costs down [8]	° Smaller scale activities which do not produce homogenous products and capital flow [3]
Environ-mental	° Climate change as driver of awareness/NBS demand [6]	° Typically, high risks of restoration projects [8]
Legal/ Regulatory	° Pro-environmental policies, planning, and regulatory instruments [5, 6, 11] ° Changing accounting frameworks [10]	° Inconsistent regulation [6] ° Lack of industry standards [6] ° Lack of Regulation requiring private sector adoption of NBS [6] ° Lack of enforcement of environmental regulations [2] (Escovar-Fadul et al., 2022)

Sources:	1: (Egusquiza et al., 2021)	5: (Mayor, Toxopeus, et al., 2021)	9: (Somarakis et al., 2019)
	2: (Escovar-Fadul et al., 2022)	6: (McQuaid et al., 2021)	10 : (Toxopeus & Polzin, 2017)
	3: (Kampelmann, 2021)	7: (Mekuria et al., 2020)	11: (Kasim, 2007)
	4: (Knowlton et al., 2021)	8: (Mohr & Metcalf, 2018)	12: (Vidickienė et al., 2021)

Political factors mainly focused on the support and awareness of NBS in the political context. There is an increased awareness around NBS and also increased policy support, such as the EU pushing the NBS agenda further and initiating funding opportunities like the Horizon 2020 programme, which is a strong driver for NBEs (McQuaid et al., 2021; Somarakis et al., 2019). However, this support is oftentimes viewed as inconsistent or even missing and while there is an awareness of policymakers, there is still a lack of in-depth understanding of NBS and how to support it which constraints businesses focusing on NBS as their core business (Escovar-Fadul et al., 2022; McQuaid et al., 2021).

From an economic perspective, there are also relevant support mechanisms for NBEs to help them succeed, such as business accelerator programmes (McQuaid et al., 2021). Furthermore, industry networks and collaborations have shown to be a relevant driver, with NBEs reporting their importance and literature having underlined this importance considering the multi-stakeholder nature of NBS (McQuaid et al., 2021; Mekuria et al., 2020; Somarakis et al., 2019). With increased political and academic awareness there is an increased availability in skilled workers in the field of NBS as well as trainings to skill the workplace (McQuaid et al., 2021). In contrast to this, Escovar-Fadul et al. (2022) reported a lack of skilled worker. The disparity between this two research might be due to the fact that the scope of McQuaid et al. (2021) included Europe, while the scope of Escovar-Fadul et al. (2022) was the Caribbean region. This might point towards the skill set of workers having a potential to be both a driver and a barrier for NBEs depending on their geographical scope. Furthermore, Vidickienė et al. (2021) pointed out that depending on the location of the activities, local workers might lack capacities, meaning that one would either have to import skilled workers or train local workers.

Depending on the market, there might also be an increased awareness and interest into NBS, which Escovar-Fadul et al. (2022) reported for coral reef restoration in the tourism sector. If the tourism sector has a higher demand due to the increased risk awareness, this would turn to be an important driver for CRREs. Still, missing awareness of NBS in the private sector was also reported which would inhibit NBEs that aim for a business-to-business (B2B) strategy (Mayor, Toxopeus, et al., 2021; Somarakis et al., 2019).

From a financial perspective, a higher availability of funding drives NBEs, while financing is still considered difficult to achieve and thus inhibits NBEs which usually need high initial investments for their project completion (Mayor, Toxopeus, et al., 2021; McQuaid et al., 2021). Additionally, cost savings of NBS in comparison to grey infrastructure might drive the demand

(Somarakis et al., 2019). However, Brathwaite et al. (2022) found that for coral reefs only the coral gardening technique might lead to a cheaper coastal protection alternative then grey infrastructure would. Finally, the fact that profits of NBS are oftentimes long-term and manifest rather in savings than in actual profits is a large barrier which NBEs need to overcome through a good business strategy and profitable ways to capture value or which needs further policy support (Mayor, Toxopeus, et al., 2021; Somarakis et al., 2019). And even if the benefits are valued and made profitable, NBS usually have multiple benefits which are relevant for multiple stakeholder, whereas each stakeholder individually might not be willing to pay for a single benefit (Mayor, Toxopeus, et al., 2021).

Drivers in the social category include a high public interest into NBS and NBEs and it supports their business if NBEs collaborate with academia and engage the local communities in their nature-based activities, such as educating locals (Knowlton et al., 2021; McQuaid et al., 2021; Mekuria et al., 2020; Mohr & Metcalf, 2018). Nonetheless, Mohr and Metcalf (2018) pointed towards a gap between science and practice which inhibits successful restoration businesses and additionally disparities in awareness across NBE sectors is an inhibiting factor (McQuaid et al., 2021). Furthermore, Vidickienė et al. (2021) also found that in the case of establishing ecotourism businesses, local communities had a negative attitude towards the additional tourism flow the ecotourism business might lead to.

With technological innovations evolving rapidly, there are also many chances for NBEs through smart technologies or platform technologies to use them for their business, such as for monitoring or to connect with investors (McQuaid et al., 2021). Furthermore, there are also technological advancements specifically in the coral reef restoration sector which might offer business opportunities for CRRE such as artificial intelligence (AI) monitoring of coral reef health or enhanced coral growth (Knowlton et al., 2021; Mohr & Metcalf, 2018). With these rapid technological innovations there is also the chance for NBEs to drive their cost down and thus make profitability easier to attain. Next to those technological drivers there is also technological barriers, such as the difficulty of outlining the effectiveness of NBS or measuring the impact of NBS (Mayor, Toxopeus, et al., 2021; McQuaid et al., 2021). While this is a barrier, if combined with the driver of rapidly developing technology, it might actually turn into a driver for NBEs that make use of that technology. Finally, current CRRE are typically smaller scale activities which do not produce homogenous products and thus no homogenous capital flow (Kampelmann, 2021).

The environment is an important driver, as climate change and anthropogenic impacts have become widely accepted over the last decades, driving the demand for NBS (McQuaid et al., 2021). Nevertheless, restoration projects usually also follow a high risk due to climate change and the complexity of ecosystems, making any restoration process difficult and risky (Mohr & Metcalf, 2018).

Finally, looking at drivers and barriers from the legal perspective, the findings are quite similar to the political perspective. There are environmental policies and regulatory instruments that drive the establishment of NBEs and support their activities such as changing accounting frameworks or reporting standards (Kasim, 2007; Mayor, Toxopeus, et al., 2021; McQuaid et al., 2021; Toxopeus & Polzin, 2017). Nonetheless, the regulations are inconsistent, hard to oversee, and there are lacking industry standards (McQuaid et al., 2021). In particular, there is a lack of regulations requiring the private sector to adopt NBS are missing, which would otherwise support the buyers of NBS that NBEs could cater to (McQuaid et al., 2021). Additionally to those barriers, the regulation that exist in the marine area are oftentimes lacking in enforcement (Escovar-Fadul et al., 2022).

2.7 Summary

There are many challenges in the implementation of NBS. One of the main challenges lies in the fact that NBS in most cases benefit multiple stakeholders at the same time (Mayor, Toxopeus, et al., 2021). Due to these multiple benefits, stakeholders tend to not feel a direct responsibility to pay for the NBS and thus securing financing is difficult.

As defined by Kooijman et al. (2021), an NBE is an enterprise which has nature as the core of their business and fulfils economic activities by selling products or services. While the concept of an NBE is relatively new in the academic literature, it does not mean that NBEs have not yet emerged. However, the amount of NBEs is still comparably limited and research on NBE examples that would be comparable to coral reef restoration has been scarce. Furthermore, no literature analysing businesses focusing on coral reef restoration as their core business have been identified. Nonetheless, the few examples outlined in Section 2.4 have offered some insights into how NBEs have structured their value capture in different ecosystems. By comparing these value captures to different suggestions made in the literature about coral reef restoration as a business, certain similarities have been identified.

When it comes to drivers and barriers of such NBEs, the literature review showed that none were analysed specifically for CRRE, however, there are drivers and barriers outlined in the literature for NBEs or for coral reef restoration. While internal factors were little researched, more external factors were found in the literature review and were summarised in Table 2-5. Finally, while there has been little research about coral reef restoration as a business, Gibbs (2021) has argued for a socio-technical shift and expects a growing market in coral reef restoration.

3 Conceptual frameworks of relevance to coral reef restoration enterprises

This section will outline relevant conceptual frameworks as a background for the analysis of CRRE. For this, first different business model frameworks are presented resulting in the proposition of an adapted business model framework that best reflects the unique nature of CRRE. Second, this section also presents frameworks that are of relevance to analyse drivers and barriers, for which separate frameworks were chosen for internal and external factors.

3.1 Business Model Frameworks

To ensure competitiveness, businesses produce different and ideally unique strategies and business structures. The business model canvas is the most prevalent framework for businesses to structure their strategy and for academic literature to analyse companies. It "is traditionally used to support companies and businesses in identifying and structuring their value proposition and the elements required to develop a strong and feasible business model for the delivery of a product or service to the market" (Mayor, Zorrilla-Miras, et al., 2021, p. 3). For this thesis, a business model framework is needed to build the base for the analysis of the results from the data collection procedure. This section will elaborate on various business model frameworks and conclude in the description of the framework chosen to guide the analysis of RQ1.

The classic business model framework is the Business Model Canvas (BMC) developed by Osterwalder and Pigneur (2010). However, this BMC was developed in line with the shareholder doctrine, focusing on maximizing profits. This is manifested in Osterwalder and Pigneur's BMC through a traditional perspective of business value creation, meaning that the BMC focuses on the relationship to business partners and customers while leaving out the relationship of the business to the natural environment and society (Lüdeke-Freund et al., 2018). As a result of this limited consideration of the environment and society, several authors devoted their research to adapt and expand the BMC by Osterwalder and Pigneur to include sustainability expectations to show how sustainable companies can create value beyond the traditional economic focus (Bocken et al., 2014; Geissdoerfer et al., 2018; Lüdeke-Freund et al., 2018). The overall sentiment of the literature is that to truly incorporate the triple bottom line, the architecture of businesses has to innovate how to create, deliver, and capture value with consideration to the environment and society and reflect this in the BMC (Lüdeke-Freund et al., 2018). Sustainable value creation takes into account that the business creates economic value for itself by offering not just benefits to the customer, but also the environment and society at large (Patala et al., 2016).

For the analysis of this thesis, the literature review included the search for a version of the BMC that would include the triple bottom line while also reflecting the complexities of NBS. Identified examples include the Natural Assurance Schemes Canvas developed by Mayor, Zorrilla-Miras et al. (2021), which was not used as part of this thesis, as they focused on assurance specifically for disaster risk reduction and this would only be partly applicable to the context of CRRE. Another example identified is the Nature-Based Solutions BMC (NBS-BMC) (Connecting Nature, 2019), which will be explained in more depth in the next section.

3.1.1 Nature-Based Solutions Business Model Canvas

The NBS-BMC (shown in Figure 3-1) is a further development from Osterwalder's business model canvas (Osterwalder & Pigneur, 2010) by the Connecting Nature project, which is

funded by the European Commission (Connecting Nature, 2019). The changes in comparison to the BMC and their reasoning are outlined in this section.

First, Connecting Nature (2019) expanded the traditional value proposition to include the triple bottom line, similar to other authors in the domain of sustainable business models (Bocken et al., 2014; Connecting Nature, 2019; Lüdeke-Freund et al., 2018). Additionally, they changed the term "customer segments" to "key beneficiaries" to reflect the added benefits from NBS to not only the customers but also a wider audience. To reflect that those beneficiaries can overlap with the partners of NBE, the key beneficiaries are positioned next to the key partners. Finally, the framework includes the section called "governance", to highlight the importance of NBEs to find an operational strategy to ensure long-term success of the NBS.

Furthermore, Connecting Nature (2019) changed the financial section of the BMC to better reflect the complex cost and revenue structures of NBS. For one, they did this by renaming "revenue streams" to "capturing value". Because NBS are oftentimes a public good, revenue streams are not as straightforward, but in some cases other indicators rather than direct revenue are needed to quantify the value captured by a business investing in NBS to access funding from public sources (Connecting Nature, 2019; Toxopeus & Polzin, 2017). Such indicators could for example be increased value of land due to the NBS, new job creation, or CO_2 reduction. Those would be indirect revenue streams that are covered under the "capturing value" section. In addition to the value capture, the framework also includes the section "cost reduction", which is to display the unique cost reductions which a business profits from due to the nature of NBS, such as volunteer workers or waste reductions.

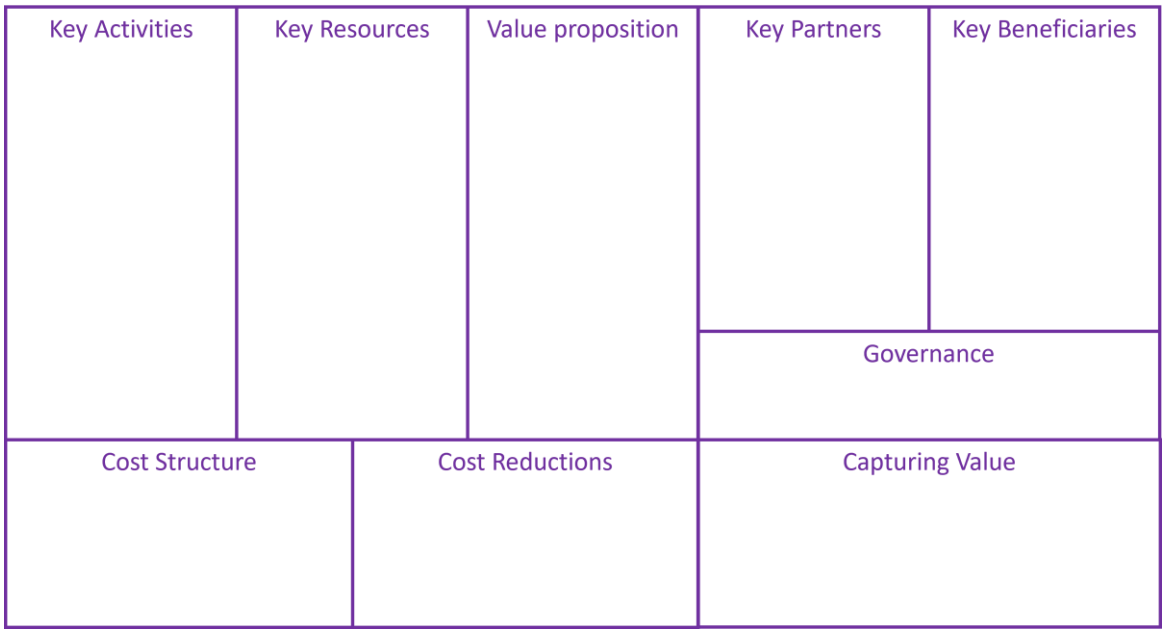


Figure 3-1: The Nature-Based Solutions Business Model Canvas. Source: Connecting Nature (2019).

The NBS-BMC framework aligns the most with the needs an NBE would have for a BMC. For one, it includes the triple bottom line which is a crucial part of the value proposition of an NBE. Furthermore, it accurately reflects the unique needs and implications NBS have for an operational environment through including governance of the NBS solution and through the inclusion of cost reductions that occur due to the unique nature of NBS contributions to the environment and society. Nevertheless, the framework was developed with urban management in mind and with less of a traditional business focus, meaning less emphasis on the profitability

of the NBS. Thus, this thesis uses the NBS-BMC to derive its own BMC proposition to properly adapt to the nature of the activities of NBEs. This BMC proposition is outlined in the next section.

3.1.2 Own proposition: Nature-Based Enterprise Business Model Canvas

The traditional BMC does not reflect a triple bottom line as well as the unique characteristics a business faces that tries to implement NBS. On the other hand, the NBS-BMC was developed to perfectly reflect the triple bottom line as well as the unique characteristics of NBS but does not include the traditional for-profit business thinking. This is why, this thesis proposes to combine both frameworks to a new framework, which will from here on be called the Nature-Based Enterprise – Business Model Canvas (NBE-BMC). This framework only differs slightly from the NBS-BMC. For one, it adds back the "customer segments" section, to better differentiate between general beneficiaries and beneficiaries who are willing to pay for the benefits. This section is placed together with the key partners and key beneficiaries section because of the argument mentioned by the NBS-BMC, where key partners and key beneficiaries overlap. All three section are overlapping, but a clear outline is needed to identify and differentiate paying-customers, beneficiaries, and partners to work together. Furthermore, subsections to both the value proposition and value capture are added to make a clear distinction between the types of value. For value proposition, the triple bottom line was added to outline the values in each of the three domains.

In the case of capturing value, it was divided into revenue streams and other values to clearly outline the revenue, while still accounting for the difficulty of NBS to be quantifiable. As many NBS are perceived as public goods, some values might not generate direct revenue streams. One example of this is reduced CO_2 in the atmosphere. If a company finds a way to monetize those values through for example carbon offsetting schemes, those are reflected in the "other" section of value capture.

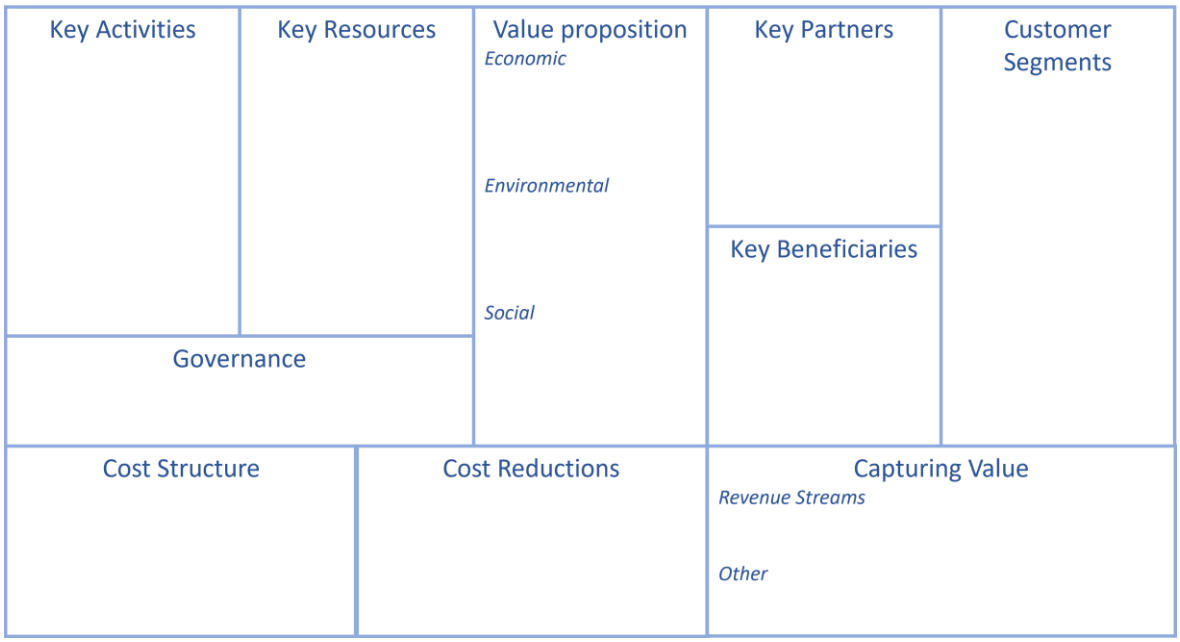


Figure 3-2: The Nature-Based Enterprise Business Model Canvas. Source: Own elaboration with influences from Osterwalder & Pigneur (2010) and Connecting Nature (2019).

3.2 Frameworks for factors that influence sustainability strategies

To analyse internal and external drivers and barriers, the following two frameworks have been chosen. For internal drivers and barriers the internal organisational capabilities framework by Stubbs and Cocklin (2008) was chosen and adapted to better fit the context of CRRE. For external drivers and barriers the PESTEL framework was chosen (Aguilar, 1967). Both frameworks were chosen as they offer an analytical basis to identify drivers and barriers and are outlined in this section.

3.2.1 Internal organisational capabilities

In addition to the need for a business model framework, this thesis also requires frameworks that focus on the strategic identification of internal and external influencing factors of businesses for RQ2.

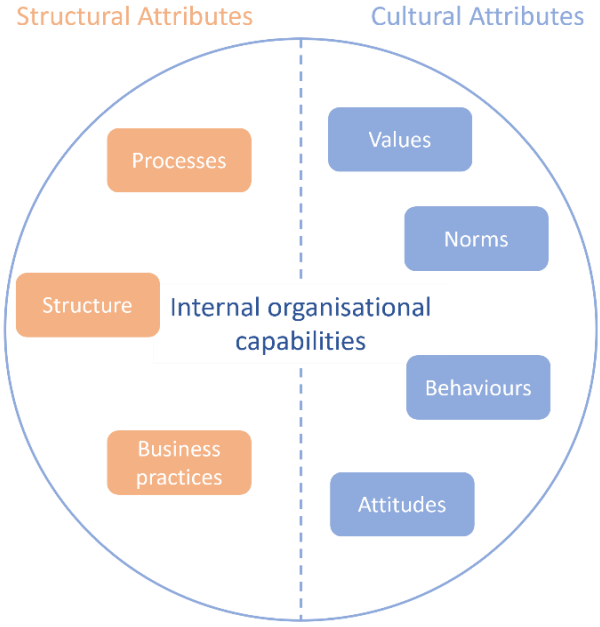


Figure 3-3: Internal organisational capabilities. Source: Adapted from Stubbs and Cocklin (2008).

Stubbs and Cocklin (2008) did early work on sustainable business models and analysed two case studies regarding their characteristics that contributed to their sustainability. As a result of their analysis, they developed a framework which grouped the characteristics into structural and cultural as well as internal organisational capabilities and socioeconomic environment. Structural characteristics refer to internal processes, how the organisation is structured and the strategic business practices they follow (Stubbs & Cocklin, 2008). On the other side, cultural characteristics refer to norms and values, as well as behaviours and attitudes within a company (Stubbs & Cocklin, 2008). This framework aids in the classification of business model attributes which might drive or inhibit the sustainability strategy of a company (Boons & Lüdeke-Freund, 2013). Thus, it is chosen as analytical framework for RQ1 and will inform the interview guide as well as the analysis through offering inductive themes.

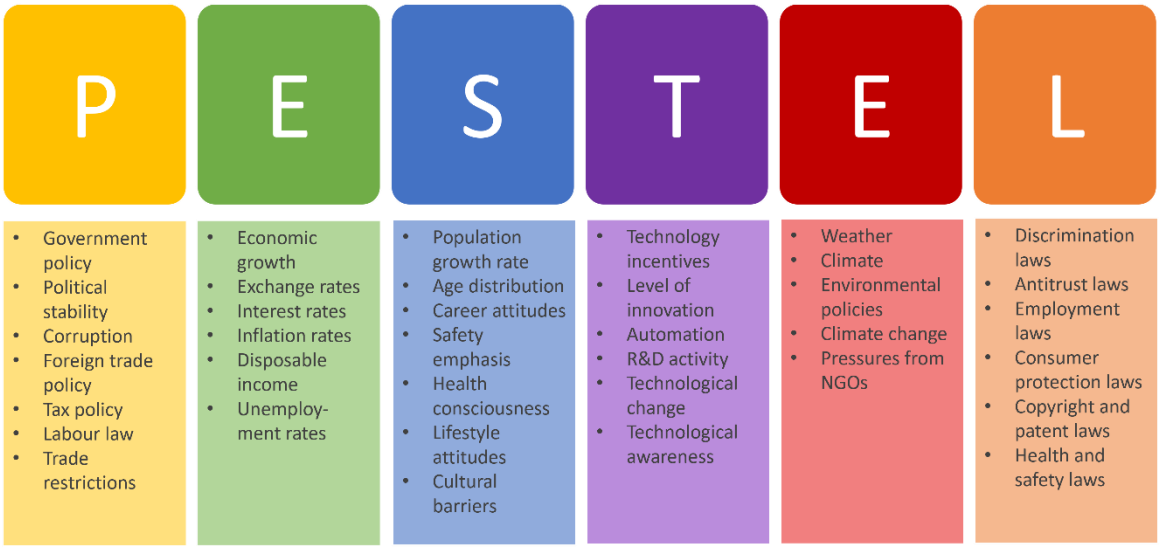
While the original framework also includes an external dimension, this being the socioeconomic environment, this thesis only uses the internal dimension for the analysis of internal drivers and barriers, shown in Figure 3-3. This focus was chosen considering that other frameworks were identified in the literature which were chosen as a basis for the analysis of the external influencing factors which will be elaborated on in the next section.

3.2.2 External drivers and barriers for business strategy

For external factors, the PESTEL framework has been identified and will be elaborated on in this section. Originally developed by Aguilar (1967), the PESTEL framework is a strategic tool for a business to scan their environment to identify external influencing factors that might be relevant for the strategic success of the company. Initially, the framework only consisted of the PEST part, meaning the analysis of Political, Economic, Social, and Technological factors (Aguilar, 1967). Later, the two sections EL were added to the framework, meaning the

additional analysis of Environmental and Legal factors, making the nowadays widely used PESTEL framework (de Bruin, 2016). A detailed explanation of what each section entails is depicted in Table 3-1.

Table 3-1: PESTEL Framework. Source: de Bruin (2016).



With its six sections, the tool aims at aiding the identification of relevant external influencing factors for a company. Considering that RQ2 asks about internal and external drivers and barriers, the PESTEL framework will be used as an aid for the identification and analysis of external drivers and barriers within this thesis. For one, it will inform the interviews by using this framework to scan the external environment of the interviewees. Furthermore, it will also serve as deductive themes for the initial analysis which will then inform inductive themes emerging from the analysis.

4 Research design, materials, and methods

This section will elaborate on how the research was conducted for this thesis. First, the research design is explained, then the methods for data collection are outlined, and finally the method and procedure of the data analysis is described.

4.1 Research design

To answer the two research questions outlined in Section 1.2, a qualitative approach was chosen. This was chosen because the emergence of coral reef restoration enterprises is a comparably new phenomenon which has not been researched in this way before. A qualitative approach is especially suited to study little-known phenomena and allows for creativity in the data analysis to identify new patterns (Patton, 2002; Tracy, 2010). Therefore, a qualitative approach is fitting to analyse the new phenomenon of CRRE for this thesis and the findings can pave the way for identifying variables which could then be closer researched with a potential future quantitative research design in mind (Creswell & Poth, 2016).

This thesis aims at identifying patterns and a general explanation for the value capture strategies and the drivers and barriers of coral reef restoration enterprises through the analysis of the collected data. As such, the underlying logic of this research had a deductive-inductive character, considering that first data was collected and then analysed through predefined themes informed by the literature review. This was then further analysed to outline redefined themes and finally it lead to new categories that have not been previously defined in literature (Creswell & Creswell, 2017). Figure 4-1 below outlines the research design of this thesis. It is comparable to the research design of Mohr and Metcalf (2018), who applied a similar research design regarding drivers and barriers for businesses in the restoration economy.

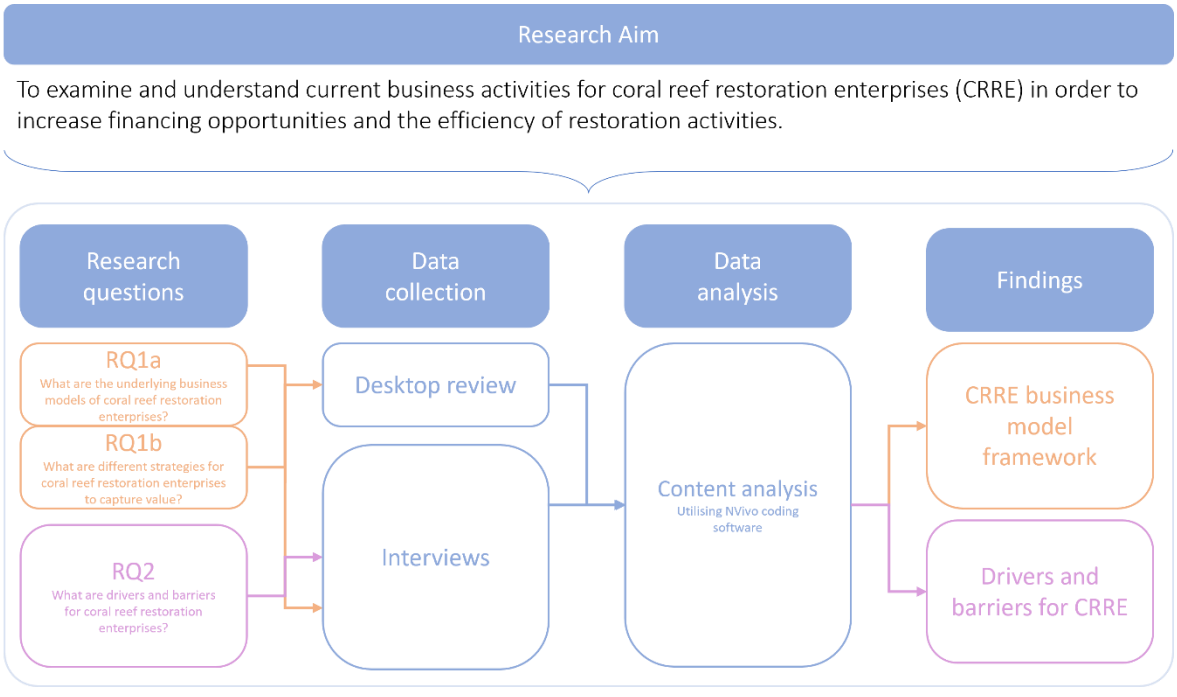


Figure 4-1: Research design. Source: Author.

Initially, a literature review was conducted of relevant literature relating to NBS in a business setting and how this relates to CRRE. This literature review informed the interviews through a framework of a BMC for RQ1 and a framework for internal as well as one for external drivers

and barriers for RQ2. The interview method chosen for the research was in-depth semi-structured qualitative interviews of business practitioners in the coral reef restoration sector. This kind of interview is appropriate in cases where the researched phenomenon is poorly understood, which is the case for CRRE (Mohr & Metcalf, 2018). In qualitative research, triangulation of data sources is key for a higher validity of the analysis (Creswell & Creswell, 2017), which is why the interviews were accompanied by a desktop review of relevant newspaper articles, homepages of CRRE, and secondary interview data. The list of documents included in the document review are in Appendix A. This document review added complementary information to the interviews. Furthermore, the information gathered in the interviews of CRRE was further triangulated by interviewing a second group of interviewees, which included relevant market actors within the coral reef restoration sector. All information was analysed through a mixed deductive-inductive content analysis using the NVivo 12 Tool, which ultimately answered the two research questions.

4.2 Data collection

As outlined in Figure 4-1, this thesis incorporated two different methods of data collection. According to Creswell and Poth (2016), part of the characteristics of good qualitative research is the collection of multiple types of data for a rigorous data collection procedure. Furthermore, the data collected has to be enough to support significant claims (Tracy, 2010). To fulfil both requirements of multiple types of data and enough data, this thesis built its data collection from a literature review, which informed the interviews as well as outlined the initial themes for the deductive-inductive analysis. Furthermore, this thesis conducted thorough interviews with representatives of CRRE which constitute a high percentage of existing CRRE in the market. It also included a complementary desktop review. The method behind the literature review, as well as both the interviews and the desktop review will be explained in more detail in the following sections.

4.2.1 Literature review

Within the scope of this thesis, a literature review was conducted to understand two areas of relevance for CRRE: First, the nature-based business area with a focus on academic articles that examine the relationship of businesses and nature-based solutions and the possibility of businesses to engage in nature-based solutions as their core activity. Second, the coral reef restoration area. As literature specifically about the business perspective of coral reef restoration was hard to find, the literature review focused on a) articles related coral reef restoration to business engagement or economic relevance b) articles that to some extent included a discussion about the potential commercialization of coral reef restoration or c) offered an overview of the activities that would need to be undertaken and the costs and benefits that would result from the restoration. A thorough literature review focuses on concepts (Webster & Watson, 2002), thus the focus on these two areas was to understand how they could related to one another and ultimately to identify concepts to build the backbone for the analysis of this thesis.

To begin with, a general internet-based search on relevant academic articles was conducted. For this search a total of seven keyword combinations have been searched in the search engine "Google Scholar". The initial keywords where the following with 1) being for the nature-based business-related search and 2) being the coral related search:

> 1) "nature-based solutions and business", ""business" from nature-based solutions," ""restoration" sustainable business models," "nature-based enterprise," &

2) "coral reef restoration business," "coral reef business," "coral reef restoration market," "commercial coral reef restoration"

Some of the keywords were chosen right from the beginning, while others, such as the nature-based enterprise or the commercial coral reef restoration, where chosen based on the keywords in relevant articles. With this initial keyword search, a number of papers were identified which through their citations and keywords led to the identification of other papers.

Within this review, the concept of NBE was identified, which explains the phenomenon of businesses engaging with NBS as their core activity. This NBE concept was then further researched towards NBEs specifically engaging in ecosystem restoration or stewardship considering that those are the engagements with NBS that come closest in similarity to what a CRRE would engage in. To better understand how this could be translated to CRRE, specific examples of NBEs that engage in restoration or environmental stewardship were searched for as well as drivers and barriers for NBEs. Furthermore, the literature review had a second focus, which was the research into the commercialisation potential of coral reef restoration to better understand how NBEs could engage in coral reef restoration.

4.2.2 Interviews

As a next step, in-depth semi-structured interviews were conducted to triangulate the findings from the literature review. One of the main benefits of semi-structured interviews is that the guide offers the structure which ensures that the necessary topics will be covered throughout the interview, while also offering sufficient flexibility to dive deeper into emerging ideas of relevance (Adeoye-Olatunde & Olenik, 2021).

Participant selection

The interviews within this thesis were conducted with two distinct groups. The first and main group of focus involved CRRE, meaning businesses that focus on the commercialisation of coral reef restoration as their primary business activity. In total, seven representatives of CRRE were interviewed as part of this research. Participants were chosen through a judgment sampling approach, which is used in the case where the researcher has knowledge in the area of interest and makes a judgment call as to which participants would be able to answer the questions (Harrell & Bradley, 2009). To search for participants, desktop research was conducted in which CRRE were identified. All participants of the interviews are listed in Table 4-1. Considering that the coral reef restoration market is comparably new and there are only limited CRRE established yet, the judgment as to whether a CRRE qualified for an interview depended on the fact whether they actually fulfilled the requirement to be a CRRE. If they did, the researcher reached out to these companies and tried to set up an interview. Relevant companies were found globally and the locations of those interviewed are displayed in Table 4-1. The inclusion of CRRE on a global scale was chosen based on the fact that for one, there are only limited CRRE in the market and limiting the geographical scale would have meant to miss out on relevant interview partners, and furthermore, it was chosen to better represent the different efforts and strategies that are currently being implemented across the market. The interview partners of the first group were in each case founders of the CRRE, except in one case in which a long-time implementing partner was interviewed instead as the founder was not available.

The second group of interviewees, market actors, refers to organisations that also either engage in coral reef restoration themselves or actively support coral reef restoration as their main activity. In their case, the judgment as to whether include them in an interview or not was

made based on the fact of how influential the organisations were in the coral reef restoration market. The organisations who appeared to be most influential through their partnerships and internet presence were contacted to inquire for an interview. The group included NGOs and international organisations that focused on coral reef restoration and are displayed in Table 4-1. These were included in the data collection procedure as they are currently the dominant organizational form in the coral reef restoration market. While they depend on grants or other external funding, some of them include economic activities that generate income which are relevant to analyse for a full picture when it comes to value capturing for businesses and even if they do not include any commercialisation activities, their interviews provide valuable input for drivers and barriers and offer the option of triangulating the information gained from interviews in the first group. This thesis interviewed market actors in order to gain a better understanding of the market in which CRRE operate, to triangulate the findings of the external environment of CRRE, and to better understand the collaborations within the market. Finally, interviewing these participants also provided additional information about external support they might give to CRRE, considering that all participants interviewed in the second group were to some degree either a partner to CRRE or worked in a comparable manner. Similar to the first group, in this group the choice of participants was not limited by their geographical location to ensure representativeness. The interview partners were in all cases project leaders.

Table 4-1: List of interviewees. Source: Author.

Code	Category	Type	Location	Size
B1	Business	Hybrid	Asia	Micro
B2	Business	Hybrid	Asia	Small
B3	Business	Start-up	Asia	Small
B4	Business	Start-up	Americas	Micro
B5	Business	Start-up	Americas	Micro
B6	Business	Established	Africa	Small
B7	Business	Start-up	Europe	Micro
M1	Market actors	Business	Europe	Large
M2	Market actors	Non-profit	Americas	Micro
M3	Market actors	International organisation	Americas	Large

The type of the businesses was organised in three categories: hybrid, start-up, and established. Hybrid referred to those businesses who also ran an NGO for the restoration part of the business. While they were profitable businesses, they decided to turn the restoration activities into an NGO for advantages regarding the receival of donations and/or tax reductions. They were still classified as a CRRE considering that they had a profitable business model and did focus on restoration as their core activity while the NGO aspect was merely to their bureaucratic advantage. Established CRRE were established longer than 5 years ago and reported to have a comparably stable financial situation (an unstable situation during the Covid pandemic did not count into it). Start-ups were the CRRE which were established less than 5

years ago and reported to be still in the process of establishing financial stability. This categorisation was chosen to distinguish first the hybrids from the non-hybrids and to show that the majority on the market are currently start-ups and thus their strategy is still being established.

For the size of the organisations, this thesis took the reference of the Organization for Economic Cooperation and Development (OECD) for business sizes (OECD, n.d.). In this case, micro is for less than 10 employees, small for 10 to 49 employees, medium for 50 to 249 employees and large for 250 or more employees.

Interview structure

The interviews were structured through the research questions and two types of interview guides were developed – one for the CRRE and one for the second interviewee group. For the CRRE, the interviews first focused on answering RQ1 through business model and strategy related questions. For RQ2, the content of the interview guides was largely based on the interview guides used by McQuaid et al. (2021), as their research interests were closely aligned with the research of this RQ. The interviews first focused on asking for drivers and barriers without any prior input from the researcher to the respondents to see what they view as relevant. Then further questions were asked that involved the outline of drivers and barriers identified in the literature review (see Table 2-4 and Table 2-5 in Section 2) to find out if the respondents have faced those specific factors throughout their business establishment and day-to-day processes. For the second group, the interview guides were adapted to respect their distinct perspective resulting from the fact that they do not attempt commercialisation themselves. Here, the business model related questions were cut out, questions were added about how they work with CRRE, and the questions regarding RQ2 were adapted to account for their different perspectives. The structure of the interview guides matched the codes in Table 4-4.

Due to the geographical distance between the researcher and the participants, all interviews were conducted online via Zoom. During the interviews, several methods were undertaken to ensure a thorough data collection. The participants were asked for permission to record the interview and with their agreement, the full interview was recorded and after transcribed using the programme 'freesubtitles.ai'. Furthermore, notes were taken and structured under the two topics: business model and drivers and barriers. Finally, the respondents were asked for permission to be reached out to in case any questions arose after the interview process. All interviews lasted for one hour except one interview in which the participant was only available for half an hour.

Creswell and Creswell (2017) outlined general limitations that arise through the data collection procedure of interviews, such as the unnatural setting that might lead to potential or filtered responses. To minimise these limitations, a desktop review was chosen which will be outlined in the next section. Next to these general limitations, specific limitations arise such as the limited number of practitioners that result from the limited number of CRRE in the market, however the responses were comparably high and a substantial proportion of CRRE within the market agreed to an interview.

4.2.3 Desktop review

As a means to triangulate the information regarding business models gained by interviewees, the data collection methods included a desktop review. Here relevant newspaper articles, secondary interviews, and homepages of CRRE were reviewed to search for relevant

information regarding business model design and value capture strategies of CRRE. For this, homepages, newspaper articles, and secondary interviews about CRRE that were interviewed within this thesis as well as those who were not interviewed as part of this thesis were reviewed. The aim of this review was to find complementary information regarding the business model structure of current CRRE and commercialisation strategies, as well as to triangulate the information gained from the interviews.

A list of all grey literature and webpages reviewed as part of the desktop review is attached in Annex A. The included documents are by no means exhaustive of all available information, as the search is limited by language barriers, limited internet presence, and limited time to review all given information. Nonetheless, the review aimed to include data about all identified CRRE even those not interviewed to offer an extensive analysis about CRRE active in the market.

4.3 Data analysis

To analyse the collected data, this research conducted a content analysis. For RQ1, data from both the interviews as well as the desktop review was used. In contrast, RQ2 is based solely on data from the interviews. Table 4-2 shows an overview of the data analysis procedure.

Table 4-2: Overview of content analysis. Source: Author.

	RQ1	**RQ2**
Data source	Interviews + Desktop review	Interviews
Content analysis procedure	Deductive-inductive	Deductive-inductive
Programme	NVivo 12	NVivo 12

Prior to the content analysis, literature was reviewed through the use of a literature matrix for which the programme Microsoft Excel was used. As the literature review focused on both the business relationship to NBS as well as any information regarding CRRE, the literature review matrix was split into two to reflect these two search topics. After the initial keyword search, the author skimmed through all identified articles and categorised information into sub-topics within the literature matrix (see Table 4-3). These themes were chosen deductively, and no redefined themes were included inductively. The information from the literature review informed the deductive themes used for the initial coding structure of the analysis of RQ1 and RQ2.

Table 4-3: Themes of the literature review matrix. Source: Author.

NBS and business	**Coral reef restoration commercialisation**
• What is NBS • Relationship and interaction of NBS and businesses • Business models including NBS • Drivers • Barriers • Examples of restoration businesses	• Benefits of coral reef restoration • Interaction between businesses and coral reef restoration • Value capture strategies • Profitability of coral reef restoration

Subsequently, a content analysis which redefined the initial codes was performed regarding RQ1 and RQ2. Both content analyses were conducted in a deductive-inductive manner using the software NVivo 12. The themes where first chosen deductively by using the categorisation of the frameworks identified in Section 3. Those themes are displayed in Table 4-4. The information from the interviews and desktop review were coded into these themes to allow

for further identification of patterns and categories. Next, the inductive analysis took place, where the coded information was revised to identify categories within the predefined themes. For RQ1, both data from the interviews as well as the document review was used. The deductively chosen themes are based on the in Section 3.1 outlined aspects of the business model framework and throughout the analysis new themes emerged which will be outlined in the findings section. For RQ2, only data from the interviews were used for the content analysis. The themes were deductively defined through the Internal Organisational Capabilities framework for internal factors and the PESTEL framework for external factors (outlined in Section 3.2.1 and 3.2.2) and similarly to the content analysis of RQ1 new themes emerged inductively throughout the analysis process, which will also be outlined in the findings section.

Table 4-4: Initial coding structure for the content analysis of RQ1 and RQ2. The cursive words show the sub-codes to the non-cursive words. Source: Author.

Codes for RQ1 (informed by the BMC and NBS-BMC)	**Codes for RQ2** (informed by the internal organisational capabilities framework and by the PESTEL framework)
Value proposition	Internal barriers
- Economic	*- Cultural attributes*
- Environmental	*- Structural attributes*
- Social	Internal drivers
Customer segments	*- Cultural attributes*
Key beneficiaries	*- Structural attributes*
Key partners	External barriers
Key activities	*- Economic*
Key resources	*- Environmental*
Governance	*- Legal*
Cost and revenue	*- Political*
- Capturing value	*- Social*
- Cost reductions	*- Technological*
- Cost structure	External drivers
	- Economic
	- Environmental
	- Legal
	- Political
	- Social
	- Technological

5 Findings/Results & Analysis

The next sections provide information about the business strategy of CRRE, followed by details of identified drivers and barriers. Section 5.1 will focus on answering RQ1a and RQ1b by offering a CRRE business model framework and outlining the different value capture strategies. Section 5.2 will answer RQ2 by outlining relevant internal and external drivers and barrier for CRRE which have been identified in the interviews.

5.1 Business models of Coral Reef Restoration Enterprises

With coral reef restoration being a comparably new business activity, CRRE that entered the market have produced different solutions to the question of how to make coral reef restoration profitable. This section will outline the findings regarding the different configurations of the business strategy of CRRE, corresponding to RQ1 of this thesis.

The strategies that CRRE have chosen, differ greatly from one another, thus also their business models differ. Considering that CRRE work with NBS, their business model is complex in nature, with the benefits not always being directly attributed to the customer. Nonetheless, the analysis has found certain patterns of the strategies. These are outlined as configuration options in this section. The classification of business model patterns can be useful for the storing and retrieving of relevant information regarding the strategy of different businesses (Lüdeke-Freund et al., 2018), thus the analysis produced a CRRE business model framework for a comprehensive overview of the different strategies and configurations CRRE are undertaking. Inspired by work on business model configurations of circular economy and the sharing economy, the business model framework and its configuration options are visualized in a morphological box (see Table 5-1) (Curtis, 2021; Lüdeke-Freund et al., 2019; Tukker, 2015).

	Attribute	Configuration options				
Value proposition	Economic	Improved restoration efficiency	Attractiveness	Impact communication	Improved monitoring	Risk reduction
	Environmental	Restoration	New reefs	Low environmental impact	Likeness to nature	Coastline protection
	Social	Individual contribution	Aesthetic value	Education	Support of local community	
Stakeholder	Key partners	Tourism industry	Government	Insurance companies	Restoration projects	Scientific community	NGOs	Suppliers	Local community	Fishing industry	Other industries
	Customer segment	Tourism industry	Government	Insurance companies	Restoration projects	Real estate	Polluters	Consumer	Other industries		
	Key beneficiaries	Tourism industry	Government	Insurance companies	Restoration projects	Real estate	Local community	Consumer	Fishing industry		
Value facilitation	Key activities	Restoration	Dive shop	Education	Communication						
	Key resources	Ocean-based	Land-based	Substrate							
	Governance	Subscription model	"Home" reef								
	Cost structure	Material for restoration	Boat & equipment	Staff	Travel costs	Shipping of structures					
Value capture	Revenue streams	Restoration service	Education	Planting experience	Diving	Consulting					
		Touristic tours	Maintenance and monitoring	Merchandise	Coastal protection infrastructure						
	Other	Donations	Government funding	Incubator/accelerator programmes	Biodiversity credits	Cryptocurrency					
	Cost reductions	Administrative volunteers	Scientific volunteers	Restoration volunteers							

Table 5-1: CRRE Business Model Framework. Source: Author.

Each section of the framework refers to aspects of the NBE-BMC outlined in Section 3.1.2. The configuration options show the possible mix-and-match combinations that CRRE have on the market and no attribute is limited to only one configuration option. Nonetheless, there

are cases of companies that implement only one of the available configuration options in specific attributes of the business model. The following sub-sections of section 5.1 will present the findings of each attribute and their configuration options in depth.

5.1.1 Value proposition

As outlined in the NBE-BMC, the value proposition of a CRRE like other sustainable business models includes the triple bottom line. This section explores possible value propositions of CRRE within economic, environmental, and social values. Furthermore, this section will also elaborate on how different combinations of value proposition are used by CRRE to set themselves apart from the competition.

The economic proposition

Considering that coral reefs are a public good in nature, economic benefits are oftentimes not as clear or direct as in a traditional business approach. Nonetheless, the CRRE analysed within this thesis have established strategies to offer direct and indirect economic benefits to their customers to make their business case. This section will present the direct and indirect economic benefits that are part of the value proposition of CRRE and can be seen as configuration options for their strategy.

Improved restoration efficiency was identified as the key value proposition offered to customers by almost all CRRE interviewed as part of this thesis. This configuration option refers to different strategies of how CRRE have improved the coral reef restoration process to distinguish themselves from other organisations. These strategies can be categorised under the following characteristics:

- Adaptability
  This refers to the potential of the restoration solution to be adaptable to varying environments. This characteristic was especially part of the strategy of CRRE who aimed at scaling up their restoration activities to a multinational scale. In this case, they developed solutions to make their restoration solution adaptable to geographic particularities so that a restoration in other countries was comparably easy to implement.
- Scientific soundness
  This refers to CRRE being able to prove the quality of their restoration activities by including scientific investigations and procedures for the development of the restoration procedure. Through this, they offer increased security for their customers that their product or service is of high quality. While this strategy was widely used by CRRE analysed, it was mostly the case for those businesses, which were founded by people with a background of marine science or similar.
- Restoration speed
  This refers to a shortened timeline for the corals to grow through improved restoration practices. Here, the strategies differ between CRRE, as a few offered an improved restoration speed, while most others referred to the restoration practices as a long-process and thus offered different governance solutions instead.
- Survivorship
  This refers to restoration practices that secure a higher survivorship of corals than in traditional reefs or other restoration practices. While not offered by many CRRE,

some emphasised that their practices have improved survivorship through different strategies such as biomimicry[5] and/or engineering improvements.

- Low cost
  This refers to better price performance of restoration offered by only a few CRRE who's restoration is cheaper compared to others. This was achieved through economies of scale or through the employment of volunteers.
- Climate resilient restoration
  This refers to the aim of few CRRE to improve the restored reefs by ensuring that the new corals are better adapted to the negative impacts of climate change than current corals who suffer under the impacts. This includes the adaptation of corals to rising sea temperatures through a process called assisted evolution[6], as well as improved infrastructure for the corals to settle on.

Attractiveness is a value proposition that was consciously or unconsciously aimed for by all the CRRE interviewed and analysed, however, the specific applications differed between businesses. This configuration option refers to economic gains customers can achieve through the added beauty of the coral reefs, which mainly manifested in an increased in touristic attractiveness, but which also manifested in increased real estate value or in an increased attractiveness of the used structures for the restoration. The main characteristic of attractiveness included touristic attractiveness, meaning that the restoration service through the beauty of corals would lead to an increase of guests for the customer. In some cases, the restoration also included education scenters or the possibility for tourists to tour the operations of the restoration, which was also an increased economic benefit for customers manifesting in the localisation becoming more attractive for tourists: "We've got marine discovery centres […] and that creates a whole guest experience [for the guests of the resort], with a whole lot of environmental and conservation awareness" (B6).

Next to the increased touristic attraction, increased attractiveness also includes the increased property value due to the beauty of the restored reefs. Finally, it also includes the strategy to make the restoration structure more visually appealing. The restoration structure – the structure on which the corals settle – was in most cases a simple frame or designed in a way to make the restoration scalable and adaptable (see adaptability under improved restoration practices), but one CRRE made it their unique strategy to increase the visual appeal of the frames by making them a work of art. The goal of that is to raise awareness by catching the interest of people through the artistic appeal of the structures: "You can reach people with it and reach people emotionally. […] That simply helps to really bring people to the subject who are not at the seaside or don't have anything to do with it, who first ask themselves, what is that? The colour and the material are appealing, and people find that somehow interesting and then they are drawn in and continue to ask." (B7).

Impact communication includes the service of reporting to the client about the impacts which in many cases is associated with the monitoring practice once the restoration process has been started. Here, some CRRE made it their value proposition to offer impact reporting to their customers so that they could benefit from the restoration activities by being able to

[5] "Biomimicry is a science-based technique or philosophy that emulates nature's forms, processes, and ecosystems to inspire more sustainable designs. [It] is an interdisciplinary method inspired by living beings in nature [and] aims to find solutions to challenges faced by humanity." (Srisuwan et al., 2022, p. 1).

[6] Assisted evolution in coral reef restoration is a process in which traits of corals are enhanced through human interference for a better resilience to environmental pressures (van Oppen et al., 2015). As this includes a form of manipulation of nature, this process is acknowledged as controversial.

use this as a marketing or reporting opportunity themselves. "We can offer impact that they can also include in their sustainability and news report, or Environmental, Social, and Governance (ESG) and news reports, depending on the geography they work at. For example, in [one country we work in] all listed companies have to report their ESG performance every year to the authorities, so that also gives us an additional benchmarking" (B3).

Improved monitoring is a configuration option which is only being implemented by one CRRE so far. It includes the services of improved monitoring in addition to the restoration itself. This CRRE specialised in improving their monitoring technology and thus offers the added benefit of more efficient and/or more reliable monitoring as a service. This includes the monitoring of reef health and if present, how diseases spread, and a comparation of growth of the reefs due to the restoration service.

Risk reduction is an important benefit of coral reef restoration resulting from the ability of coral reefs to safeguard coastal regions considering that they dissipate 97 percent of the wave energy which without the coral reefs present would otherwise hit the shoreline with full force (Ferrario et al., 2014). Some of the CRRE analysed focused their activities on selling the restoration services to customers who would benefit from this risk reduction and thus placed the restored reefs in locations that are likely to suffer from storms or otherwise strong waves. While only a few of them made this their explicit strategy, there is the potential that other CRRE might also provide this benefit to customers without being directly aware of it.

The environmental proposition

Environmental benefits are of course an integral part of the value proposition of CRRE, however, oftentimes they might not always directly benefit the paying customers of CRRE. Nevertheless, they are the core of CRRE, who have managed to go beyond merely benefiting nature in the ways that coral reefs traditionally do by developing different strategies for additional environmental benefits. All environmental benefits that have been identified throughout the analysis will be outlined in this section. However, it is important to note that the configuration options of the environmental value proposition are not as clearly to distinguish as in the section before. Some overlap but have been separated to better outline different strategies used by CRRE.

Restoration of degraded coral reefs is of course the main environmental benefit CRRE offer. "When we started, it was just a big [coral] rubble field that no one went to" (B1). "Right now, we actually deploy these structures in heavily degraded waters, so in places where it's completely turned into desert, where corals and other marine organisms will have no chance to recover unless there's the next or another tectonic event that pushes the crust up" (B3). Through the restoration of those degraded reefs, biodiversity and nature is restored and thus nature directly benefits.

New reefs is outlined as a value proposition in addition to the restoration, seeing that restoration in heavily degraded reefs produces new reefs. However new reefs refer to the establishment of reefs in an area where there was no original reef that has degraded. Some CRRE reported to have established new reefs for customers such as resorts to bring the reef closer to the property for an added attractiveness (see economic values). "So, part of the project was trying to bring in those reef fish closer to the island, and to develop basically a new ecosystem on the reef flats. So even within a few weeks and months, you start to see fish in the lagoon that you wouldn't ordinarily see, because normally they wouldn't venture on such an exposed landscape, because it's literally just bare sand" (B6).

Low environmental impact during the restoration process has been a strategy followed by all CRRE analysed, however, each business focused on different areas to reduce the impact of the restoration activities. Some focused on the structure, meaning the structure for settlement of the corals was designed with materials that would have a lower impact on marine life than other alternatives. These materials included clay, terracotta or other bio-based material that was said to be completely bio-degradable. Another focus was to reduce carbon emissions throughout the restoration process by minimising boat travels and using advanced technology to have the boats emit less carbon. Furthermore, some also included renewable energy to their operations to further reduce carbon emissions.

Likeness to nature is a value proposition in which CRRE tried to be as close to nature in their restoration activities as possible. This was on one hand achieved through visual likeness, meaning that the structures on which the corals have been attached are meant to not be visible in future to not be detectable that a human intervention has taken place in that area: The corals are "so big that you cannot see the structures anymore" (B2). On the other hand, this also includes a technical likeness to nature through biomimicry design of the structures, so that the restoration process is close to what nature would do by itself.

Coastline protection is an environmental benefit resulting from the restoration of degraded benefit or the establishment of new reefs instead of grey infrastructure such as wave breakers. While this is a strategy of risk reduction for coastal communities (see economic values), it also holds environmental benefits as deterioration of natural shorelines is prevented.

The social proposition

The societal value of coral reef restoration is not as pronounced as compared to the value it brings to the environment. Nevertheless, restoring coral reefs offer direct social benefits to coastal communities. Despite those already known benefits, CRRE analysed within this thesis have found more ways to propose social value through their activities than the values of food security and coastline protection that are directly associated with coral reef restoration. Those additional value options are outlined in this section.

Individual contribution is a value proposition that CRRE offer to the individual consumer as the beneficiary. Here, individuals benefit from the feeling of contributing to restore reefs and help the environment. These individuals are the customers themselves, such as in the case of touristic coral reef restoration where tourist get to transplant corals or the case of adopting a coral (further explained in Section 5.1.4): "Coral restoration is becoming more interesting in the diver community. It's a new and exciting kind of activity that people can participate rather than just go and leisure dive." (B2) In these cases, individuals might make the purchase decision based on the value that they receive from helping corals and subsequently the environment.

Aesthetic value of corals is inherent. Coral reefs are perceived as beautiful and having healthy coral reefs offers aesthetic benefits to individuals: "It's a sight to behold, it really is" (B6). This value was reported to be of high importance, as this also supports the motivation of people to engage with coral reef restoration as a customer: "These are divers who were diving for 10, 20 years, so they directly see the benefit of what we're doing because they have experience in the ocean" (B2).

Education has been outlined by many interviewees as an integral part of their business philosophy. While some focused on educating the local public, others focused on educating tourists to raise awareness. In all cases, this value proposition was motivated by the founders of CRRE to raise awareness and influence future support of coral reefs: We "try and inspire

people from all over the world to get involved because even though we're working in one small area if we can use that as a training facility to have a global reach then that's way more effective than just one area" (B1).

Support of local community was reported as an important part of restoration. While not all CRRE decided to actively engage in this, the vast majority of CRRE analysed offered at least one form of community engagement with benefits to the local community. Some of those included a scholarship to educate local women in diving, the initiative to try and employ locals for the restoration activities, education activities for locals, and collaborating with local university students. Generally, many interviewees pointed out that it was crucial to offer value to local communities, as they were also the ones suffering the most under declining reef health. Thus, the restoration activities in itself offer value to the local community through improved livelihoods and food security.

5.1.2 Stakeholders

As will be outlined in Section 5.2.2 about external drivers, stakeholder engagement and partnerships are crucial for a CRRE. Furthermore, the stakeholder landscape is complex and intertwined as in many cases the partners, customers, and beneficiaries overlap. The interviews have shown that most stakeholder overlap by being at least two if not all three: key partners, customers, and beneficiaries. Figure 5-1 shows how the stakeholder overlap in the three categories. However, it is important to point out that the overlap does not necessarily have to be within one CRRE. For example, while the government might be key partner and key beneficiary of one CRRE, another CRRE might have outlined the government as customer and key beneficiary. This section will elaborate on relevant key partners, customer segments, and key beneficiaries of CRRE and outline how and why they overlap.

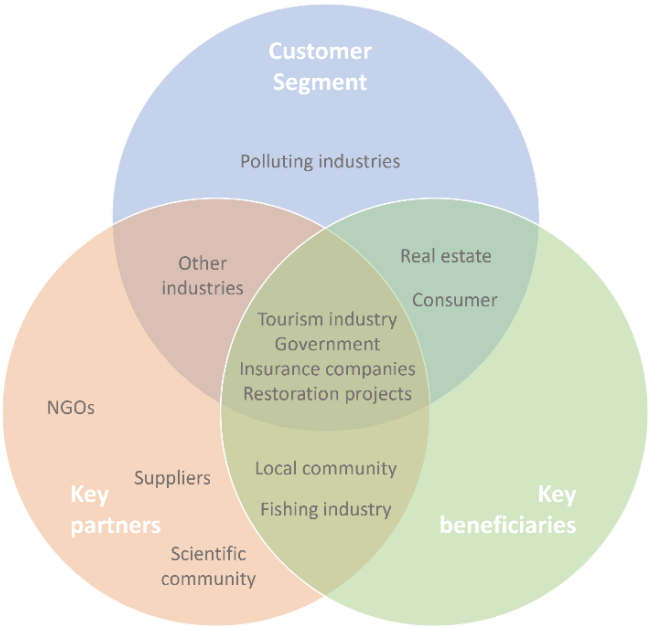


Figure 5-1: Venn diagram of customer segment, key partners, and key beneficiaries. Source: Author.

Looking at the diagram, the biggest overlap of stakeholder can be seen between key beneficiaries and customers, with some of those also overlapping with key partners. This points towards the fact that either CRRE try to enable key beneficiaries to be paying customers and/or beneficiaries actively seek out CRRE to fulfil their need of restored coral reefs. The fact that some of them also overlap with being a key partner, points out the importance of those actors as they are not only benefiting, but also willing to pay and a valuable partner to implement as well. It also becomes visible that most stakeholder overlap to a certain extent and that most who do not overlap are key partners. So, while the CRRE have some key partners who help in the implementation and nothing more, all other partners (except for polluting industries) overlap in at least two categories. The following sub-headings will elaborate on the stakeholder and their multifunctional purposes.

The centre: The overlap of key partners, key beneficiaries, and customers

The tourism industry, governments, insurance companies, and other restoration projects have been identified within all three stakeholder categories: key beneficiaries, customers, and key partners. The fact that they overlap into all three categories also point them out as highly relevant stakeholders.

The **tourism industry** has already been identified in the literature review as an important stakeholder for coral reef restoration. This understanding has only been reinforced through the interviews. Not only does the tourism industry in coastal regions highly depend on healthy coral reefs, but it was also mentioned as the easiest entry market (oftentimes mentioned as "low hanging fruit" in interviews). This explains the overlap between key beneficiary and customer. However, the tourism industry is also an important partner of CRRE, as many of the interviewees reported to work together with different tourism institutions, such as tourism agencies to arrange end-consumers as customers, dive shops to implement the restoration activities, or resorts to establish a mutually beneficial partnership for their guests to join in restoration activities or educational partnerships. Thus, the tourism industry has generally been mentioned as being within all three categories at the same time by most CRRE. The main types of relevant actors identified within the tourism industry can be classified into: Hotels & resorts, dive industry, tour operators, and tourists.

The **government** is naturally also a stakeholder in all three categories, however not all CRRE have reported to work with the government in all three categories. Most have outlined that the government is a key partner, be it for the allocation of permits, choosing a restoration location, or for the aid in finding local implementation partners. Furthermore, the interviews reinforced the findings from the literature review, where the government was stated as a key beneficiary of coral reef restoration. "Governments have a stake in it, in terms of economic prosperity and food security, with a lot of fisheries depending on coral reefs" (Bradbury, 2018). However, while the government was reported to be a key beneficiary by almost all interviewees and a key partner by most interviewees, only a few reported that the government was a customer by funding the restoration activities.

Insurance companies have been mentioned as a stakeholder in all three categories. Nevertheless, there was no case where an insurance company overlapped as a key partner and as a customer within the same company. Insurance companies who insure properties or pay for storm damages highly benefit from coral reef restoration, as reefs offer additional coastal protection. While an insurance company thus can be a key beneficiary of coral reef restoration activities, most have not reported them to be a paying customer, but rather a partner. It was mentioned that insurances found it difficult to be a paying customer since it would not be a donation with a CRRE, but rather a business transaction and currently insurances have bureaucratic procedures which hinder the transaction. Nonetheless, some interviewees were hopeful towards insurances becoming paying customers in the future, once their internal processes have adapted to the new market situation.

Restoration projects refer to other coral reef restoration projects that CRRE engage with. Both the CRRE and the other restoration projects mutually benefit from a partnership, which explains the overlap between key beneficiaries and key partners. However, in some cases, a CRRE would engage with another project in a way that would qualify them to fulfil all three categories. Some CRRE reported that they would educate other projects, or they would supply other projects with corals for their restoration activities. Those activities lead to other restoration projects also being a customer. One example is a CRRE that would train other restoration projects in a form comparable to a consultancy. Another reported that they would

sell their improved corals that are adapted to climate change to other restoration projects to accelerate and improve their restoration. However, this was only for a few cases, thus in most cases other restoration projects were either just beneficiaries and partners or in some cases the CRRE did not engage with other restoration projects.

The overlap between customer segment and key beneficiaries

When it comes to customers who also benefit from restored coral reefs, but do not engage in partnerships, two stakeholders have been identified. As it is visible in the Venn diagram (Figure 5-1) all stakeholders who benefit from the activities of CRRE either overlap in being customers, partners or all three at the same time. This outlines a strategy of CRRE where they identify key beneficiaries and initially try to acquire them as paying customers. This is the case for real estate firms and developers and consumers.

Real estate in coastal regions depends on healthy reefs for their property value. First, a healthy reef nearby makes the property more attractive and thus raises property value, second, a healthy reef also means risk reduction of the property losing value in the future. This is because reefs protect coastal areas from storms through wave dissipation. Through reduced waves, beach erosion is reduced, which would otherwise negatively affect property value. Some interviewees have reported that due to these factors, real estate has a willingness to pay for the service of coral reef restoration and thus builds an important customer.

Consumer in this context refers to the individual consumer of coral reefs in terms of paying to enjoy coral reefs. This includes tourist divers, who pay to dive and experience coral reefs or pay to be able to do the restoration themselves, non-diver tourists, who for example pay to tour the restoration centre or education centre of coral reefs, and other consumers, who pay by adopting a coral. All of these examples show customers of interviewed CRRE who are willing to pay. They overlap as key beneficiaries, considering that they (as mentioned in Section 5.1.1) benefit from the aesthetic value of coral reefs. As they perceive coral reefs as beautiful and as worth preserving, they are willing to pay for them to be restored, to view them, or to learn about them.

The overlap between customers and key partners

In the case of the overlap between customers and key partners, the interviews identified industries which for some CRRE were only customers and for other CRRE were customers/partners. These industries included the fashion industry, the cosmetic industry, and the pharma industry. Those industries would partner with CRRE to on the one hand use the activities of CRRE for their marketing and ESG reporting, while also offering additional revenue to the CRRE. One example of this was a clothing brand that would give a certain percentage of the revenue of sales of a specific clothing line to the CRRE. Considering that this would in the end provide revenue to the CRRE, they can also be classified as the customer, however the customer in that case is the consumer who buys the product potentially also to support coral reef restoration.

The overlap between key beneficiaries and key partners

Respondents pointed out that they aimed at identifying key beneficiaries so that they should ideally translate into customers. As they benefit, they should also be willing to pay for it. However, this is not the case for the local community and the fishing industry. While these stakeholder benefit from the activities of CRRE, they are no paying customers. For the local community, this could be due to the fact that they do not have the funds available to pay CRRE.

The **fishing industry,** however, highly depends on healthy coral reefs for long-term fish security. A desire or an expectation was voiced by some interviewees that the fishing industry should or would be a customer eventually. Most interviewees agreed that they expect the fishing industry to see the necessity and be willing to pay for it, however, none has explicitly stated that they have the fishing industry as a paying customer. Nevertheless, the local fishing community was pointed out as a relevant partner in implementation by one interviewee, who pointed out that they were crucial to work together with for a successful implementation of the restoration activities.

Furthermore, the **local community** in general was outlined as a crucial implementation partner who also highly benefitted from coral reef restoration. Almost all interviewees partnered with the local community and pointed to their importance. It is "so important to engage with the local communities, because otherwise you have no idea who to approach or with what strategy to approach" (B3).

Non-overlapping stakeholders

While most stakeholders fulfil at least two or more functions, four stakeholder types have been identified that only fit into one category. Still, they are important stakeholder for the implementation in the case of the key partners, and important customers in the case of the polluting industries and should thus not be disregarded as unimportant.

Polluting industries are corporate actors who with their production negatively impact the coral reefs directly, like the shipping industry, or indirectly, like air flight companies. The larger scale CRRE have pointed out that the polluting industry is a comparably easy customer to convince. "They understand the impact and they are often obligated to have this allocated budget. So those are usually willing to pay, and you don't have to go through a long sell cycle to tell them why they need to, because they have to, and they understand that they have to" (B3). Thus, they are also customers that are a "low hanging fruit" and hence easy for CRRE to recruit.

NGOs are crucial partners for CRRE to implement the restoration. This collaboration can take any form. CRRE work with NGOs such as foundations to receive their support in implementation, international awards, and initiatives to receive publicity, or with local NGOs to benefit from their network for the planning and implementation. Particularly the larger scale CRRE reported to work strongly together with NGOs, especially local NGOs, to implement the restoration projects in the various locations.

Suppliers are important the same way for CRRE as they are for any other business. CRRE depend on them to supply them with the materials for the structures, with the shipping opportunities, or with the assembly of the structures. More information about the resources needed from suppliers are in the section about key resources (see 5.1.3).

The **scientific community** has also been outlined by many interviewees as crucial partner. For successful implementation, advanced scientific methods are needed and CRRE reported that they stay in close contact with the scientific community (or in some cases the founders are still part of the scientific community) so that they keep updated on new findings which will improve the restoration practices. Some also reported that especially in the beginning of the start-up period, they have collaborated closely with scientists as consultants to develop the restoration method.

5.1.3 Value facilitation

To facilitate their business activities and earn revenue, certain aspects are of importance for a company to consider. This section talks about aspects of relevance to CRRE when delivering their value to the customer. Part of this are the key activities a CRRE needs to focus on for their value delivery, what resources they mainly need to fulfil these activities, how they structured their governance of the reefs, and what main costs they have.

Key activities

The different activities that are of importance to a CRRE have been identified to correspond to four main categories: activities related to their restoration, their dive shop, to education, or to communication.

Restoration is of course the main activity of CRRE considering that this is also the core of their business. Nevertheless, not every business structured their restoration activities in the same way. First of all, the type of restoration differs (see Section 2.1). The two types identified that were being used by CRRE were coral gardening and substratum enhancement methods. Overall, it was evident that smaller-scale CRRE preferred coral gardening as a method whereas those CRRE that aimed at up-scaling their activities to a multinational scale focused more on the substrate method. However, there was one exception in which a CRRE that aimed at scaling their activities did use the coral gardening method, thus this distinction cannot be generalised.

Dive shop describes the CRRE who run a normal dive shop next to their restoration activities, meaning that they offer typical dive certification courses[7] and fun dives[8]. This was the case for all hybrid CRRE analysed and for some of the CRRE start-ups, who did it in a complete for-profit manner. Furthermore, if a CRRE had a dive shop next to their conservation efforts, it typically meant that they were not scaling up their activities, but rather worked in the geographical location the dive shop was situated in. This could be the case due to the commitment the dive shops have to their specific place it was situated in. Those CRRE who did not link their conservation to a dive shop were not constrained through the location of the dive shop, but could rather adapt their restoration to anywhere, while the ones with a dive shop needed to work where the dive shop was situated. Nevertheless, the dive shop had the advantage that for one they could earn additional revenue through the non-conservation related activities, their restoration efforts also attracted divers to their dive shop, the revenues from the dive shop supported the restoration budget, and they could profit from selling divers the experience to transplant corals: "The conservation side of things wasn't an afterthought, it was always the primary goal. But we had to establish the dive shop first and get it a name for itself, get it to be at a profitable state before we could expand the conservation efforts. […] The idea wasn't to start the conservation programs as a marketing thing. But it's just ended up that it has actually given the dive shop good publicity because of the conservation work." (B1).

Education includes the education of individuals through conservation diving courses, touristic tours, or educational marine centres. This activity overlaps with the restoration and the dive shop activity, as for example the restoration dive courses included the restoration

[7] Dive certification courses are courses for people who want to become proficient in diving. The courses can be held in several levels from beginner to master and, upon completion, they certify the divers with a diving licence that allows them to dive in certain depths.

[8] Fun dives are for divers who already have at least the lowest dive certification level and wish to dive in a place to experience it. It is typically for dive tourists who want to see a dive site.

activities and the formation to be a diver. Furthermore, education could be non-dive related such as the marine centres or the touristic tours: "The coral route was to take them to get to know the terrestrial ecosystems, the mangroves, and then the relationship between mangroves and the importance of reefs" (B4).

Communication, for one, includes the marketing strategy of CRRE to generate customers. However, most participants reported that they did not invest enough time into their marketing and that they deemed it necessary to invest more in the future. Additionally, the communication of the progress of the restored reef also belongs into this category. Here, some CRRE made it their strategy to inform customers about the reefs process through photos and information in regular intervals: "We'll take a lot of photos and videos, we'll take photos of each of the reef stars. We have a bamboo tank where we laser cut the names and logos of companies" (B2). This, participants said, they engaged in for a higher transparency for the customers.

Key resources

When analysing key resources, this thesis focused on resources that were specific to CRRE's restoration activities and depended on the different strategies CRRE implemented. The resources outlined in this section are not meant as an exhaustive list of resources, but the aim was rather to outline and distinguish between the key resources for CRRE to implement their individual restoration strategies.

Analysing the different resources important to the activities of CRRE, three categories were identified: ocean-based resources, land-based resources, and substrate. The distinction in strategy is mainly between ocean-based and substrate. While ocean-based resources mainly refer to the resources of relevance to CRRE focusing on coral gardening as their restoration strategy, resources for substrate refer to CRRE that focus on substratum enhancement methods, which in all cases were land-based. When it comes to substrate, all CRRE who followed this strategy had land-based facilities in which the substrate is produced, such as 3D-printing facilities or manufacturing facilities of the structures. The produced substrate is then transported to the site of restoration, where they are placed in the ocean. Nonetheless, a distinction between ocean-based, land-based, and substrate was chosen, because most, who engaged in coral gardening were ocean-based, but one of the CRRE analysed established a land-based system in which the coral nursery was on land with water tanks meant to establish improved conditions for faster growth rates and higher survivorship of the coral. Thus, there is an overlap for the category of land-based, as not all coral gardeners were ocean-based and not all land-based referred to substrate methods.

Each category has some resources that are key to their strategy. For the ocean-based resources, the most important resources are the material to make the structures as well as the boat and diving equipment. For the structures, most of them used metal sticks which they welded together into a structure in form of a star or a house. This structure was then covered in material for corals to settle, such as sand. The boats and diving equipment were crucial, as most of their work was done in or on the ocean, such as collecting the corals, planting the corals on the structures, and placing the structures.

For the land-based resources, the most important resources are the water tanks, pumps, and nutrients. As the corals were placed in tanks on land, similar to a fish farm, they needed tanks to place the corals in and water pumps for a continuous flow of clean water through the tanks. Additionally, they added nutrients to the water to produce ideal conditions for coral growth.

Finally, for the substrate resources, the most important resources were the ingredients to the substrate as well as the technology to produce the substrate. In most cases, the ingredients were either clay or a gravel-like composition. The technologies used to make the structures in most cases was 3D-printing but there was also a case of pressing the structures. In this category, they also needed boats and diving equipment to place the structures into the ocean where they are to be restored, but in contrast to the ocean-based category, much of their work was done on land and thus the boats and diving equipment were not mentioned as key resource.

Governance

To ensure the success of the restoration process, some CRRE established a strategy to monitor the health of the reef over a time period. All CRRE interviewed argued for one of the two identified categories of governance strategies: a subscription model or a "home" reef.

A **subscription model** is being used by some of the CRRE with larger-scale restoration activities. Here, they sell the restoration as a service in a package that includes a monitoring service for a predefined number of years. These CRRE only offer their restoration in this package, which has the form of a subscription model in which an initial payment is made for the restoration and then smaller payments are made in a predefined interval for the duration of the subscription. In most cases, the subscription lasts for three years or longer and there is no option for the customer to bargain for a shorter timeframe. This is made with the intention to ensure quality and success of the restoration. In some cases, the monitoring subscription could be continued after the predefined timeframe runs out, for additional, but comparably low fees. In other cases, the CRRE argue that after the predefined timeframe no more monitoring is necessary since the coral reef would be self-sustainable latest by the end of the period and the monitoring is merely to have an overview of how the reef is developing: "The reef is designed in such a way that it actually takes over by itself or that nature takes over the reef completely and no maintenance is necessary, basically from the moment we put it down. We just want to see how it develops" (B7).

"Home" reefs are a strategy particularly for smaller scale CRRE which have their activities in limited geographical areas. These are mainly the ones who follow the dive shop strategy. Here, the CRRE only restore one reef, which is close to their base. This reef, which this thesis refers to as "home" reef, is the only focus of those CRRE, thus they continuously restore that reef and ensure its governance throughout their restoration process: The "coral restoration site, which we established almost six years ago, we've been expanding it ever since then" (B1).

Cost structure

The main costs for a CRRE depend on their strategy and scale. For smaller scale CRRE, the main costs were the boats to reach the restoration site, as well as the dive equipment. In these cases, the restoration activity itself was not reported to be an expensive activity, because many times they relied on the tourists or on volunteers.

The cost of trained staff or to train the staff, the material of restoration, and the shipping of structures was reported as high equally by CRRE of small scale as well as the ones who aimed to upscale their activities. In case of the material of restoration, it includes physical material such as the metal bars or the clay, but it also includes the assembly costs in case of the metal bars, the printing costs in case of the substrate printing, or the costs of the land-based coral gardening system. Furthermore, in most cases, the structures could not be produced on-site, which is why they had to be transported to the restoration site, which again incurred high costs.

For CRRE of larger scale, they also had additional costs through required travels. As they focus on a multi-national scale, they have to travel to the restoration sites. Also, one of the smaller scales CRRE reported added costs through travel, because their team did not live close to their "home" reef and another small scale CRRE reported travel costs as well, however, not by having to travel to the restoration site, but rather by the skilled workers who relocate to their base.

5.1.4 Value capture

For a company, there are diverse ways to capture value. The existence of a variety of ways holds especially true for NBEs, considering that the complexity of NBS leads to a need to identify non-traditional ways of capturing value. Next to the direct revenue streams, part of a value capture is also the intangible value, such as resource savings, or, as has been identified for CRRE, cost reductions (Beltramello et al., 2013). Finally, as outlined in the NBE-BMC, the nature of NBEs can also lead to indirect revenue streams such as donations or government funding, that still build part of the value capture strategy of a NBE. This section will elaborate on the strategies CRRE have identified to capture value in their activities and thus make their activities a profitable business.

Revenue streams

In total, nine revenue streams have been identified throughout the interviews and desktop research of this thesis. No CRRE focused on only one revenue stream. Instead, all CRRE emphasised the importance of diversifying their income opportunities, especially considering that restoration in itself does not always yield regular and guaranteed revenue. "We have already entered other markets where everybody is, but we said that we have to diversify" (B4). Thus, all CRRE interviewed engaged in at least two if not more of the identified revenue streams.

Restoration service is the key revenue streams for CRRE. Considering that restoration is their core business strategy, this is also the most important revenue stream. While restoration does not directly lead to profits, all CRRE have identified customers who are willing to pay for the restoration service, which is discussed as part of the section about stakeholder (Section 5.1.2). Only two of the identified CRRE did not engage in direct restoration services, but rather coordinated or mediated restoration projects instead of directly offering the restoration service. However, this was still counted into this category considering that these CRRE still aimed at the restoration, just that they took a different position within the value chain.

Education has been identified as another key revenue stream. While not all engaged in such activities, still a comparably high number of interviewees reported to engage in this. Earning a revenue would be achieved through for example offering educational workshops to corporations or universities, by offering educational dive courses with a certified degree as a scientific diver or coral reef restoration specialist, by opening the restoration site up for tourists to come and do a tour, or by opening a marine education centre. All of these options yielded revenue through either the end consumer paying for it, or a corporation, tourist agency, or a university paying for the service.

Planting experience is mainly connected to those CRRE who also have a dive shop and focus on offering the planting as an experience for tourist divers. Here, tourist divers get taken out to the restoration site and aid in the collection and transplantation of corals. Additionally, one CRRE focused on offering this experience by partnering with dive shops active on this, thus they did not act as a dive shop but rather offered the experience through partnering with dive shops.

Diving would be an additional source of income of those CRRE who also worked as a dive shop. These activities would include all activities normal for any dive shop, such as offering fun dives, dive certifications, and renting out or selling dive gear. While this activity has nothing to do with the restoration, many of the CRRE who had a "home" reef acted as a dive shop next to the restoration activities to ensure steady income. Furthermore, participants reported that the restoration would be a positive marketing tool to get more customers for the normal dive activities.

Consulting was an additional means of income for about a third of the CRRE. Oftentimes, the founders reported that throughout the process of establishing the restoration business, they found out that the skills and knowledge they have acquired are helpful to other institutions: "We realised that we also have the capacity to ally ourselves with other people or with expert consultants to offer consultancy services" (B4). Thus, they set this up as an additional possibility to earn revenue, but also as a means of helping others that try to work towards coral restoration.

Touristic tours were a means of revenue for only a few of the CRRE. Touristic tours refer to tours on land rather than the diving tours which go under the category of education or planting experience. Some of the CRRE who focused on tourists as their main revenue strategy established a tour package in which not only the restoration was toured, but also the local community or area surrounding the restoration site: "We do a whole weekend […] where we do an experience of the complete ecosystem. So, we try the local gastronomy. We try also other attractions of the area. We also visit land ecosystems and try to establish and teach about the connection that there is between land ecosystems and marine ecosystems" (B5).

Maintenance and monitoring in most cases were part of the subscription model regarding governance. Here, the CRRE who sold a subscription monitoring would have earned part of the revenue due to their maintenance and monitoring service of the restored area. That is how they would ensure ongoing success of the restoration. Furthermore, some CRRE who did not sell this as a subscription model earned revenue through maintenance and monitoring through the adopt a coral method. This method includes that consumers can adopt a coral by paying a one-time or subscription fee and part of the service would be that this coral would be cared for, and it would be monitored. Thus, those CRRE who engaged in this also tended to send the consumer ongoing pictures of the development of that coral.

Merchandise was only used as a strategy by two CRRE. Here, the consumer could buy merchandise in forms of clothing to support the activities of the CRRE and with their funds contribute to coral reef restoration.

Coastal protection infrastructure refers to those CRRE who specifically market and sell their reef structures as coastal protection infrastructure. While all reefs offer coastal protection, some CRRE actively searched for customers who needed coastal protection and developed their restoration frames in a way that would ensure improved coastal protection. That way they would restore reefs or plant new reefs in areas that are in need of improved coastal resilience.

Other

Due to the nature of NBEs as well as the fact that most CRRE were start-ups, other means of being profitable beside traditional revenue generation was available to CRRE. As outlined by Connecting Nature (2019), the fact that NBS are often considered public goods leads to difficulties for NBEs to leverage direct revenues such as outlined in the section before. While

CRRE have found strategies and customers for direct revenue, some still tried to leverage financial means through other indirect opportunities.

Donations were an additional revenue for those CRRE who acted as a hybrid business/NGO. While their business did generate revenue, they added a NGO part to their business to ensure that investors could donate to their activities. This would be leveraged through crowdfunding platforms for individual donations or by approaching companies directly for corporate donations. Furthermore, the adopting a coral strategy can also be classified as a donation if it is done by a CRRE who has a NGO section.

Government funding is of course a relevant additional indirect revenue. While the government can also be a customer and thus this would count towards the direct revenue generated, in some instances the CRRE received financial support from the government which was not directly tied to a specific service, but rather part of the government's biodiversity budget.

Incubator/accelerator programmes were reported as important by the CRRE who attempt to scale up. As they are start-ups, they have the option to leverage financial opportunities aimed at supporting start-ups. There were especially accelerator programmes that focused on climate, biodiversity, or ocean action and thus offered good opportunities for the CRRE.

Biodiversity credits were only actively used by one CRRE. However, other CRRE interviewed were looking into this opportunity and saw this as a future revenue option for them. While there is already an established market for carbon credits, the market for biodiversity credits is still developing and there is lacking policy structure. This is why the CRRE who reported to engage in this also said that the work connected with setting up the biodiversity crediting system was highly demanding.

Cryptocurrency has also only been used by one CRRE and in this case, no other CRRE actively reported to be working on this. To some degree, this can be seen as a donation, considering that the consumer buys the cryptocurrency with the aim to support the restoration activities. Nonetheless, the CRRE who engaged in this also pointed out that similar to other cryptocurrency, this can also be seen as an investment, provided that the concept of NBS cryptocurrency gains traction and the market would grow in the future.

Cost reductions

As outlined by Connecting Nature (2019), the implementation of NBS can offer cost reductions through the use of volunteers for the activities, which would mostly not be possible in non-NBS focused businesses. Through the contributions to society and nature, volunteers are willing to offer their free labour to the businesses. The interviews reported that cost reductions through volunteer work are key in most of the participants' business models and thus are a relevant advantage for CRRE. The type of volunteering used in the CRRE differs and can be sorted into three categories: administration, scientific work, restoration work.

Administrative volunteers help with the day-to-day tasks of running a business. In most cases, this manifested itself in students who would help out with the marketing of the CRRE by improving their website or carrying out their social media marketing. Scientific volunteers are volunteers who have specialized scientific knowledge in marine biology or marine engineering who help out with more complex tasks such as the monitoring of the reefs. Finally, the most common form of volunteer was the restoration volunteer. This includes activities that are directly related to the restoration such as the transplantation of corals, the building of the

structures, or the placement of the coral nurseries. Here, the volunteer is not only a cost reduction, but in some cases also additional revenue, as tourists are willing to pay for the volunteering activity to restore coral reefs.

5.2 Influencing internal and external factors

To understand the current situation of CRRE, not only understanding their business strategy is crucial, but also understanding what factors positively or negatively affect their business activities is important. This section outlines the findings regarding drivers and barriers that are of importance to CRRE both from an internal perspective and an external perspective.

5.2.1 Internal factors

Internal factors are factors that can be controlled and changed to a certain extent by the organisation they are in. Thus, looking at the internal factors offers the possibility of identifying areas of work for CRRE so that they can improve their chances of successfully implementing a CRRE business model. This section will outline the findings of relevant internal factors for CRRE by going into detail of what drivers and what barriers there are. Furthermore, this section also outlines which of the factors have been perceived as most important.

Figure 5-2 outlines the key internal factors that have resulted from the interviews with CRRE representatives. In summary, the interviews established more drivers than barriers when it comes to cultural attributes, but as many drivers as barriers for structural attributes. While some of the influencing factors are specific for at least NBEs and in some cases even for CRRE such as the difficulty of balancing profitability with ecological outcomes, most factors can likely also be seen as generally important for any start-up trying to establish itself. Nonetheless, they also apply to CRRE and have been discussed as relevant factors by the CRRE representatives.

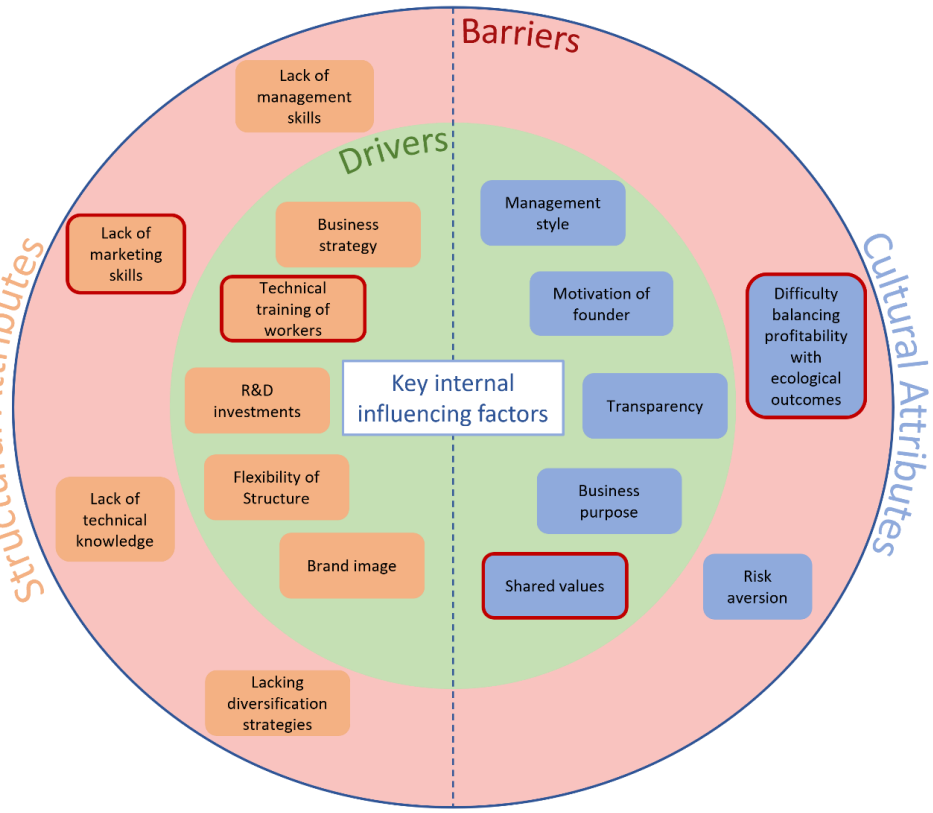


Figure 5-2: Key internal influencing factors. The boxes with a red border indicate factors which have been identified as particularly important by respondents. Source: own elaboration with influences from Stubbs and Cocklin (2008).

Internal drivers

Cultural attributes

The cultural drivers have categories that strongly overlap. Nonetheless, they have all been mentioned separately, because each of these categories has been argued to be important to their business success.

As most important driver in the category of cultural attributes, shared values within their team has been mentioned by almost every participant as crucial to their work and success. CRRE all reported that not only the founder(s) value coral reefs highly and are thus motivated, but rather the whole team is highly motivated. This leads to a good work environment, and it also attracts workers who join the CRRE because they deeply support the cause of the company. This also goes hand in hand with the driver of the motivation of the founder(s). Next to a passionate team, all founders in the interviews reported to be highly motivated about corals and founded the companies as a personal passion project: "It's been a personal passion of mine to want to do something about corals" (B2). While this in itself also leads to the founders giving their everything for the improvement of coral reefs, there is also a possibility that it fosters a culture of shared values within the company.

Management style has also been reported as a relevant driver. For one, it includes communicating the shared values among the team. Additionally, this also ties in with the business purpose, as many of the interviewees reported that a clear business purpose regarding the aid of coral restoration also led to a clearer management style and better shared values among the workers. Some interviewees even reported to reiterate the purpose in every bigger meeting and that this would motivate the workers and support their internal culture. Finally, this also includes a clear transparency within the company and towards partners: "We are very transparent about what we do. And so, every time we do a planting, […] what we'll do is we'll take a lot of photos and videos, we'll take photos of each of the reef [structures]" (B2). However, transparency is also about showing customers that what they are doing is not greenwashing, but a solid and successful restoration: "It's about finding who would be more trustworthy and deliver a solid result for them, because the least thing that these guys want is a scam. If the investment that they invest in ends up being a failure, that's the least thing that they want" (B3).

Structural attributes

On the structural side, especially the technical training of workers has been outlined as crucial driver by most CRRE. Most reported that the technical training of their workers or themselves is of high quality and aides their work. Furthermore, due to their cultural values, many reported that they attract workers with good technical training. Additionally, many of the founders had a marine science background and thus brought needed technical training into the company. Some skills were missing in the workforce and were thus a barrier instead of a driver, which will be explained further in the next section. Next to the technical training, a clear and structured business strategy has been outlined as helpful. "I think that's partially why having that strategic business plan at the very beginning was critical to get to where we are today" (B3). Those who reported to have developed a clear business strategy also reported it to be of help. Those who did not have a clear business strategy instead reported their lacking management skills as a barrier, which will be elaborated in the barrier section.

CRRE who reported to engage in research and development investments also reported that it was crucial to their work. The investments lead to improved technologies or practices which

set them apart from other actors in the market. Nonetheless, not every CRRE made those investments, but all CRRE who attempt to upscale their activities did. Furthermore, instead of having a fixed structure, some CRRE reported that specifically their flexible business structure was good and led to workers coming up with their own ideas and solutions which supported the business. Finally, the brand image was only reported as a driver by a few CRRE, however, those who did report it as a driver also said that thus it was easier for them to acquire customers as well as skilled workers and partners.

Internal barriers

Cultural attributes

Cultural attributes were generally perceived as a strength of CRRE rather than a barrier. However, two barriers have been identified. The most important being the difficulty to balance profitability with ecological outcomes. Especially for those CRRE who focused on other activities to finance the restoration, such as the dive shops, they reported to view this as a substantial barrier. "This is always a thing because my business partner is more focused on the dive side of things. So, when we look at the costing of the [restoration] courses, he doesn't want it to be a negative drain from the dive shop to the conservation side. So, the conservation side has to pay for itself and then with enough students to earn at least some profit to carry over so that it isn't a drain" (B1). This difficulty also leads to the second barrier identified: risk aversion. However, this barrier is controversial as some CRRE emphasised that they are willing to take on considerable risks for restoration improvements while others emphasised that they are not willing to take any risks due to the difficulty of balancing profitability with ecological outcomes. Thus, this barrier is only true for part of the CRRE and cannot be generalised to all.

Structural attributes

When it comes to structural barriers, the majority of barriers are about lacking skills within the workforce. The main one being the lack of marketing skills in the workforce. Almost all CRRE reported that to be one of their main barriers: "We have to learn about things that we didn't know about, like marketing and social networks. I mean, at least I haven't had the chance to learn how to do that, I didn't even have social networks because I never liked them, and I had to learn how to use social networks to be able to communicate [about our business]" (B4). Many reported that they also only noticed this barrier comparably late in the business process and are now trying to tackle it.

In addition to the lacking marketing skills, most also reported a lack of management or business skills and that they had to learn it during the process of setting up the company. As most founders have a scientific background, they in contrast lacked business background. This is also a significant barrier, as it led to disadvantages for some CRRE such as one case, where a CRRE reported that their lacking business knowledge led to their business idea being stolen by a former partner, as they did not go through the necessary legal steps involved in completing a partnership of their kind. Others reported that they simply struggled with how to manage and run a business. This also ties in with the difficulty to balance profitability with ecological outcomes as their lacking management skills sometimes meant that they focused more on the restoration rather than profitability.

Furthermore, a lack of technical knowledge within the workforce also led to difficulties for some CRRE. In most cases, the founders brought the needed scientific knowledge into the company. However, specialised knowledge was oftentimes lacking, such as knowledge about

3D printing techniques, knowledge of local workers on how to build and place the frames, and specific knowledge about coral reef restoration. Instead, many relied on a trial-and-error approach. In some few cases, even the founders were lacking scientific knowledge, which made it more difficult for them.

All the above-mentioned barriers were also reported to mainly stem from the external barrier of lacking financing. The lacking skills were all problems said to be able to be remedied by more financial flexibility. Such as CRRE saying that they lacked marketing skills, but also lacked the budget to employ a person responsible for marketing.

Finally, a structural barrier which did not refer to any skills related area was that some CRRE lack diversification strategies. Many reported that their business strategy depends on one activity and in some cases even only on a select number of customers. Those who were or still are in these positions reported to have difficulty fully establishing their business as they depend on specific activities/customers. Most CRRE who recounted this barrier also noticed it and are now actively trying to diversify their business to ensure long-term profitability and scalability.

5.2.2 External factors

While companies can influence internal factors, external factors lie beyond their control. Figure 5-3 shows the external factors relevant to CRRE that emerged from this research. These external drivers and barriers, and what they mean for CRRE's work, are discussed in more detail in this section. As oftentimes the drivers depend on or are inhibited by barriers, this section is organised into the different PESTEL categories instead of into drivers and barriers to better compare the dependencies between drivers and barriers within one category.

In contrast to the internal factors, the external factors are predominantly barriers and participants also reported to receive little external support in their activities. While the discussion about internal factors was more positive and interviewees elaborated on all the factors that aid their work, the discussion about external factors was more negatively connotated and interviewees explained all the challenges that they needed to overcome.

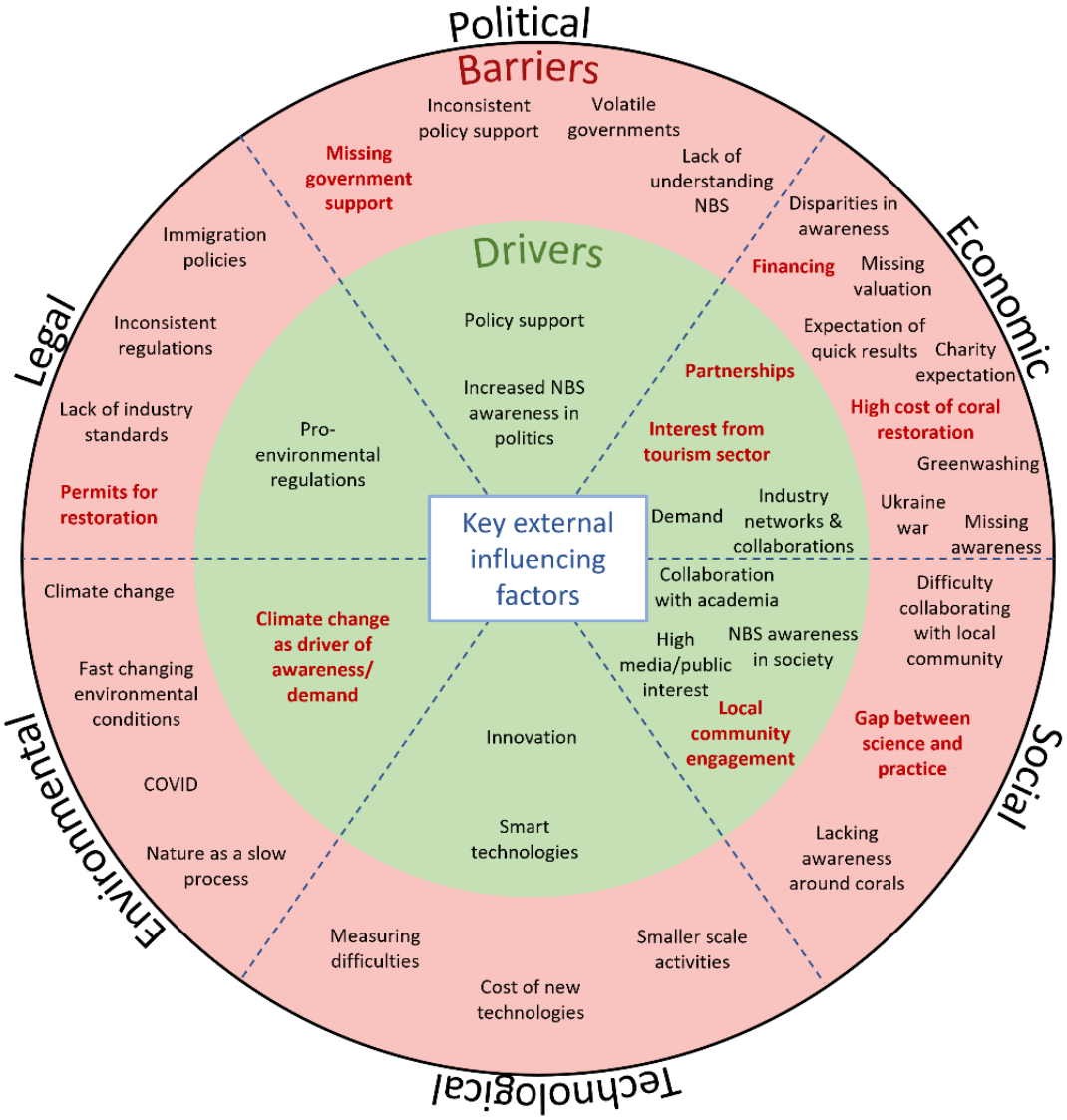


Figure 5-3: Key external influencing factors. The writings in red bold indicate those influencing factors which were identified as especially important by respondents. Source: own elaboration with influences from McQuaid et al. (2021).

Political factors

While policy support was mentioned as a driver by interviewees, it was neither mentioned an important nor a consistent driver. The interviewees mainly referred to international policy support such as through the Global Biodiversity Framework or through the United Nations Decade of Restoration. National policy support was not mentioned specifically. Furthermore, some interviewees pointed out the inconsistency of the policy support. This inconsistency led to difficulty of planning with the support. Moreover, governmental support was said to be mainly lacking or missing completely. This was one of the most important barriers for CRRE as they argued for the difficulties that came with the lacking support. Finally, the governments where CRRE acted were also highly volatile. Quick changes in regime or changes in the focus of a country could lead to additional difficulty for CRRE to plan. This is why most respondents mentioned that they do not rely on policy support or governments. Still, some respondents

pointed out that they did receive policy support, thus the government can be both a driver and a barrier for CRRE.

In addition to support, interviewees also reported that there is an increased awareness about NBS within politics which is helpful to their business. Nonetheless, this awareness does not mean that there is an in-depth understanding. On the contrary, interviewees have reported that while working with the government they experienced difficulties due to the fact that the government was lacking NBS knowledge and understanding. This barrier complicated the work of CRRE who, as outlined in the stakeholder section, depend on governments for their implementation.

Economic factors

Generally, interviewees reported an existing demand from the private sector for a restoration service. Most of the CRRE who attempt to scale up their business also said that the demand is growing each year. Even more specifically, there is a high interest and demand for coral reef restoration from the tourism sector. This has been mentioned as one of the most important drivers, as this interest also translates into the main customer segment of CRRE. The tourism sector has been named the "low-hanging fruit" by most and almost all CRRE directed their initial efforts towards the tourism sector.

While the tourism sector had a high awareness, awareness in other sectors differed. There was a disparity in awareness among sectors and some sectors completely lacked any awareness about the importance of corals. This results in a higher effort for CRRE to find customers as well as to explain to each customer the processes and the needs for the restoration. Finally, this also leads to another barrier, this being the expectation of quick results. Most CRRE reported that their customers did not understand that coral reef restoration takes time, and the results are not short-term but rather long-term. While this is a barrier to their work, most CRRE develop methods and techniques to increase the restoration speed thus overcoming this barrier.

Another important driver was partnerships. As outlined in Section 5.1.2, the needed partnerships for CRRE are extensive. Interviewees pointed out that successfully engaging in those partnerships support their activities and are crucial for their business establishment and success: "We have created contacts and alliances and we realised that one way to grow in our business is to leverage on others, so we don't have to do it all ourselves" (B4). This was also the case for industry networks and collaborations, however it was not mentioned as often or pointed out as important as partnerships in general. In contrast, some even pointed out that there were lacking industry networks.

The most important barrier for all CRRE was financing. In combination with the second most important barrier, this being the high cost of coral restoration, financial means were important but difficult to acquire. Coral restoration was said to be expensive, especially in contrast to terrestrial ecosystem restoration. Nevertheless, while many mentioned funding to be a high barrier, all CRRE who were asked why they chose to be a business instead of an NGO also said that the business strategy would help them or had already helped them in overcoming the funding barrier for the long-term. While being a business therefore helped them, it also led to another barrier: charity expectations. Some customers would approach CRRE like a charity. However, they are not charities, and some interviewees outlined the importance to make it clear to the client that this is a business transaction and not a charity interaction. Additionally, the distinction between charity and business also leads to another problem, which is that many customers currently do not have the internal channels to support CRRE as their internal

processes currently are designed to give out such funds to charities instead: "Yes, it is often difficult in the large companies to get away from the donation track. That is, to actually sell it as a product, because the internal processes are simply complicated […]. We have to talk to many people. And if you then need agreements between the individual departments, that might be another difficulty again" (B7). This barrier is why some CRRE have established a hybrid model instead so that they can leverage customers who are only capable to pay through a donation track. Nonetheless, other CRRE argue that this hybrid solution is problematic as you do not establish an actual business interaction with the CRRE selling the product of a reef structure or the service of the restoration. This business interaction should be clearly established as this will ensure stable funds and activities in the future.

Another barrier is the missing valuation of biodiversity. Whereas biodiversity is important, it is also complex to measure and valuate. In comparison, carbon emissions can be clearly calculated and put into a metric. In contrast, biodiversity does not have a clear and internationally recognised metric. While there are ways to measure biodviersity, the market has not decided on fixed metrics. Thus, the impact of CRRE is difficult to communicate to their clients. "So, for example, measuring and standardizing biodiversity, even with edge-cutting technologies like metagenomics, is applicable now. But the problem is, even if you can come up with a biodiversity ratio, the market has no understanding on that ratio, on that number. And so right now the product is there, but how do you make it digestible by the private sector? And how do you assign a value, whether it is monetary or non-monetary?" (B3).

Finally, a barrier mentioned by a CRRE is the economic impacts of the Ukraine war. This was mainly relevant for those CRRE who only focus on the tourism sector as they report that fewer tourists are traveling due to the economic impacts of the Ukraine war.

Social factors

Local community engagement was also one of the main drivers mentioned during the interviews. Not only did these mean mutual learnings, as the local community had the best understanding of the conditions on site, but it was also outlined as critical to the operations of a CRRE. The local community knows the area and conditions the best. Furthermore, their cooperation is critical for restoration activities, as they are on-site and if they do not agree with the restoration measures taken, implementation will be more complicated. Thus, "making them happy is actually de-risking our operations on one end" (B3). However, some CRRE also mentioned that collaborating with local community is also a barrier, as their goals and expectations are volatile and in some cases their goals might even inhibit their work. Nevertheless, most CRRE did not report to have those difficulties.

Another driver is the collaboration with academia, which on the other hand has the important barrier of a gap between science and practice. Most CRRE either have their founder or at least employees who are still active in academia. Those have reported that their close relationship to academia is an important driver in which they are informed about any scientific advances in the field and can thus adapt their restoration strategy accordingly. CRRE who did not have a person working in academia among their staff, did engage in other collaborations such as consultancy by academics or partnerships. Contrary to this being a driver, most CRRE reported a considerable gap between science and practice as a barrier. Most reported that academia is "in its own world" (B4) and that while they offer many scientific advancements, they do not translate such advancements into practice: "For example, standardizing biodiversity is actually quite achievable now with environmental DNA metagenomics. But translating that well-established science into practice has been quite a huge obstacle as well" (B3).

Finally, the interviewees reported a high media and public interest into NBS and restoration. Additionally, there is also a high awareness about NBS in society. This attention serves as marketing and offers more customers to CRRE. Nevertheless, most CRRE reported about this high awareness and interest being about NBS and biodiversity, but not specifically about corals. Thus, there is a high awareness, but when it comes to corals, most CRRE described that the general public does not have a high awareness and understanding of the importance of corals. Instead, they needed to convey the importance which meant additional work.

Technological factors

While there were some drivers and barriers identified from the technological domain, none of the important factors were from this domain. Both innovation and smart technologies were identified as drivers. Among those innovations which were a driver for CRRE were 3D printing technology, substrate innovations, and other innovations related to coral reef restoration. Additionally, smart technologies were also a driver to a limited extent. Some reported to make use of smart technology, most said that they wanted to include smart technologies in their business model in the future but did not figure out how yet.

Technological barriers included the high cost of new technologies. So even if CRRE identified technologies as key to their strategy, those technologies are oftentimes expensive. Furthermore, those technologies also require expertise which oftentimes is costly and limited. In addition, there is also the technological barrier that coral reef restoration is oftentimes a smaller scale activity with a difficulty to produce homogenous results. The technology used must be adapted to each complex ecosystem they are to be used in, which makes scalability a challenge.

Environmental factors

An important environmental driver is climate change as a driver of awareness and demand. This has been outlined by almost all of the CRRE. Nonetheless, climate change itself also poses a barrier to CRRE. Through climate change, there is increased ocean temperatures and coral bleaching events, which make restoration efforts harder to be successful. Furthermore, climate change also leads to increased weather disasters which affect CRRE, such as through hurricanes that destroy the restoration site or restoration equipment.

These effects of climate change also result in the barrier of fast changing environmental conditions. Because of climate change, the environment is continuously changing, which makes restoration work an everchanging challenge. "What worked a month ago may not work the next month because of the dynamic environment" (B1). Thus, the fast-changing environmental conditions pose additional stress onto CRRE who must adapt. Furthermore, while the environment is fast changing, natural restoration processes are generally slow in comparison to only grey infrastructure, posing another barrier onto CRRE. Some CRRE have tried to overcome this challenge by either making mixed NBS-grey infrastructure solutions or by improving the restoration speed through other approaches.

Finally, the COVID pandemic has also been mentioned as a barrier for CRRE, especially for those active in the tourism sector. Through covid restrictions, most of the income possibility of CRRE was reduced and they struggled. However, while they did mention it in the interviews, for most it is not a barrier anymore, as COVID restrictions have lifted and there is more tourism again.

Legal factors

Legal drivers were only limited. Most interviewees outlined that little pro-environmental regulations were in place to help them. Nonetheless, a few CRRE did outline that they benefitted from pro-environmental regulations in their base country.

However, barriers far outweighed drivers in the legal category. The most important being difficulty in acquiring permits for restoration. Currently, many CRRE struggle with acquiring official permits to conduct the restoration. This is either due to governmental bodies working slowly in granting those permits and thus inhibiting the work, or it is due to the complete lack of capability of governments to grant those permits as no legal structures are in place. The former reason while being a nuisance is not a complete barrier but rather a delay in their processes. The latter, however, does lead to challenges in how to be able to conduct the restoration at all. Here, CRRE have to resort to finding loopholes in the legislation or working with local communities, but it results in them not having a legally defendable permit which can result in future complications. In any case, the lacking ease of acquiring permits puts a strain on the activities of CRRE.

Additionally, there is a general lack of industry standards, such as for biodiversity credits or valuation of biodiversity. There are also inconsistent regulations globally and even within governments, as they either have inconsistent regulations in place or they quickly change regulations that impact the work of CRRE.

Finally, CRRE also struggled with immigration policies. Many of the CRRE interviewed rely on international workers, especially when it comes to the scientific personnel. For that, they expect them to relocate to the base country of their activities. This, however, proves difficult for some, as the process to acquire a visa for workers is either strenuous, or in very few cases impossible, impacting the possibility of CRRE to conduct their work as intended.

6 Discussion

This study provided insights into CRRE's commercialisation strategies, their business model, and the relevant drivers and barriers that influence their work. The following sections reflect on and discuss the main findings presented in Section 5. This includes firstly comparing the findings with other research results and how this thesis has contributed to filling research gaps. Then, general considerations relevant to CRRE arising from this research will be offered. Finally, this section will also discuss the limitations of this research.

6.1 Discussion of results in relation to what is known

In this section, comparisons are presented between other research results and the findings of this research. For this, it will first compare the findings from RQ1 and then the findings from RQ2.

6.1.1 Underlying business models and value capture strategies (RQ1)

As noted in the background research, there is a lack of research on CRRE. More specifically, the term CRRE has been chosen for this thesis, and no research has been conducted explicitly to analyse businesses with coral reef restoration as their core activity. Nevertheless, there has been research into the commercialisation opportunities of coral reef restoration, albeit limited to only two options (Okubo & Onuma, 2015; Rinkevich, 2015). Research on value capture strategies of NBEs engaging in restoration or nature stewardship has been outlined in Section 2.4. Therefore, this discussion will focus on comparing the findings with the already researched value capture strategies.

Underlying business models

While there is no research on the business model of CRRE, SBM research has outlined key aspects of sustainable businesses. In line with other SBM, CRRE focus on the triple bottom line in their business. Furthermore, research conducted by McQuaid et al. (2021), outlines a sub-concept of SBM, which is the NBE. A CRRE qualifies as an NBE because its core activity is coral reef restoration, which is an NBS, and it delivers products and/or services. The findings of this thesis add to the research field of NBEs by providing a business model framework for CRRE (see Table 5-1), which are NBEs in restoration in the specific ecosystem of coral reefs.

The fact that the NBE-BMC used as an analytical framework for this thesis was a combination of the NBS-BMC (Connecting Nature, 2019) and the traditional BMC (Osterwalder & Pigneur, 2010), outlines the importance of balancing profitability with the ecological outcomes. While NBS is difficult to monetise, CRRE attempt to make coral reef restoration a profitable solution. Interviewees mentioned the importance of finding a balance by findings ways in which to generate revenue, but still offer sustainable restoration that has a positive impact on coral reefs. One example of this difficulty was presented by a dive shop owner who pointed out that the diving tours were more profitable than the restoration activities. Thus, they had to balance where to invest time and resources into, which was a constant conflict.

When it comes to the business model framework, the underlying triple bottom line does not only show the companies' sustainability focus, but it is also a means of offering value to customers and stakeholder and thus crucial for the business strategy. For one, CRRE have managed to find new ways to propose value to stakeholders to make it easier for them to commercialise the restoration and to be competitive. Next to the environmental value of restored reefs and the social value of supporting local communities, the findings have outlined several strategies of CRRE to offer diverse value in the triple bottom line. These strategies are

to attract their customers and target their restoration activities to many diverse types of customers at the same time. Looking at the stakeholders, CRRE have adapted their value propositions to their target customers. This is for example the social values of aesthetic of coral reefs and individual contribution to attract tourist divers to do the planting, or the economic values of risk reduction and improved restoration efficiency to appeal to real estate customers. By finding ways to propose diversified values to different customers, CRRE have managed to appeal to a wider customer audience through appealing to their needs. This is in line with the SBM approach defined by Bocken et al. (2014), in which sustainable businesses must include a wide range of stakeholder interests. At the same time, this also offers more possibilities for CRRE to make their restoration activities profitable.

Furthermore, the literature regarding stakeholders of NBS points out that NBS benefit a wide array of stakeholders, however, this leads to a missing willingness-to-pay by single stakeholders as the NBS only benefits them partially. The analysis of relevant stakeholders of CRRE showed that there is a strong overlap between customers, key beneficiaries, and key partners (see Figure 5-1), which supports the fact that engaging with NBS means that there is a wide array of beneficiaries. However, while interviewees pointed out that there were easier and more difficult customers, all argued that there is a demand and a market for coral reef restoration and that looking at key beneficiaries is key to identifying potential customers. All key beneficiaries have shown to be at least key partners, customers, or both, with most of the key beneficiaries also being customers. This contrast in NBEs could stem from the fact that the business model of CRRE includes different value propositions for the different key beneficiaries. Through this, all key beneficiaries have at least one value proposition that is of relevance to them. In addition, the diversity of value propositions that CRRE knowingly instrumentalise for their competitiveness might increase the chances of key beneficiaries not only seeing one benefit they have from the operation, but several benefits. Finally, except for the individual consumer, CRRE matched at least one economic value with each of their customers. This might be highly relevant to achieve the willingness-to-pay for CRRE: offering an economic value which ensures that customers have an economic incentive to pay for the restoration service.

Value capture strategies

Value capture strategies for NBEs outlined in other research included the value capture through the restoration practice itself, through agricultural outputs of the restored area, and through touristic channels, such as lodging in the restoration area and tours (see Table 2-3). Two of these strategies are also key strategies of CRRE: value capture through the restoration practice itself and through touristic channels.

Capturing value through the restoration itself was the key strategy of CRRE. Most have identified customers who are willing to pay for the restoration service. Here, some CRRE also established a subscription model to account for the ongoing costs of governance. Nevertheless, CRRE have shown to engage in many more value capture strategies besides only acquiring funds through the restoration itself. This might also be because many CRRE reported finding customers that were willing to pay for the restoration a complex task. Thus, they needed to develop other strategies and diversify their outputs to ensure ongoing revenue. One of those other strategies was through touristic channels, as it has also been the case for other NBEs. The touristic tours that manifested in form of safaris for NBEs engaging in environmental stewardship, can be found within the strategies of CRRE as well. The configuration options "planting experience" and "touristic tours" are comparable. There, the CRRE generate additional income through offering tourists an experience for which they pay. Furthermore, while no CRRE engaged in lodging, customers of CRRE included real estate, which in many cases were hotels that offered lodging close to the reefs.

In contrast to the value capture through restoration and touristic channels, CRRE did not engage in any extractive activities. Restoration of land-based ecosystems offer the possibility of establishing foraging options or agroforestry systems which are meant to offer revenue possibilities in harmony with the restoration taking place. Coral reefs restoration, however, did not include any extractive activities. There is a market for extractions from coral reefs, such as the pharmaceutical industry who depends on extractive activities from corals (Spurgeon, 2001). However, no CRRE identified extractive industries as customers. This could have several reasons. For one, the high personal motivation of founders of CRRE might lead to their unwillingness to cooperate with any stakeholders who might directly harm the restored coral reefs. Second, coral reefs might be too sensitive thus those extractive activities could harm the restoration progress. Finally, there might be a brand image risk in offering goods extracted from the reef for the CRRE. This could especially hold true, since there is no widely accepted ocean-based concept for sustainable extraction in reefs that compare to concepts such as agroforestry or other sustainable agriculture approaches. While this was not explicitly asked throughout the interview process, many participants did talk about the risk of greenwashing. All CRRE interviewed wanted to ensure good practices that respect nature. Likely, the fact that none engaged in extractive activities as an additional revenue source can be brought back to a combination of all three reasons: the high motivation and thus moral attitude of founders, the sensitivity of corals, and the risk of image loss.

Furthermore, the two value capture strategies outlined specifically for CRRE in the literature, was the planting experience for divers (Okubo & Onuma, 2015) and selling biodiversity offsetting (Rinkevich, 2015). While the tourist diver strategy was a key strategy for some CRRE, it was not relevant for all. It was only relevant for those CRRE whose main strategy was to have a dive shop which engages in restoration. However, there was one CRRE which did offer this without owning a dive shop. In this case, they worked with dive shops who offered this experience and thus they were mainly the mediators in this situation. The fact that the planting experience is not relevant for all CRRE shows that there are different strategic approaches. These being the focus on different private or public sectors customers who are willing to pay for the restoration instead of single customers in form of tourists. Not only does this show that there is a demand in the market for the restoration which exceeds the demand only from the tourism sector, it also shows that the market is moving towards different business strategies for coral reef restoration instead of just a single one. Additionally, biodiversity offsetting also turned out to be part of the value capture strategy of some CRRE, which supports the claim of Rinkevich (2015).

Next to revenue streams, the engagement with NBS offers other ways of capturing value. Connecting Nature (2019) outlined additional value capture strategies for NBEs as their work with NBS might complicate direct revenue flow. This includes the funds gained from donations or government funding, but it also includes cost reductions NBEs can benefit from, such as cost reductions through the involvement of volunteers. CRRE took advantage of those value capture strategies outlined for NBEs in general. This confirms that the alternative value capture strategies outlined in the literature are also relevant to CRRE, and thus that working with NBS enables companies to pursue these value capture strategies.

In addition to those value capture strategies already outlined by other researchers, this thesis also identified new value capture strategies of relevance for the commercialisation of coral reef restoration (outlined in Section 5.1.4). This shows the diverse ways CRRE have identified to capture value. Generally, the importance of diversifying the revenue streams was outlined by interviewers, which is an important business strategy to consider to reduce revenue dependency (Datta et al., 1991). As there was no literature focusing on commercialisation

strategies of CRRE – except for Okubo and Onuma (2015) and Rinkevich (2015) – the compiled commercialisation strategies in this thesis offer new insights into the diverse ways CRRE have identified to make coral reef restoration profitable. Furthermore, this also provides new insights into how NBEs in general can expand their revenue streams through different strategies.

6.1.2 Drivers and barriers for CRRE (RQ2)

While research into internal influencing factors for sustainability-oriented enterprises has been comparably scarce, McQuaid et al. (2021) has done extensive research into external influencing factors. This thesis researched both internal and external drivers and barriers for CRRE and the discussion will focus on a comparison of the internal and external factors already mentioned in prior research to the findings of this thesis as well as particularities of the findings.

Internal influencing factors

When it comes to drivers, the literature review only resulted in two: training of workers and investment into research and development, which was mentioned as especially important for coral reef restoration (Knowlton et al., 2021; Mekuria et al., 2020). Both those drivers outlined in the literature resulted to be important drivers for CRRE, confirming that internal drivers for other NBEs can be translated to CRRE. Especially technical training was mentioned as an important driver for CRRE. This can be brought back to the complexity of NBS. Some interviewees mentioned that their small team did everything themselves and thus technical training of workers was not as important to them as they were knowledgeable in their field. However, those CRRE who outsourced their activities, such as the 3D-printing or the building of their structures, needed their workers or contractors to be knowledgeable and reported that training their workers beforehand was essential for their business activities.

The fact that research and development was portrayed as important underlines the findings from Knowlton et al. (2021), who outlined that corals are highly impacted by climate change and thus finding ways to improve restoration practices is crucial for the preservation of coral reefs. In addition, the importance of research and development could also be brought back to the business principle of staying on top of competition, meaning that the CRRE must improve their restoration in some way as a unique selling proposition to customers.

Considering that research into internal drivers of NBEs was scarce and there was no research done on internal drivers for CRRE, the thesis also expanded the knowledge on relevant drivers from the two found in literature. The findings pointed to more drivers among the structural drivers, those being business strategy, flexibility of structure, and brand image (see Figure 5-2). These three drivers can all be brought back to organisational management and leads to the conclusion whether all typical business drivers and barriers are relevant to CRRE or if there needs to be a different organisational approach for NBEs in comparison to traditional businesses. Future studies could research and compare organisational drivers for NBEs or CRRE with those of traditional businesses to further outline whether an NBE or CRRE needs to greatly differ in their organisational strategy or if the underlying strategy remains the same. This would be part of organisational theory research, which this thesis did not focus on.

In addition to the structural attributes outlined in the findings which had some similarities to previous studies, the cultural attributes resulting from the analysis were not identified in sustainability literature before and thus expand the current knowledge on relevant drivers. Generally, interviewees seemed to put greater emphasis on the importance of cultural

attributes, especially shared values within the organisation, but also the motivation of the founder seemed to be an important driver. This points towards the significance of cultural attributes and offers the conclusion that the nature of NBS, but also the value individuals give to coral reefs particularly, are strengths of CRRE. It also leads to the question whether this is unique to coral reefs through the value it is being given, whether it can translate to all organisations working with NBS, or whether it is not unique to NBS at all.

When it comes to barriers, the findings support the results from previous research. Almost all barriers, both from the structural and from the cultural attributes, were mentioned in previous literature. There was only one barrier which was not mentioned in literature before, which was the lacking diversification strategies. This has been discussed in the previous section about the business model. Thus, the findings regarding internal barriers from this thesis confirm barriers identified in previous literature for NBEs. Subsequently, barriers for NBEs can be generalised as barriers for CRRE. Considering that the barriers were the same while the drivers differed, it could further point towards the fact that the importance of cultural attributes for CRRE can be brought back to the value of coral reefs and that this is unique to CRRE. However, this would need to be further researched by looking into the internal drivers of other NBE sectors and ecosystems to compare.

External influencing factors

Regarding external influencing factors, there were many similarities between what has already been identified in the literature before and the findings of this thesis. This further confirms the external factors outlined for NBEs in the literature. Additionally, it also supports the understanding that external influencing factors of NBEs are similarly valid for CRRE and thus there is the possibility that external influencing factors are mostly the same for all NBEs and there are only a few ecosystem or NBS specific factors. Still, this thesis identified some external influencing factors which have not been mentioned in previous research before. Thus, this section will focus on discussing the differences and why they might be unique to CRRE.

When it comes to new findings for external drivers and barriers, most are due to the specifications of coral reef restoration as an NBS. Considering that previous research for external drivers and barriers for the most part concerned other NBEs and not CRRE specifically, it is not surprising that this thesis has outlined additional drivers and barriers specifically for CRRE. For drivers, it included the high interest of divers, which depends on corals being of high importance to the diving community. Furthermore, there is the demand for coral reef restoration from the private sector as a driver. This demand could stem from a general demand for ecosystem restoration due to the UN decade on restoration or due to a general rise in climate change mitigation funds. It could also result from the fact that the private sector sees climate mitigation measures as risk reduction. Finally, it could also be due to a consumer demand for more sustainable companies which thus invest into coral reef restoration. From the interviews, it seems that most likely two reasons lead to this increased demand: polluting industries who have funds allocated to atone for their damages and the tourism industry being so dependent on coral reefs.

Except for the two drivers, only additional barriers have been identified particularly for CRRE, showing that the unique nature of coral reef restoration leads to more disadvantages than advantages. For one, there is the high cost of coral restoration. As mentioned by interviewees, ocean-based ecosystems bring higher costs with them already due to the fact that one has to have the additional diving equipment and boats. This is also why the cost savings of NBS in comparison to grey infrastructure identified in the literature were not of relevance for CRRE, as coral restoration does not usually bring cost savings according to the interviewees.

Furthermore, corals are highly sensitive to climate change influences, which is why the additional barrier of dynamic environmental conditions apply. While this can be important for other ecosystems as well, it is still an additional barrier identified particularly for CRRE. Next to those barriers, there are also barriers for CRRE due to their global reach. Because many of them are either located in developing countries or work globally with developing countries, barriers arise such as the volatile governments. Immigration policies can also be brought back to their global position, considering that workers for CRRE migrate to the restoration locations. This is in contrast to NBEs who are only active in one country with all their workforce and skills being present. Finally, a driver identified in the literature was not confirmed in this research, which is the availability of funding instruments. Interviewees reported not to have much funding instruments available. This could have for one the reason that coral reefs have less availability in funding than other NBS which lead to different conclusions between this thesis and McQuaid et al. (2021). Furthermore, it could also be due to the fact that McQuaid et al. (2021) conducted their research in Europe and this thesis had interviewees globally with many being from developing countries. Thus, this also leads to the question whether there is a disparity in funding opportunities between developed and developing countries. Finally, literature also pointed out the barrier of NBS benefits being scattered between actors. As discussed before, CRRE did not agree with this statement. Instead, they found a way to instrumentalise the scattered benefits by outlining economic benefits for relevant stakeholders that originate from of coral reef restoration.

In addition to those external influencing factors that were specific to coral reef restoration, this thesis also identified some new factors which do not necessarily have to be specific for coral reef restoration. These factors are an extension to the factors identified for NBEs in previous literature. One of these is the missing standards on how to assign value to biodiversity. While this is inhibiting CRRE, it is not specific to them, but rather a problem across organisations implementing biodiversity actions (Sobkowiak, 2023). The lack of standards makes it difficult for organisations that improve biodiversity to communicate their progress, which has implications for CRRE. Next to this barrier, there is the influencing factor of current crises, these being the COVID19 pandemic and the war in Ukraine. The reason that this had not been mentioned as an influencing factor before is most likely due to the novelty of those events. Finally, another barrier that was not identified before is the difficulty of collaborating with local communities. As this was only mentioned by one interviewee, it is likely that this barrier is dependent on the geographical context. Nevertheless, it also raises the question of how the government could support this by mediating between local community and CRRE.

Generally, the analysis of external barriers has shown that there are factors who can be a driver and a barrier depending on the context. One example of this is how policies can be a driver if they support CRRE in their implementation, or a barrier if they inhibit it. This duality has not been identified for internal factors and thus shows the potential external factors have to positively or negatively affect CRRE. This conclusion is highly relevant for policymakers, as it shows that offering a supportive environment for CRRE can strongly aid them in their process to restore reefs. The majority of the external influencing factors currently being barriers also shows that at present, CRRE face more barriers and have to rely on themselves to overcome them. Thus, there is room to improve external support CRRE are receiving.

6.2 Overall reflections on CRRE

This thesis had a research focus manifested in the two research questions which were discussed in the previous section. However, the analysis of the business model and strategy of CRRE and what internal and external factors are of relevance to them lead to the emergence of other

questions worth discussing. These reflections are presented and discussed in this section and also offer topics for future research.

Why a business and not an NGO for coral reef restoration?

In the analysis of strategies to capture value for coral reef restoration, there is an underlying question of why a business is better than an NGO. The perspectives of the interviewees indicated that only a business could be fully financially self-sustainable and because there is a funding gap when it comes to coral reef restoration, establishing a business offers ways to overcome this gap. On the other hand, there have been difficulties reported resulting from being a business instead of an NGO, such as customers wanting to donate to NGOs instead of actually handling it as a business transaction. Thus, these situations would point towards the fact that being a business might even reduce funding situations. Nonetheless, the general consensus was that being a business allowed the founders to finance the restoration all of them were so motivated to do. Furthermore, the CRRE who were aiming to scale up also mentioned how upscaling coral reef restoration in their opinion can only happen by establishing a profitable business model for it. Finally, the emergence of CRRE in addition to NGOs might show the rising importance of coral reef restoration. By making the restoration profitable, other customers and other funding opportunities might be leveraged that further support coral reef restoration. Also, with the motivation of having to be profitable, CRRE invest into research and development to further improve the restoration process. This has the potential to overcome the challenge within coral reef restoration that they are degrading so quickly that current restoration practices would not suffice to ensure healthy reefs in the future (Knowlton et al., 2021).

Restoration efficiency as the most saturated strategy

As mentioned in the previous paragraph, there is a need to invest into research and development to improve coral restoration. When looking into the value proposition strategies CRRE have developed (see Table 5-1), the most saturated and most applied strategy is restoration efficiency improvement. Why this is the most saturated strategy can be traced back to the fact that coral reefs are declining rapidly and current projections of the future calculate that even in good case scenarios the vast amount of coral reefs will not survive (Bindi et al., 2018; Knowlton et al., 2021). Thus, there is a need of restoration, which will likely increase in the coming years. With the current projections, the restoration efforts that are being done at present do not suffice and current corals are not adapted to future ocean conditions. Subsequently, improved restoration efficiency is likely the most important value proposition of CRRE. This is because simply restoring reefs is not enough anymore with the everchanging environmental stresses on coral reefs. Instead, it is necessary to find ways to accelerate the restoration process through accelerated coral growth or to adapt corals to these changing environments through methods such as assisted evolution (van Oppen et al., 2015). This need could be why most CRRE focus on improved restoration efficiency as a strategy as this will likely be the characteristic driving their competitiveness.

Two main approaches of CRRE: scaling up or keeping it local

Even though the value capture and value proposition strategies differ greatly between CRRE, the findings did point towards one distinction to categorise two types of CRRE. There were those who attempted to scale up their activities and establish a business on a global scale with restoration activities around the globe and then there were those who only restored at their base (the "home" reef strategy or if they restored in different places but in one country) and

did not plan on expanding the business to cover restoration projects on a multinational scale. This also resulted in one main difference when it came to their strategy. The small-scale ones usually followed strategies connected to dive shops (such as offering the planting experience and other dive courses). In contrast, none of the upscaling CRRE engaged directly with diving, did not offer planting experiences for divers except as mediators and not as implementors, and rarely focused on the individual consumer as their customer but rather focused on businesses and organisations.

Seeing that there is this distinction, it opens the question as to why all CRRE that want to scale up chose this approach, as there seems to be a consensus among them that this is the best approach to scale up their activities. For one, it likely has to do with the landscape of the customers. Government as well as private sector usually include customers with a larger budget in comparison to a single consumer. Already by finding one customer such as a business, the CRRE receives enough funds to restore a coral reef of a pre-defined size. Furthermore, most of the CRRE who attempt to scale up also follow the subscription-model strategy. This ensures ongoing and stable funds. In contrast, a consumer does not offer the same amount of stability. Looking, for example, at a diver who comes for a planting experience, there is a chance that this diver will only consume this experience once or maybe a couple of times a year at best. Thus, those CRRE have to ensure ongoing interest into their activities and acquire new customers at a running basis. Both aspects which reduce the stability of the financial flow. Especially seen in some of the comments of those smaller scale CRRE who said that the pandemic had a negative impact on their financial stability, while the same has not been reported as strongly by the larger scale CRRE.

Furthermore, the smaller scale CRRE were also geographically rigid, as they were bound to one location through their dive shop. While there is the chance to open other dive shops in other locations, this includes comparably high initial investments and also means having to recruit new customers at the new site. In contrast, the approach of the upscaling CRRE offers more flexibility. They have a home base out of which they acquire customers, build the structures in one place, and are then flexible in shipping the structures and sending restoration personnel to sites around the globe.

As the emergence of CRRE is comparably novel, it remains to be seen whether the approach taken by the CRRE to scale up actually succeeds in them scaling up their business. However, the fact that they already reported key private sector customers contributing significantly to their revenue, and the fact that the small scale CRRE did not report that, points towards the fact that the approach actually supports in scaling up the business.

Discrepancy between governments being key beneficiaries but not customers

Only a few CRRE reported to have the government as a paying customer. Instead, most reported that they at most received limited financial aid by the government but did not have a governmental body as their customer. This is despite the fact that the government is mentioned as key beneficiary in the literature. Thus, while governments appear to be an ideal customer, the reality shows they are not. Why there is this discrepancy could have several reasons. One reason could be that the public sector prefers to work together with NGOs instead of businesses. Also, governments likely have strict public procurement processes for which CRRE might not fulfil the criteria. In that case, the business status of CRRE might inhibit them in acquiring governmental bodies as customers. Furthermore, there could be a general lack of public funding allocated towards coral reef restoration. Seeing the importance coral reefs have for coastal regions, additional funding would, however, be necessary. Finally, this

could be due to the situation of island and coastal tropical states. Coral reef rich areas are located at coasts in tropical regions (see Figure 1-1). This region mostly consists of developing countries, which tend to have fewer financial resources available. Nevertheless, seeing that governments greatly benefit from coral reef restoration in their vicinity, it seems reasonable that they could in future also be more important customers. Also, some CRRE have reported to have governments as their customers, thus, governments that are affected could work on allocating money towards coral reef restoration.

Divergence between view of market actors and of CRRE

This thesis interviewed market actors who are not CRRE but who are active within the market of coral reef restoration to have a better understanding of the position of CRRE. One aspect that particularly stood out was the divergence in opinions regarding external influencing factors. Both CRRE and market actors were shown lists of potential external factors and were asked to point out those factors which they believed were relevant to their business – or in the case of market actors, what they believed was relevant to CRRE. Market actors tended to answer considerably more positive than CRRE. When asked about external factors, they discussed about all the drivers for CRRE, how much funding possibilities are available, how much governments aid CRRE in their work, and how policymakers supported the cause. On the contrary, CRRE primarily reported barriers and the little support that was available. This divergence in perception was substantial.

Reasons for this divergence could be manifold. One reason could be that CRRE are not aware of the funding and support opportunities that are available. Thus, there is a lacking communication or outreach for available support mechanisms, and this would need to be improved. Furthermore, it could also be due to the support mechanisms being directed at NGOs engaging in coral reef restoration instead of CRRE, thus not actually being available to them. Another reason could be that while there is much support available, it is not instrumentalised to actually be easily accessible. This could be, for example, due to bureaucratic procedures that make it difficult for CRRE. Finally, there is also the possibility that market actors have a misperception of the extend of support available and that CRRE who are active in the field see that there is none. In any case, CRRE do not benefit from support in the extend that market actors expect. Why this is the case cannot be answered through this research. Nevertheless, it shows that additional support for CRRE is needed whether it already is available and needs to be made more accessible or whether there is none available yet.

Is commercial restoration equally good for the environment?

This thesis did not research the environmental implications the practices of CRRE have. It focused on analysing the business strategy as well as the influencing factors. Nevertheless, coming from a sustainability perspective, it opens the question as to whether the restoration practices of CRRE are as environmentally friendly as those of NGOs or other organisations engaging in coral reef restoration.

For one, the practices identified have been fairly similar between NGOs and the smaller scale CRRE, thus, there should not be significant differences in their impact on the environment. There is, however, a greater difference in practices between NGOs and CRRE who attempt to scale up their activities. While this thesis has no possibility of answering the question about their environmental impact, it is, however, important to point out that all founders and workers of CRRE had a strong internal motivation to help coral reefs and the environment. Furthermore, all CRRE, especially the ones scaling up, worked closely with scientific evidence

and academic representatives (if they were not themselves already an active academic). Thus, the practices were closely monitored about their impact on nature. Finally, when asked about the difficulty of balancing profitability with ecological outcomes, all interviewees reported that they focused on the ecological outcomes first and that in most cases it was profitability that came short. This could also be brought back to the strong internal motivation all of the founders had. Therefore, while this is no answer to the actual ecological impacts, it does underline the care with which CRRE engaged in improving restoration practices so as to not damage nature.

6.3 Limitations

While this research has shed light onto the business strategies of CRRE and what relevant internal and external factors influence their work, the research was also accompanied by certain limitations. The limitations included those due to CRRE being a novel concept, limitations due to the chosen method, and limitations due to lack of funding. This section will outline those limitations.

Considering that CRRE is a novel concept and most of the business only just started emerging, limitations apply. For one, there is little prior research to CRRE specifically, which is why this thesis had to draw on NBE research instead. However, even research on NBE is comparably novel and not much has been researched. Furthermore, the fact that most CRRE just established themselves and considering that it is a new market with currently few entrants, there were only limited possible respondents. While the limited amount was evened out through a high response rate of CRRE, there still only are few business cases from which to draw information. Finally, the fact that CRRE are just starting to be established also leads to there not having enough time passed for CRRE to set up a fixed strategy, system, and long-term viability. As they are currently rather in the beginning of their strategic journey, the information they gave also reflects this situation. It would be interesting to repeat this research once time has passed or expand on this research with a more in-depth focus on CRRE once they are fully financially self-sustainable and established.

Furthermore, due to the limited amount of CRRE, the geographical scope has been chosen to be global, thus not restricting the scope. While this was consciously chosen for this research, as otherwise there would not have been enough participants to understand this phenomenon, it does compromise the generalisability and comparability of the results. Seeing that each country has their own legislation for biodiversity and coral reefs, as well as different market dynamics, especially the external factors are difficult to generalise that have been mentioned by the interviewees. Nevertheless, the widened scope was necessary to receive enough information. To reduce limitations arising from that, the researcher tried to focus on those influencing factors which have been outlined by several CRRE to not include factors that might only be relevant in only one specific country. Still, if the market expands in the future, additional research with a geographical limitation would possibly improve the generalisability of the results when it comes to external factors.

Additionally, limitations arise due to the choice of methods (Creswell & Creswell, 2017). For one, there are limitations to the data collection method of interviews. Here, the results are highly dependent on the participants. First, the interviewees are speaking out of their own experience, which is filtered through their personal view and is not objective. This can for example be seen in the divergence between responses from CRRE and market actors, where the two groups explained different views. Thus, this is up for interpretation by the researcher. Second, the presence of the researcher in the interviews may lead to a bias in the responses of interviewees. Even though this the researcher tried to present the questions with no bias

towards an outcome, participant may still have an opinion on what the researcher might want to hear and could thus answer accordingly. This can be done knowingly if the participants aim to influence the results, or unknowingly as hidden bias.

Next to limitations of the data collection method, the data analysis process is also limited in certain regards. Qualitative research is often done to explore a phenomenon for which little research exists so far. As it is highly dependent on the interpretation of the researcher, there is a possibility that the researcher introduces a bias as they expect to find something, or they prefer one outcome over another. Reflexivity offers a counter measure, meaning that the researcher reflects over their background and how it might shape their findings. The background of the author being in business, there is a slight bias towards CRRE being successful in their endeavour. This background was also the reason, why the researched did not choose to compare CRRE to other market actors such as NGOs but did instead only look at the strategy of CRRE to not influence the results. Furthermore, next to the potential bias, qualitative research also makes generalisability difficult. As the goal of this research was to explore the phenomenon of CRRE and not to generalise back onto NBEs, it is a fitting method. Nevertheless, future research is needed if the results of this thesis are to be used to generalise into other NBE sectors or ecosystems.

Finally, this thesis was lacking funding which is why no travels to investigate the CRRE in more detail were possible. As a consequence, all engagement with CRRE was online and thus a limited understanding of the phenomenon is expected in comparison to being on-site and engaging for a period of time with the subjects of research.

7 Conclusion

With there being a dire need for coral reef restoration, this thesis focused on understanding and analysing businesses focused on coral reef restoration as their core activity – named Coral Reef Restoration Enterprise. The aim was to understand how coral reef restoration could be made profitable and thus overcome the funding challenge which currently is the main challenge in the coral reef restoration sector, to contribute to currently lacking knowledge about CRRE, and, through it, to show how to support them in their quest to restore the ocean reefs. This research was achieved through qualitative methods: by interviewing seven CRRE and three otherwise relevant market actors and by conducting desktop research, both with a subsequent content analysis. Through these methods, this thesis provided empirical as well as practical conclusions for the following research questions:

RQ1a: What are the underlying business models of coral reef restoration enterprises?

RQ1b: What are different strategies for coral reef restoration enterprises to capture value?

RQ2: What are drivers and barriers for coral reef restoration enterprises?

For RQ1, this thesis proposed a business model framework for CRRE (Table 5-1). The results showed that CRRE developed diverse business strategies including diverse strategies to capture value and thus make their business profitable. This underlines that there is a market and customers who are willing to pay for the restoration service. It also shows that it is possible to make coral reef restoration profitable and balance ecological outcomes with economic ones.

CRRE achieved to outline and implement many different value propositions from all three domains at the same time: economic, environmental, and social. This helped them to better attract diverse customers who all benefit from different value propositions. Also, the values they delivered to customers were manifold but oftentimes at least one economic value was part of the value delivery, which might point towards there only being a willingness to pay if a (indirect) monetary advantage was included for the customer. An exception for this were individual consumers as customers, as they did not benefit from any of the economic values the CRRE proposed.

Regarding relevant stakeholders for CRRE, this thesis found that they oftentimes overlap between being key partners, key beneficiaries, and customers. Especially key beneficiaries have shown to be of high relevance to CRRE's strategy, as they either also were customers or key partners or both. The stakeholders who overlap in all three categories were the tourism industry, governments, insurance companies, and other coral restoration projects. Arguably, those overlapping stakeholders can also be summarised as the key stakeholders for CRRE. Additionally, main customers for CRRE have shown to be either consumers from a touristic perspective or business customers from different industries, the main ones being polluting industries.

In terms of capturing value, the findings outlined different revenue streams of relevance to CRRE. The different revenue streams show that revenue for CRRE is not only generated through the restoration service itself, but rather CRRE diversified their activities to support the restoration service through additional means of capturing value. Next to classic revenue streams, two additional options have been identified to capture value as a CRRE: other monetary contributions such as donations or government funding, and cost reductions through the use of volunteers for the work. Both of those are due to CRRE engaging in NBS and thus these two options for value capture are of relevance to NBEs in general.

The findings for RQ2 involved the analysis of internal and external drivers and barriers that either support or inhibit a CRRE in their work. While the findings regarding internal factors resulted in a majority of drivers that outline how a CRRE can positively influence themselves, external influences found mainly barriers showing how the current external environment for CRRE rather inhibits their work. For internal factors, mainly internal skills and shared values are of relevance next to the difficulty of balancing profitability with ecological outcomes. For external factors, the most important factors were from the economic domain, both for drivers and barriers. In addition, local community engagement, missing government support, climate change as a driver for awareness, and the difficulty of obtaining permits for restoration were found to be of high relevance.

7.1 Practical implications and recommendations

This thesis contributed to the knowledge about coral reef restoration as a profitable business opportunity and drivers and barriers of such businesses. As a result, there are practical recommendations for practitioners in the field of coral restoration as well as policymakers

Practitioners in the field of coral restoration

As this thesis analysed the current strategies employed by CRRE, it offers relevant insights into how a CRRE can propose and capture value. With the business model framework for CRRE, this thesis offers a framework for CRRE to evaluate their current business model and possibly add new strategies to their portfolio. In addition to using the framework as a strategy support, this thesis also found internal and external drivers and barriers for CRRE. The findings on internal factors offer an overview for CRRE on what they can influence to improve their internal affairs, while the external factors can be used to prepare CRRE for the hardships they are to expect.

Specific implications and recommendations are:

- Include a diversified portfolio of value propositions
- Offer an economic benefit next to environmental and social benefits to all costumers other than the individual consumer
- Improve restoration efficiency as it is a key value proposition
- Identify key beneficiaries and involve them either as customers, as key partners, or both
- Diversify value capture strategies
- Focus on improving internal drivers, as those can be influenced, and invest in skilled employees, especially those with business strategy and marketing skills
- Employ an atmosphere of shared values within the business

Finally, the findings are not just relevant for CRRE. Also, NGOs or other market actors can use the findings to understand and work with CRRE, to understand their own organisation's external environment, and to improve the external factors for CRRE.

Policymakers

Next to practitioners in the field of coral reef restoration, with its research about external drivers and barriers, this thesis also concludes relevant recommendations for policymakers. With the global pressure on coral reefs and the current estimates on the devastating effects

climate change will have on them, policy action is needed to support institutions restoring reefs.

Specific implications and recommendations are:

- Improve financial support for CRRE in their start-up period
- Policy can be a barrier or a driver; improve policy support for CRRE such as through biodiversity quotas for polluters
- Establish standards on biodiversity valuation
- Improve procedures for permits

7.2 Recommendations for future research

This thesis has examined the business strategy and relevant drivers and barriers of CRRE on a global scale. However, as research on CRRE is limited and the concept of a CRRE is new, there are ample opportunities for future research.

First, there is the possibility to expand on this research. As it has faced limitations due to its global scope, future research is needed with a focus on one geographical area. This is to make the results more specific and contextualised. Currently, the results are comparably broad as each CRRE most likely faces different external situations and hardships. Analysing CRRE in one geographic region would allow for results that are more specific to the regional context. Furthermore, there can be several studies focused on different regions which could then compare the differences between diverse regions/countries. In addition to expanding the research by limiting the scope, the research can also be expanded by being repeated at a later stage. Currently, the majority of CRRE have only been founded within the last four years. By repeating the study at a later stage, the CRRE have had a chance to establish more sustainably, to solidify their strategies, and to conclude long-term learnings.

Second, this research compared the drivers and barriers of NBEs with CRRE in the discussion section. However, the research into internal drivers and barriers for NBEs have been limited and not specifically researched. Thus, there is the possibility of researching the internal drivers and barriers for NBEs. Furthermore, the research into influencing factors could also be duplicated into an NBE working in a different ecosystem, such as land-based ecosystems, and then comparisons could be drawn between relevant differences in influencing factors between land-based and ocean-based ecosystems.

Third, as outlined in the discussion, there is a chance of the organisational drivers of CRRE being similar if not the same as those of traditional businesses. Thus, it would be interesting to research and compare if the organisational drivers differ at all. This could offer relevant insights into the management approaches of CRRE and NBEs in general, showing if there are specific aspects that founders of NBEs have to take into consideration in comparison to traditional businesses.

Fourth, the concept of a CRRE builds on them being profitable in comparison to an NGO. This thesis focused on researching CRRE. However, the research leads to the question as to how CRRE are more or less successful or impactful than an NGO in restoring reefs and in what aspects they differ. Comparative research could be conducted in which the differences between NGOs and CRRE could be researched with the results including advantages and disadvantages of the respective types.

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Appendix

Appendix A: List of webpages used for the document review

Type	Name	Link
Homepage	Reefy	https://reefy.nl/
Homepage	Rrreefs	https://www.rrreefs.com/
Homepage	Coral Vita	https://www.coralvita.co/
Homepage	Reef Support	https://travel.reef.support/
Homepage	Blue Corner	https://www.bluecornerdive.com/marine-conservation
Homepage	Mars Coral Reef Restoration	https://buildingcoral.com/
Homepage	Reefscapers	https://reefscapers.com/
Homepage	Archireef	https://archireef.co/
Homepage	Procoreef	https://www.procoreef.com/
Homepage	Intellireefs	https://www.intellireefs.com/
Secondary interview data	Impact Economist interview	https://impact.economist.com/ocean/ocean-health/building-a-business-in-coral-reef-restoration
Secondary interview data	Greenbiz interview	https://www.greenbiz.com/article/how-startup-coral-vita-making-business-case-restoring-reefs
Secondary interview data	Techcrunch interview	https://techcrunch.com/2021/01/05/coral-vita-cultivates-2m-seed-to-take-its-reef-restoration-mission-global/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAAgwjfxCR5Y3BzBEeCYuWW0cQ5YaD70EKq9TQz0tn36tdQv8g_kbAXHHr1VAJkCS6CX2_a-DK8SfQLW7HinJ8ZrUAp9blbo9VKfOqS-dnmhKnT6e9Mv7HkkzwsH9l_bHYSIZ4Kz5K3OT49TkNEKkIS4zZOJ3WR_FPIGBQzCp_d-5
Secondary interview data	Musingsmag interview	https://www.musingsmag.com/coral-vita-gives-new-life-to-damaged-reefs/
Newspaper articles	Washington Post article	https://www.washingtonpost.com/climate-solutions/interactive/2022/coral-farms-restoration-bahamas-coral-vita/
Newspaper articles	Utah Business article	https://www.utahbusiness.com/this-woman-wants-to-save-our-coral-reefs/
Newspaper articles	The Guardian article	https://www.theguardian.com/environment/2020/aug/26/hong-kongs-terracotta-tile-army-marches-to-the-rescue-for-coral