# D3.3 Tailored finance arrangements, market analysis, bankable business plans and financial scalability plans for coastal restoration at the Pilots and beyond

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## REST-COAST

## Large Scale RESToration of COASTal Ecosystems through Rivers to Sea Connectivity


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# Reasons for 1 month delay

The D3.3 deliverable builds on the delayed D3.1 and D3.2. Originally, other work packages were expected to provide data for quantifying ESS values, monetising them, and offering insights into relevant costs and benefits for funding opportunities. However, the pilots often lacked the necessary data. Consequently, the team had to develop new methods to overcome this data challenge, which required additional time. Quantifying and monetising ESS is generally difficult, especially with coastal ecosystems, which are more dynamic than terrestrial ones. Additionally, within various pilots, the coordinators were not specifically engaged in or lacked expertise in financial aspects. As a result, their involvement in this deliverable received less priority, time, and contributions. The project partners did not prioritise business models and plans, focusing instead on implementing other work packages and intending to develop the business models themselves when the timing and opportunity were more suitable. Furthermore, the deliverable was highly ambitious as described in the DoA. Consequently, this deliverable demanded extraordinary effort, and the team made a great effort to limit the delay to one month.

# Preface

The REST-COAST Project (Large scale RESToration of COASTal ecosystems through rivers to sea connectivity) is an EU Horizon 2020 research project (Grant agreement No. 101037097) whose overall goal is to address with effective and innovative approaches and tools the key challenges faced by coastal ecosystem restoration across Europe. The approach chosen for this project will deliver a highly interdisciplinary contribution, with the demonstration of improved practices and techniques for hands-on ecosystem restoration across several pilot sites, supported by the co-design of innovative governance and financial arrangements, as well as an effective strategy for the dissemination of results.

WP3 focuses on the design /application of innovative financial arrangements and bankable business plans that support restoration upscaling in the pilots. KPI-C verification: Innovative financial arrangements/business models (≥5) tailored to the different sectors involved in restoration (execution to monitoring) and to Pilot specific features, with a self-check viability test.

# Summary

The REST-COAST project under the EU Horizon 2020 initiative aims to restore coastal ecosystems through Nature-based Solutions (NbS) across Europe. Deliverable 3.3 focuses on co-developing business models and developing business plan propositions (also called financial arrangements) and financial scalability plans for coastal restoration. The overarching goal is to expand the funding base for NbS, and address the multifaceted challenges and opportunities inherent in financing and implementing these initiatives.

The investigation reveals that most NbS projects predominantly rely on public funding due to the inherently public nature of the benefits derived. This funding, however, often fails to capture the full value of the ecosystem services provided, pointing to a pressing need for improved financial mechanisms such as taxes or tariffs. Quantifying these ecosystem services presents a significant challenge, yet it is essential for monetizing the value of NbS and attracting additional funding. Carbon credits, while promising, currently provide only a fraction of the necessary funding, complicated further by difficulties in accurately quantifying carbon sequestration, especially in marine ecosystems. Private funding sources are available but involve significant challenges, including capacity constraints and the necessity for intensive relationship management. Top-down frameworks for carbon credits can provide an opportunity to reduce capacity and knowledge constraints on a local level, and with this increase private funding. Eco-tourism stands out as a notable potential revenue source, though it frequently necessitates legislative changes to enable the effective implementation of user fees or taxes.

This report recommends establishing dedicated institutions or frameworks to manage NbS projects consistently and ensure adequate funding. It also calls for policy adjustments to incentivize private sector investments in ecosystem restoration, leveraging detailed data on costs and benefits to stimulate financial engagement. Furthermore, it highlights the need for innovative business models that can operate within existing economic and regulatory frameworks yet push for systemic changes to bolster sustainability and resilience. Engaging a broad range of stakeholders, including the private sector, is advised to distribute financial risk and increase resource pooling.

Deliverable 3.3 underscores the complexities of financing and implementing NbS at scale but also illustrates substantial opportunities for innovation in business models and financing mechanisms. Strategic adjustments and an integrated approach are essential for NbS to significantly contribute to coastal restoration, providing vast economic, social, and environmental benefits.

# List of Figures

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# List of Abbreviations

Here is an exhaustive list of abbreviations from the REST-COAST Deliverable 3.3 document:

| | |
|---|---|
| AFI | Artificial Floating Islands |
| BAS | Bulgarian Academy of Sciences |
| BMC | Business Model Canvas |
| BOD | Biochemical Oxygen Demand |
| CBA | Cost-Benefit Analysis |
| CICES | Common International Classification of ESS |
| CMCC | Euro-Mediterranean Center on Climate Change |
| CORILA | Consortium for Coordination of Research Activities concerning the Venice Lagoon System |
| CSR | Corporate Social Responsibility |
| DFI | Development Finance Institutions |
| DoA | Description of the Action |
| EGD | European Green Deal |
| EIB | European Investment Bank |
| ESS | ESS |
| EU | European Union |
| IOC | Intergovernmental Oceanographic Commission |
| KPI | Key Performance Indicator |
| NbS | Nature-based Solutions |
| NGO | Non-Governmental Organisation |
| NOC | National Oceanographic Commission |
| NFM | Natural Flood Management |
| OPEX | Operational Expenses |
| PES | Payment for ESS |
| UNCCD | United Nations Convention to Combat Desertification |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WEF | World Economic Forum |
| WP | Work Package |

*Wadden Sea tidal marsh mud flat  Photo credit: creativenature.nl*

# Part I

## Setting the Scene

# Chapter 1. Introduction

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## 1.1. Background

**Coastal regions are amongst the most productive and biodiverse environments, yet they are experiencing progressive degradation and escalating risks (e.g.** (Amores et al., 2020; Reguero et al., 2020). European coastal ecosystems and biodiversity are under pressure from multiple threats, including a warmer climate, coastal erosion, rising sea levels, pressures from fishing and aquaculture activities, pollution and eutrophication from land- and sea-based activities such as agriculture, coastal urban development and mining activities, and the spread of invasive species (EEA, 2024). Such pressures result in the declining extent and functioning of ecosystems and as such a reduction in the goods and services derived from nature that benefit our economy and society (Abelson et al., 2020; E. Barbier, 2012; Duarte et al., 2013). To address this situation, the European Union is putting in place strategies, policies and mechanisms, for example, the European Green Deal (EGD), the EU Biodiversity Strategy for 2030, the EU Adaptation Strategy, and Habitat Directives. At the international level, several global agreements and policy processes support these strategies, i.e. United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement, the Sendai Framework, the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD). Governments, financial institutions, and businesses have therefore committed/pledged themselves to increased restoration efforts through several high-level global commitments, such as the Bonn Challenge.

**The implementation of nature-based solutions across all landscapes including coastal areas is considered key in achieving the objectives of major EU policy priorities**. The Commission defines nature-based solutions as: "*Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*." (EC, 2024). Nature-based Solutions (NbS) present a credible means to address key societal issues, e.g. managing water scarcity, poverty alleviation, biodiversity loss, climate change, and disaster risk reduction. There is also an increasing awareness of the economic benefits of nature-based solutions and their ecosystem services (ESS) (EC, 2021). For every dollar spent on ecosystem restoration, between US$7 and US$110 in economic benefit is estimated to be derived from ESS gained (The World Bank, 2022). The World Economic Forum (WEF) estimates that nature-positive policies could attract more than US$10 trillion in new annual business value and create 395 million jobs by 2030 (WEF, 2020).

**However, despite a high-level recognition of the benefits of NbS and coastal restoration, their implementation for restoration and reversing of coastal degradation is challenging.** Several barriers have been identified. One barrier is a lack of public and political understanding of the value of coastal ecosystems to society and hence lack of support (Hobbs & Harris, 2001). There is also a lack of expertise to implement locally appropriate solutions in a systemic portfolio. In addition, governance fragmentation hinders the integration of different dimensions in management and incorporates long-term objectives (Sánchez-Arcilla et al., 2022; Sørdahl, 2023). There is also scarce funding from predominantly public sources, which will not be sufficient to meet the amounts required to address the scale of the challenge (Sánchez-Arcilla et al., 2022). There are often no markets where restoration actions can be sold. Instead, ecosystem restoration is largely seen as a cost; rather than a worthwhile investment that brings multiple benefits and can help achieve policy goals and contribute to risk reduction and cost avoidance (R. S. de Groot et al., 2013). Moreover, substantial financial flows, including subsidies, continue to drive environmental degradation (Deutz et al., 2020) and are an order of magnitude greater than flows beneficial to the environment (Koplow & Steenblik, 2022; OECD, 2020). Thus, sustainable financing of restoration requires overcoming these barriers, putting in place long-term and diversified sources of revenue and reducing unsustainable financial flows.

**Overcoming these barriers requires re-shaping of the economic governance to enable and drive systemic changes to make the finance work for economic development, social impacts and environmental sustainability and resilience (UNDP 2024).** In REST-COAST this is framed as a transformation of governance, which includes the financial aspects. To realise transformations, knowledge is needed on how to upscale and mainstream NbS into the relevant societal development. However, while several investors and private sector actors are acknowledging NbS as an opportunity, projects are typically small in scale. A study by the European Investment Bank reviewed 1364 projects where 72% of them covered less than 1 km$^2$ and 81% had investment costs of less than €10 million (44% reported costs below €1 million) (European Investment Bank, 2023). Also, a recent report from the European Environment Agency (2021) elaborates on the limited experience of NbS beyond local (pilot) contexts.

**Upscaling NbS is a challenge with many dimensions where more knowledge and standardisation are needed to support upscaling.** There are several finance mechanisms available, and being developed, including tourism-related taxes and fees, debt-for-nature swaps, conservation trust funds, and payments for environmental services to name a few. However, these mechanisms have not become standards or efficiently deployed to enable larger-scale and cross-sectoral integrated interventions (The World Bank, 2022). This can have many different reasons, for example, there is a widespread lack of information on the costs to different actors involved in deploying nature-based solutions (both initial set-up and ongoing management), making it tricky for decision makers to establish to what extent funding will fully cover activities. The lack of standardized methods for the assessment and monitoring of NbS and the lack of clarity on the distribution of costs and benefits of NbS across actors are named as major challenges for replicating and applying NbS at a wider scale (Nature-based Solutions Knowledge Hub, 2024). It is also not very known how different funding opportunities interact, including how to demonstrate additionality and how multiple environmental benefits from a single project can be ‘stacked’ or ‘bundled’ to recognise the breadth of goods generated. More knowledge relating to financing for scaling up and mainstreaming NbS is therefore needed to make a significant change on the ground.

**With this background, this deliverable is developed with the overall purpose of increasing the knowledge of how economic governance can be reshaped to broaden the funding base for NbS and identify the related challenges and opportunities.** This report is building on previous deliverables in REST-COAST, specifically those in the WP3. These focused on gathering theory and evidence for developing funding and finance arrangements for coastal restoration (Favero et al., 2022), and a review of innovative public funding, finance and provisioning arrangements relevant to the pilots (Favero & Hinkel, 2023a). Building on the existing progress and knowledge, this report will aim to identify some overall direction of actions needed for upscaling restoration. Such insights will contribute to the understanding of how to build a more sustainable finance architecture with public and private sector partners. Despite past and existing efforts, there are several gaps in knowledge on how to move forward in enabling more financing, and what drives and enables the transformation, including a lack of concrete case studies.

**The objective of this report is therefore twofold:**

- To present a rich array of cases (9) illustrating different dimensions of NbS funding and financing for upscaling and implementation. Each case has aimed to co-develop business models for NbS, market analysis for NbS, business plans and better understand the financial and governance challenges to scale up these solutions. Often, the economic governance system was not in place to enable a real business plan targeting investors, but instead, these can be regarded as more theoretical business plans.
- With the help of insights from the cases and associated literature, it addresses the gap in the literature about the challenges and opportunities of NbS financing and implementation. The report uses insights from the available business and upscaling plans from the cases to provide concrete insights.

**Target audience**

This report can not only benefit practitioners, researchers, policy makers and decision makers working to upscale restoration in these sites, and in similar areas, but also a broader audience working to address and broaden financing e.g. sustainable development, adaptation and integrated water resources management in general. It also is addressed to financiers in the green economy, to provide insights on where they can contribute and capitalize on existing opportunities and overcoming barriers.

Through the development of business plans, the deliverable contributes to presenting and sharing relevant NbS data (costs, benefits, funding, financing and implementation arrangements) for building the needed evidence base for NbS. Such data can be useful for those audiences working with strategies and planning around NbS, to help inform on these aspects.

## 1.2. Structure and scope of the report

The report has three parts, starting with an introduction, and an explanation of the methods and frameworks. Part 2 is a synthesis and discussion of the main results. Part 3 presents the collection of 9 case studies including NbS business models and business plans.

| | |
|---|---|
| Part 1: Introduction, methods and frameworks | Setting the report in its context, outlining the steps, methods and frameworks deployed to obtain the results. |
| Part 2: Synthesis and discussion | Presents the overarching insights derived from across all the pilot cases and discusses the identified barriers and opportunities. |
| Part 3: 9 Pilot case studies | 9 pilots case studies as concrete examples from around Europe in the REST-COAST project; presents business model propositions and plans for additional activities at the landscape scale. |

**Geographical scope**

We illustrate the development of the business models and plans in nine pilot sites, that represent the main EU regional seas (Baltic, Black, North, Atlantic and Mediterranean) as part of the H2020 REST-COAST project, and Innovation Action. See Table 1 for an overview of the pilot sites, their restoration actions and their size. See the map below for the location of cases.


**Figure 1 Map containing the locations of the REST-COAST pilots**

**Scope of intervention**

**Table 1 An overview of the pressures/rationales and the NbS interventions in the REST-COAST pilots.**

| Pilot site | Pressure/rationale for restoration | NbS Intervention |
|---|---|---|
| Arcachon Bay | Seagrass decline of original seagrass beds, from socio-economic development and climate changes. | 1 ha of (Active) Seagrass bed restoration with specific technique with the outlook to the whole of Arcachon Bay. |
| Ebro Delta | Anthropogenic pressures and climate change. | 350 ha of Wetland/Lagoon restoration. |
| | Eroding coastlines due to upstream dam construction (reducing sediment input to the beach). | Beach nourishment & dune restoration. |
| Eems-Dollard | Reclaimed salt marshes (now polders/agri lands) subsiding, peat oxidation, flooding/waterlogging. | Raising agricultural lands with sediment from the estuary. |
| | Silt concentration in the estuary is too high, and removal will benefit marine biodiversity. | Clay ripening from excess sediment (suitable for dike constructions). |
| | Hard dikes have reduced the conditions for biodiversity because transition zones are lacking and have increased turbidity in the estuary. | Creating a multifunctional zone in between two parallel dikes. |
| Foros Bay | Rapid socio-economic development (a port, oil refinery) and urbanization including pollution and eutrophication. | 17 ha of (Active) Seagrass bed restoration. |
| Nahal Dahlia | Water scarcity, over-exploitation and salinisation of groundwater, decreasing water quality and biodiversity in the reserve. Low fish and crop yield, damage from flooding. | Planned NbS: Dam relocation, dam removal and replacing with a weir, rewilding fishponds, flood water reservoir, habitat improvement. |
| Rhone Delta | Abandoned salt mines created hyper saline environments and dike reduced sediment transport. Pollution and water abstraction from upstream agricultural areas. | Restoration of coastal lagoons and vegetation (Re-naturalization of former industrial zone, and connectivity). |
| Sicily Lagoon | Intensive agriculture (water withdrawal) and touristic activities. Fragmented habitats, pollution, invasive species. Illegal hunting. | Wetland restoration. Fight invasive species and reduce coastal erosion. Dune stabilization. Improve connectivity between sea and lagoons. |
| Venice Lagoon | Erosional processes, deepening of the lagoon, general sediment loss, erosion of mudflats, and salt marshes, silting-up of tidal channels. | Salt marsh restoration. |
| Vistula Lagoon | Geo-political rationale, NbS was a co-benefit of digging a channel to the Lagoon to the Baltic Sea. | 190 ha Artificial (bird) island. |

# Chapter 2. Frameworks, tools and methods

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This chapter gives an overview of the frameworks and tools (provided in boxes) and methods applied in the case studies found in part 3 in this report. First, we describe the phases of the business model development, and thereafter more in depth the method for these three phases. The tools and methods provided should not be seen as a blueprint as there are several different approaches in developing business models and plans.

## 2.1. Developing an introduction to the pilot

Before the analysis of the business model, a short introduction to the pilot was developed in order to show the current setting of the restoration area and activity. This step included a brief description of:

- Location, geography, natural and ecological context
- Main actors and governance context
- A short mention of the restoration activities
- The context of climate change within the area and restoration activities
- Including a map to illustrate the locality of the pilot

## 2.2. Defining the scopes of analysis for business model development

Using the NbS business model framework, data was collected to understand the business model of "The starting point" and "Extension 1" and "Extension 2" meaning upscaling to landscape level (step 4). See Figure 2.

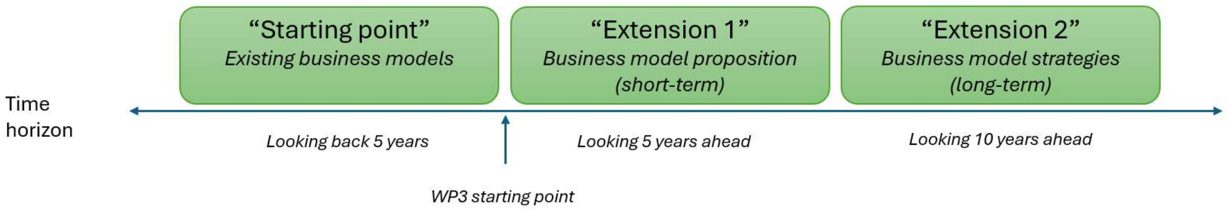

**Figure 2 Three-phased structure to define the scopes of analysis used in the cases**

The pilot studies were described and analysed according to three steps:

**“The starting point”: Existing business models** – This refers to our point of departure, or in other words, what has been done in the respective cases so far, during the past (more or less) five years. The geographical scale varies depending on pilot size.

**“Extension 1”: Business model proposition and business plans** – Given the starting point, extension 1 outlines what are the next steps to be taken regarding ecosystem restoration activities in the cases between now and 5 years from now. For the interventions that are being planned, and given the results and experiences from past projects, we co-developed business model propositions for the cases.

We call these propositions for two reasons. Firstly, the business models are supportive, meant as inspiration, and are non-binding. Decision-making regarding the preferred funding, financing and implementation strategy lies beyond our (WP3) span of control. Secondly, although parts of the proposed business models are supported by evidence and financial calculations, not all data that is required for a fully bankable and implementable plan is currently available.

**“Extension 2”: Financial scalability plan** – When looking further ahead, until about 10 years from now, and at a larger physical scale, what activities and interventions are envisioned? (what is envisioned in the longer term, up to ten years from now).

2.3. Step 1: Identify the business models of a selection of NbS that are currently in place (the “starting point”).

The current activities of the REST-COAST project (pilot scale) were studied to provide a baseline and starting point. This information can provide valuable for co-developing additional business models in step 2 and make use of challenges and opportunities learned within the initial project. Furthermore, the information can be used to compare and evaluate the difference in the financial scalability plan (step 3). The business model will be further described in the next step.

Funding, financing, and implementation arrangements for the REST-COAST pilots were identified in collaboration with REST-COAST project partners and stakeholders. This tapped into the previous work in the WP 3 developing the NbS business model framework and the inventory of innovative financial instruments developed in Favero et al. (2022) and Favero & Hinkel (2023), respectively.

**To describe the NbS business models that are currently in place, the following information was collected:**

- The current **restoration activities** (biophysical aspects) and their **incentives** within the pilot scope
- **Key stakeholders** relevant to the restoration intervention.
    - Characterizing stakeholders (grouping according to public and private nature and their level basin, regional, local, supra national) – identifying the initiator
    - Analysing stakeholder needs and different perceptions of value propositions.
    - Define roles such as Initiator (could be different from the initiator of the current version BM), Beneficiary, Funder/Grantor, and Financier.
- **Identifying Ecosystem Services & economic good typology** using the CICES framework**. See Box 1.**

**ESS investigated**

Within REST-COAST there is special attention for five distinct ESS (ESS). Biodiversity is not included on the ESS list but is considered separately. The five ESS were selected due to their potential to deliver tangible Green Deal benefits, through systemic interventions in design (continuum river/delta/estuary-coast), impact and practice. They also provide support to everyday life with quantified short/long-term benefits for European coastal populations, demonstrating Green Deal advantages to many citizens from all sectors.

- **Food (Fish) Provisioning**. Contribution of habitats as spawning / nursery area. Coastal restoration can result in stronger fish populations by restoring spawning and nursery habitats. A coupling can be made between restored biotopes and their spawning- or nursery function (for instance the role of shallow coastal waters, lagoons or seagrass meadows).
- **Climate Change Regulation**. Contribution of habitats to carbon sequestration. Coastal restoration can capture carbon from the atmosphere and store it underground in coastal wetlands. Carbon sequestration is expressed in kg equivalent $CO_2$/ha/year. This metric is a commonly used quantification of the amount of stored carbon and can be coupled to different types of restored biotopes, specifically the saltmarsh subtypes as well as seagrass meadows.
- **Water Quality Purification.** Contribution of habitats to nitrogen and phosphorus removal rate. Coastal restoration can purify surface waters by enlarging their capacity to remove nitrogen and phosphorus from the water column. This can be achieved by increasing residence time and/or by restoring coastal vegetation. This will increase burial (P and N) or denitrification (N). A common metric is the removal rate in g P/N per $m^2$ per year. This can be coupled to restored biotopes (i.e. lagoons, marshes, seagrass), in combination with other parameters (river flow).
- **Reduction of coastal erosion risk.** Contribution of habitats to erosion resistance. Coastal restoration can increase the resistance against the erosive forces of currents and waves by restoring habitats that disseminate wave energy and/or provide more firm, erosion-resistant soils. For example, salt marshes offer a firm natural resistance against erosion and seagrasses can disseminate waves before they enter the coastline. Metrics are the shoreline migration rate for various habitats and the wave dissemination capacity for various habitats.
- **Reduction of coastal flooding risk.** Contribution of habitats to protection against flooding. Coastal restoration can restore habitats that form a natural barrier against high flood levels during storms, such as coastal dunes and seagrass. A metric is the elevation of natural habitats relative to sea level, and wave amplitude reduction.

Within WP3, several other ESSs, such as recreation, and cultural values were identified. Therefore, the analysis in this deliverable describes additional ESS if relevant for the specific pilot case.

**Box 1: The CICES framework – the used classification system for ESS**

The ESS were analysed in several pilots using the Common International Classification of ESS (CICES) version 5.1 which has been based on a large variety of scientific publications including coastal ecosystems (Haines-Young & Potschin, 2018). This framework was developed as a standardized system for identifying, organizing, and describing these ESS to facilitate better understanding, management, and valuation of natural resources.

The CICES framework has strong overlap with other frameworks such as the Millennium Ecosystem Assessment, TEEB and IPBES Classifications. However, CICES does not categorize supporting-ESS. Since they are considered integral components of the foundational frameworks, processes, and functions defining an ecosystem they are considered within the scope of the project.

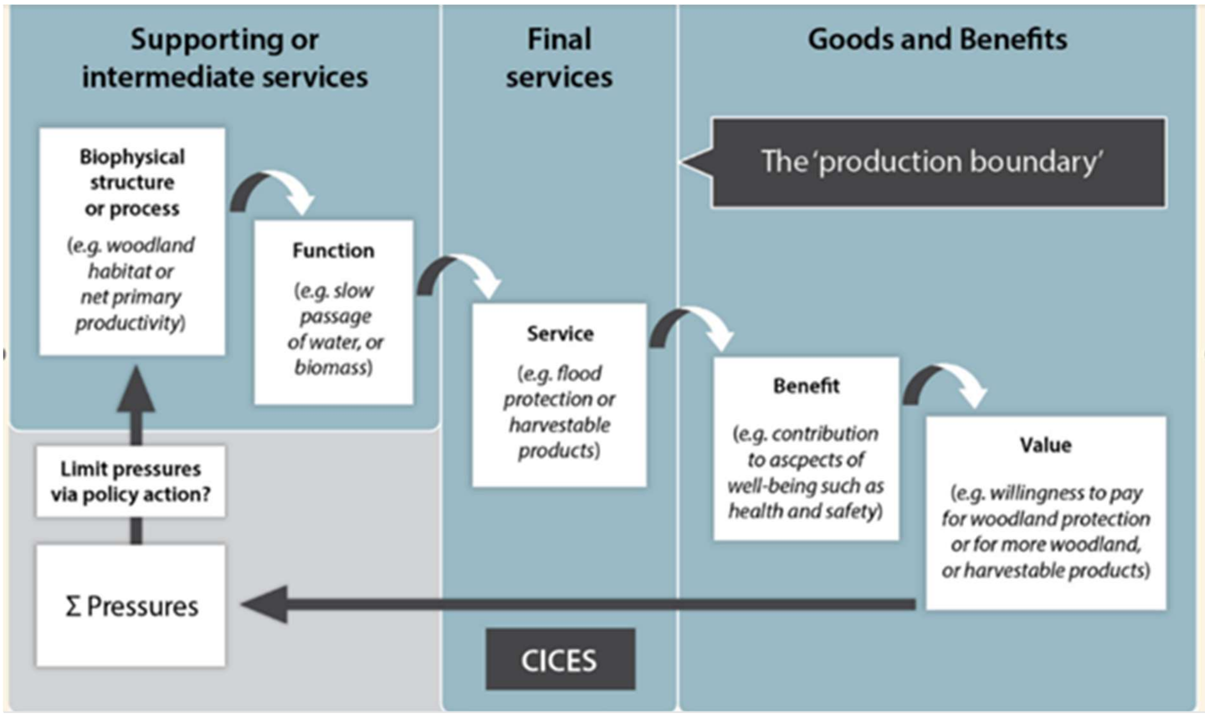


**Figure 3 Overview of interaction ESS value and pressures and CICES**

Based on economic theory on the classification of goods (Ostrom, 1990) four categories of goods can be individuated: private goods, public goods, toll goods and common pool resources. The ESS provided by the restoration activities are categorized by this classification since they can provide valuable insights for the business model or plan. See Box 2 for the Framework for ESS classification.

Box 2: Framework for ESS classification

The framework for classification of ESS characterise these as economic goods based on their excludability (the ability to prevent non-payers from benefiting) and subtractability (whether one person's consumption reduces availability for others), as already outlined by Ostrom and Ostrom (1977). These dimensions define four fundamental types of goods: public goods, common pool resources (CPRs), club goods, and private goods (Figure 2.3). The characteristics of economic goods affect the way that these can be sold efficiently through market institutions. Public goods, like reduction of coastal flooding risk, are non-excludable and non-rival, making them difficult to sell and typically funded through public resources. CPRs are subtractable but non-excludable, leading to overuse and depletion without careful management. On the other hand, private goods and club goods, which allow for excludability, are more easily managed through market transactions or membership fees. Provisioning ESS such as fish tend to fall within these categories.

**Figure 4 Characterization and definition of economic goods (Hess & Ostrom, 2003)**

| | **EXCLUSION IS FEASIBLE** | **EXCLUSION IS DIFFICULT** |
|---|---|---|
| **COMPETITION**<br>Rival/Finite<br>Subtractability is high | **Private goods**<br>Finite goods produced for profit | **Common goods**<br>Finite natural or human produced good with free access or<br>**Common pool resource**<br>Subtractable natural or human made resource with free access, which as a result, are likely to be overused, or a good that cannot easily be fenced e.g. water, fish, pasture, irrigation systems, animal populations. |
| **COMPETITION**<br>Non-rival/Infinite<br>Subtractability is low | **Club goods**<br>Infinite goods, which can be excluded from consumption, for example a beach, where a hotel can exclude everyone but the hotel guests from using it. | **Public goods**<br>Goods from which all members of a group benefit if any one member receives the benefit, e.g. clean air, national defence, lighthouse, beautification projects, police protection. |

### 2.3.1. The NbS business model

We call these propositions for two reasons. Firstly, the business models are supportive, meant as inspiration, and are non-binding. Decision-making regarding the preferred funding, financing and implementation strategy lies beyond our (WP3) span of control. Secondly, although parts of the proposed business models are supported by evidence and financial calculations, not all data that is required for a fully bankable and implementable plan is currently available.

**To describe the NbS business model further the following information was collected, examples of various sources of funding, financing and implementation arrangements:**

- **Sources for funding** (payment) which provide the necessary capital for NbS through **granting** by either a governmental or private party. The payment is expected to provide (non-monetarized) rewards that improve natural, social or other factors by for example ESS.
- **Sources for funding (payment) for restoration activities through "value capture".** This structure captures the benefits of the restoration activity through for example taxes of tariffs that can provide revenue streams that flow back into the restoration activity.
- **The financing instruments used for restoration activities** which raise capital for NbS with the structure to re-distribute generated revenue from the restoration effort back to investors (e.g. loans, green bonds, environmental impact bonds etc.).
- **The procurement / implementation arrangements**. A procurement arrangement describes the contractual arrangements between responsible stakeholders in which the NbS project is carried out (e.g. subcontracts, in house delivery etc.). The procurement arrangement often covers certain part(s) of the restoration activity (construction). This while an implementation arrangement can encompass the entire life cycle of the NbS, including for example land acquisition and a longer-term strategy.

Additional information regarding these categories can be found in Favero and others (Favero et al., 2022).

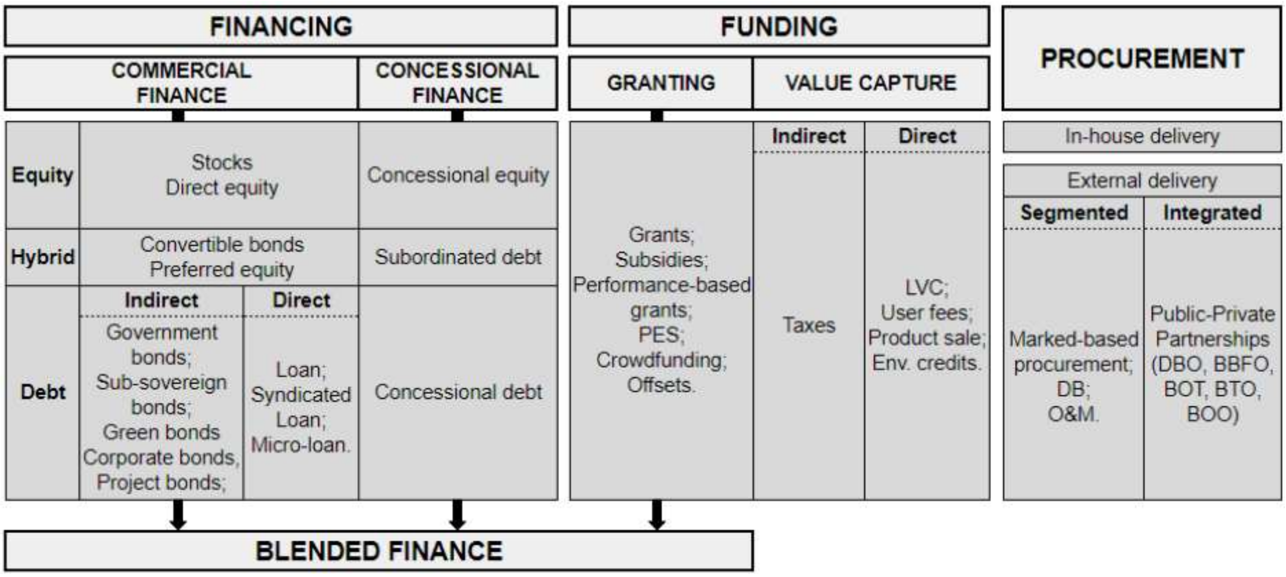


**Figure 5 Overview of NbS contractual arrangements (Favero et al., 2022).**

**Table 4.2 - Overview of main innovative financial instruments identified**

| | NBS Transaction affected: | (Collected evidence) Implemented in: | |
|---|---|---|---|
| **Green Bonds** | Financing | Europe, Africa, North America | Ecosystem restoration, coastal adaptation |
| **Environmental Impact Bonds** | Financing | North America, Africa | Stormwater management, ecosystem restoration |
| **Project Bundlings** | Financing<br>Granting | South-east Asia, Africa, Latin America | Ecosystem conservation and restoration, coastal adaptation |
| **Smart contracts** | Financing<br>Granting<br>Value capture<br>Procurement | South America, Europe, Africa, South-east Asia | Reforestation, Ecosystem conservation |
| **Blockchain tokens** | Financing<br>Value capture | Africa, Oceania, Latin America, Europe, South-east Asia | Reforestation, sustainable agriculture, ecosystem restoration |
| **Public Private Partnerships** | Financing<br>Procurement | Europe, Oceania, North America | Beach nourishment, green corridors |
| **Carbon credits** | Value capture | South-east Asia, North America, Latin America, Africa | Mangrove, seagrass and wetland restoration, reforestation |
| **Eco-labels** | Value capture | South-east Asia, Latin America, Africa | Sustainable fisheries, mangrove restoration, ecosystem restoration |
| **Ecotourism user fees** | Value capture | Latin America, Oceania | Marine and coastal ecosystem conservation |
| **Betterment levies** | Value capture | North America, Europe | Beach nourishment, coastal adaptation |

**Figure 6 Overview of main innovative financial instruments (Favero & Hinkel, 2023a).**

- Within the starting point for the pilots, critical funding and financing challenges and opportunities are identified. Categories for financial barriers are previously identified in Favero & Hinkel (2023).

**Table 2** Categories for financial barriers identified in Favero & Hinkel (2023).

| Financial barriers | Description |
|---|---|
| High-performance risks | The financial and non-financial performance risks of coastal NbS projects are rather high, with a negative impact on the overall risk-return profile. |

| | |
|---|---|
| Low measurability of impacts | Intangible services such as biodiversity and cultural values, and social and environmental outcomes are difficult to measure. |
| Site-specificity of NbS assets | NbS assets are site-specific, which makes related investments difficult to redeploy to other uses or convert into cash without losing significant value. |
| Long lead time | The transaction property of long-time scale results in a long lead time in NbS investments. |
| Insufficient project size | Transaction costs are high relative to project size and project revenues and hence worsen the risk-return profile of smaller-sized projects, due to constrained budgets and the lack of economies of scale. |
| Jointness | Multifunctionality, i.e. the joint production of multiple ESS, requires coordination efforts, with complex legal and administrative environments. |
| Low revenues | Inability to charge beneficiaries for the services they receive, and the high incentives to free rides. |

### 2.4. Step 2: Develop the potential business models of a selection of NbS for the coming 5 years

Additional restoration as compared to the starting point (i.e. extension 1) would require additional funding and therefore can benefit from **new business models**. The previous steps described were therefore repeated for the extension to scope and provide promising ideas to develop into business plans.

The **business plans** provided greater detail about how the selected models will operate, including specific strategies for delivering the identified value propositions. Because the steps taken in developing business models and business plans largely overlap and have been described above, only the **business plan methodology** will be outlined here. Important to note is that the business plans carried out in this study can be considered as more theoretical business plans and therefore the term “business plans proposition” will be used. This is because none of the pilot cases were ready to develop business plans at the time of the project writing for various reasons which will be discussed in part 3.

Several approaches can be used to develop business plans, including the Business Model Canvas and the NAIAD approach. Both approaches were used to capture the information in this report. Because these methods largely overlap, the methodology will describe the business model canvas.

**Box 3: The Business Model Canvas**

The Business Model Canvas is a strategic tool designed to help organizations visualize, design, and refine their business models. Traditional Business Model Canvas (BMC) was developed by (Osterwalder & Pigneur, 2010). The tool has been further adapted to NbS-specific business models by (McQuaid et al., 2021), to address the unique challenges and opportunities associated with value propositions founded on ESS.

In order to allow businesses to clearly identify strengths, potential challenges and areas of innovation related to a specific business model, the business model canvas maps out key elements of a business model in a simple, visual format.

| | | | |
|---|---|---|---|
| **Value proposition** | Problems addressed | Benefits produced<br>-Environmental, economic, social, cultural benefits | |
| **Value creation** | Key partners | Regulation and Governance | |
| | Key resources | Customer segments | Stakeholders |
| | Key activities | Customer relations and channels | Beneficiaries |
| **Value capture** | Costs | Revenue streams | Financing and funding |
| **Transversal categories** | Impact indicators | | Risks |

Figure 7 The key components of a Business Model Canvas (BMC).

**The following steps were taken to create business plans for the pilot cases:**

**<u>Stakeholder analysis</u>**

First, a stakeholder analysis is developed in order to identify key stakeholders for the restoration activities. This can be supported through a visual stakeholder map (power/interest matrix) or by describing key actors and their interest in the NbS. This also builds on the analysis done previously (if relevant).

Afterwards, the **<u>NbS-Business Model Canvas (see Figure 7)</u>** is used to structure**,** visualize, design, and refine business models. The NbS-Business Model Canvas considers the following dimensions:

**<u>The value proposition</u>** considers the environmental, social and economic value proposition. The environmental dimension describes how the NbS **address** and **solve** relevant **problems**. Therefore, it describes the motivation behind the initiation of the NbS, for example, eutrophication or coastal erosion and flooding. With this, it describes the **benefits** and **ESS** produced by the NbS per dimension.

Examples of value propositions:

- Dunes can dampen wave energy which provides flood risk reduction, providing benefits for local inhabitants by protecting assets and industry.
- Seagrass restoration can provide a nursery for fisheries, benefiting fishermen.
- Sediment stabilization due to restoration activity, reduces the need for dredging for local ports, decreasing costs and navigation challenges for ports and public authorities.

- **Key partners** are identified which are required to deliver the resources and activities of the NbS. This can include citizens/businesses/governments/other stakeholders that could potentially provide payment directly or indirectly. This process will be supported by referenced literature, stakeholder interviews or quantitative modelling from the pilot site.
- **Regulation and governance** describe relevant regulation and governance framework in which the NbS takes place (e.g. Natura 2000, level of governance).

**Value creation and delivery**

- **Key Resources**: include the most important assets and skills required to make an NbS provide the value proposition. This includes the identification and characterisation of potential implementers and key resources to realise the NbS. When relevant, innovative financial arrangements from Favero & Hinkel (2023) should be discussed and considered for implementation.
- **Customer segments**: categorize potential customers for the NbS (tourism, local businesses etc.)
- **Stakeholders**: are identified and categorized according to legal status (public, private, NGO)
- **Key Activities:** indicates what actions are necessary to deliver an environmental, economic or social value proposition. Key activities can also consider monitoring and maintenance of the restoration. The mission and objectives of the restoration initiator define the overall mission of the initiator or organization committed to extending NbS, in the pilot area. This includes restoration objectives and the main problem to be solved.
- **Customer relations and channels**: identify how an NbS initiator communicates with and reaches its beneficiary segments to deliver a value proposition. For an NbS scientist, this can be a conference or a scientific paper.
- **Beneficiaries**: describe actors or sectors who directly or indirectly benefit from the NbS.

**Value capture** describes how the strategy for implementing restoration intervention can allow to earn revenues from the provision of ESS and/or from economic activities to beneficiaries and customers. This includes identifying and characterizing potential grantors (i.e., those granting or donating money for the implementation of an NbS) and beneficiaries (i.e. those directly consuming the ESS) via taxes, sales, tariffs, etc.

- **Cost Structure:** describes the necessary costs for constructing, maintaining and delivering the NbS.
- **Revenue Streams**: The cash an Initiator generates from each beneficiary, e.g. Eco-tourism, Carbon credits, Payment for ESS (PES) schemes. Estimating the monetary value for the NbS was done by references to literature (R. de Groot et al., 2012). There was no time available in this project to carry out a full analysis using the relevant accepted methods
- **Financing & funding** instruments that support the NbS. When relevant, Innovative financial arrangements from Favero & Hinkel (2023) should be considered for implementation.

**Transversal categories**

- **Impact indictors** that are relevant to measure the progress of the NbS and can inform key stakeholders.
- **Risks** factors that can threaten successful implementation of the restoration activities.
- **Barriers & enablers** for the successful implementation of the NbS.

**Additional categories**

After describing dimension from the NbS-business model canvas, additional categories are considered within the pilot cases in order to create a comprehensive NbS business model or plan:

- **A market analysis** is carried out to scope the potential market for the ESS, including an identification of key beneficiaries (those directly enjoying the ESS) or those willing to provide grants or financing to the NbS. This is based upon insights from the initiator, stakeholders and is supported by both scientific and grey literature review. This also should include local and regional trends for different markets (e.g. increasing tourism), national and regional trends (increasing regulation) increasing environmental pressures (e.g. real estate development) or important socio-economic industries that could provide a potential market for the ESS (e.g. oil refinery, ports). Increasing pressures from climate change (sea level rise, storms), disaster risk (e.g. risks from beach erosion) maturity of carbon sequestration markets, etc.
- **Economic and financial projections** such as costs and revenue streams, potential cash flows, break-even points and financial gaps
- **Risk and contingency plan** defining risks and mitigation strategies for achieving the NbS upscaling restoration objectives, e.g. delays and bureaucracy/high transaction costs.
- **Critical funding and financing challenges**, illustrating the financial and funding challenges identified for the implementation of the proposed NbS “extension 1” and related business model.

## 2.5. Step 3: Develop potential business models using NbS at landscape scale for the coming 5 -10 years.

A larger-scale and longer-term perspective is adopted here. The objective of this task is to provide a perspective on how additional funding and finance can be acquired that may allow the implementation of restoration plans at landscape scale and thus move beyond the (single) project-based funding and financing. This includes an assessment of funding, revenue streams and financing needs at landscape scale for the next 5 to 10 years.

**What does landscape scale (upscaling) mean to the pilot?**

This study investigated how the pilot researchers viewed upscaling, and not from any pre-determined definition of landscape scale. Based on the previous knowledge and definitions, the information collected from the pilots to assess the landscape scale to the pilot was the following*:*

- The geographical boundaries (e.g. aided by a map) illustrating the complete area relevant for upscaling
- Main activities for upscaling
- The time scale for upscaling

**Box 4: Landscape scale**

There is no single accepted definition of the landscape scale. The term is used to refer to a large spatial scale in which natural and human relevant processes and factors take place (including a range of ecosystem processes uses and policy objectives). The European Landscape Convention (Council of Europe, 2000) introduced a definition of a landscape as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and human factors*." A landscape scale is therefore a manageable unit of scale which is substantially larger than an individual plot of land or water, and normally smaller than a river basin.

**Key questions for investigating upscaling:**

**Question 1: What are the barriers for upscaling (finance / governance context) preventing upscaling?**

Upscaling can be described as the need for pilots to become an integral part of a societal program at landscape/country level. Here there are transformative needed, which can be a challenging process, because what is a success to a pilot is not necessarily a success for mainstreaming or upscaling the pilot at a landscape level. This is sometimes referred to as a pilot paradox, see Fig 8 in the box below.

**Question 2: What are the enablers - institutional and financial arrangements for overcoming key barriers needed at the landscape level for upscaling?**

Based on the data collected from the cases, avenues for overcoming the barriers were identified, for example, the need for ESS quantification, governance, changing funding structures or finance arrangements for upscaling. Furthermore, the requirement of restructuring existing policy from the current condition is described. For example, a barrier such as policy fragmentation could be overcome by horizontal institutional coordination. This step also investigated the potential higher-level policies and other enabling instruments for overcoming barriers (e.g. policy integration mechanisms).

In terms of investments, pilots can be implemented with smaller investments by a single financier, but for upscaling more structural means are needed, for example in financing by a more prominent investor, or by a dedicated funding strategy such as a tax or pooling of financing. Financing restoration at scale often requires a coalition of investors and donors that support a consortium of actors implementing a suite of actions on the ground (The World Bank, 2022).

**Box 5: Pilot paradox**

If the governing conditions in the pilot are very different from those required in the mainstreaming, they need to change. See **Error! Reference source not found.**. For example, a pilot is small scale and has clear boundaries with free space to experiment. It often involves enthusiastic forerunners and is driven by a certain kind of entrepreneurial or creative leadership. For a pilot to scale up, it needs to become aligned with the existing governance system, i.e. being more representative and generalizable, embedded in the organization, involving more stakeholders, a more structured approach, and more persistent leadership. That a pilot and an upscaling of the pilot have different measures of success has been called the pilot paradox (Vreugdenhil & Slinger, 2023). To upscale, the pilot needs to replace what actually has helped the pilot to succeed (i.e. conditions for internal success) to transform into fitting in with the upscaling conditions (here: conditions for external success) (van Buuren et al., 2018).

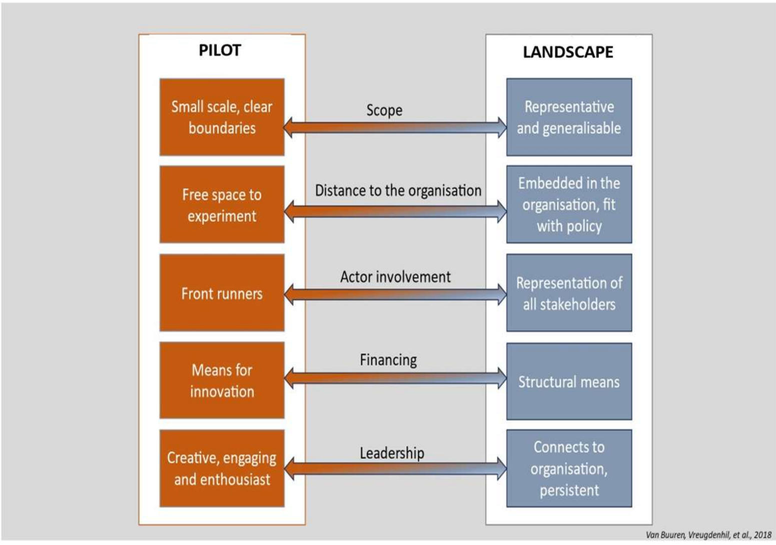


**Figure 8 What are successful conditions in the pilot phase is not necessarily successful conditions at landscape scale.**

## 2.6. Data collection and analysis methods

This study adopted various methods for data sampling, collection and analysis. The basis lies in the exchange with the pilot studies: as such, the researchers both collected and captured knowledge from the pilots and supported partners in the pilots (also known as 'action research', in line with the hexagon model of activities (Mayer et al., 2013). The level of engagement varied across pilots, as pilots were in different implementation phases, e.g. testing, project design or preparation for implementation.

The data was collected using interviews (individual or focus group discussions) and literature reviews, including previous publications within the REST-COAST project. In addition, observation, document analysis and validation were methods applied.

**Semi-structured interviews:** Interviews were guided by a written list of questions and topics, which could be covered in a particular order, or which could be adapted to follow the natural flow of respondents' answers (Kvale & Brinkmann, 2015). This flexible format made it possible to explore people's views and descriptions and produced richer data (ibid). For all pilots, key informants were known from the existing project coordinators and related partnerships. They could therefore be selected for specific purposes (purposeful sampling) and if need be other key persons were identified and selected with the help of other key informants (snowball sampling) (Patton, 2015).

A group interview is sometimes also referred to as a **focus group discussion**, which usually consists of six to ten subjects led by a moderator (Chrzanowska, 2002). Unlike interviews, participants can hear each other's responses and make additional comments (Patton, 2015). Group discussions took place in the context of various workshops and meetings.

**Observation:** To fully understand the complexities of a situation, observation captures the unfolding of events, critical interactions, and their context, and includes interacting with the actors involved (ibid). Observations mainly took place during workshops, meetings and involved communications between practitioners, researchers, policymakers, and other actors.

**Document analysis**: Document analysis (e.g. papers and reports available online, interview transcripts) is a systematic procedure for reviewing or evaluating documents. It entails finding, selecting, appraising (making sense of), and synthesizing data, in such a way that empirical knowledge is produced, and understanding is developed (Bowen, 2009). Document analysis was applied at all stages of this study. The term document includes interview transcripts.

**Validation:** The work aimed to achieve validity, reliability and trustworthiness, rigor and quality (Lincoln & Guba, 1985). Validation was achieved by sharing the milestone and chapters for review with pilot partners. All cases were validated in July 2024.

## 2.7. Teamwork and engagement timetable for co-creation

**Task coordination and approach**

*Early start:* The task planned from M22 to M44, started already at M19, April 2023 to duly consider the need to tailor the work to the context of the nine project pilots through a co-development process, synchronising the work with other ongoing tasks in WP3 (T3.2), WP4 and WP5.

*Coordination:* The task team had an initial kick-off meeting. After that, due to the complexity of T3.3, the different responsibilities assigned to different partners, the need for coherent and homogeneous outputs, and coordinating the interaction with the pilots, a series of WP3 coordination meetings were established on a bi-weekly basis. During the most intense periods, this was once a week.

*Dividing the work:* The initial approach was to divide the work between partners so that DELTARES would be responsible for T3.3.1 and T3.3.3 and PERNICE for T3.3.2 but in mid-January 2024 the team decided to divide the responsibility of the work in the pilots between Deltares on the one hand (6 pilots) and PERNICE, on the other, (3 pilots - Venice Lagoon, Sicily Lagoon, Nahal Dalia). The co-creation is described separately for these two work streams:

**List of specific key meetings and pilot-specific engagements organised by date by DELTARES and partners for Rhone Delta, Eems Dollard, Ebro Delta, and Arcachon Bay:**

*Design of co-creation:* The process for co-developing D3.3 involved a core team of partners in each pilot, supported by a pilot coordinator and a broader group of stakeholders in each pilot. The meetings were sometimes face-to-face, sometimes online and undertaken in the form of collaborative workshops aiming for co-creation. See Annex 3 for an example from Ebro Delta. While the specific number of meetings varied depending on the specific pilot, in principle there were three main types of interactions:

- Inception meeting/kick-off task.
- Interview/focus group discussion/workshop for T3.3.1-T3.3.2 (financial arrangements and business plans).

- Interview/focus group discussion/workshop for T3.3.3 (upscaling).

In addition, several ad hoc meetings and email exchanges were also carried out to:

- Follow up to fill in missing data/information (online).
- Foster cross-pilot learning (online).
- Facilitate exchanges and sharing at the General Assembly meetings (face to face).

**List of specific meetings:**

- **19-21 July 2023** – On-site visit to Ebro Delta pilot, Spain - engaging DELTARES, ALBIREM, UPC, EURECAT, PERNICE and several stakeholders; also engaging a master student who conducted a systems analysis for the pilot (DELTARES). The thesis is available here: https://resolver.tudelft.nl/uuid:42da8645-7bce-4e01-b2bb-ea2e1f9d8313
- **1 Dec 2023** - Eems Dollard meeting in Groningen with Pilot coordinator and several stakeholders together with WP4 and DELTARES.
- **12 Dec 2023** - Workshop, collaboration day for the Financing Working group for the Eems Dollard case in Groningen. Representatives from WaterLANDS also present with DELTARES.
- **13 Dec 2023** - Rhone Delta, France - engaging TDV, DELTARES, ALBIREM, PERNICE and several stakeholders.
- **26 January 2024** - One day on-site meeting with Eems Dollard pilot to harvest data and discuss upscaling and financial indicators, in collaboration with other work packages, with DELTARES)
- **30 January 2024** - Interview with Vistula Lagoon coordinator and stakeholders on ideas for NbS business model proposition with DELTARES.
- **6 March 2024** - Workshop/collaboration day for the Financing Working group for the Eems Dollard case at Deltares.
- **20 March 2024** - Interview with Arcachon pilot coordinators and stakeholders on NbS business model proposition with DELTARES.
- **21 March 2024** - Interview with Foros Bay pilot coordinators and stakeholders on ideas for NbS business model proposition with DELTARES.
- **2 April 2024** - Interview with UPC for further detailing sand nourishments/dune restorations in the Ebro Delta with DELTARES.
- **10 June 2024** - Interview with Rhone Delta and stakeholders with DELTARES.
- **11 June 2024** - Interview with Arcachon Bay coordinator and stakeholders with DELTARES.
- **14 June 2024** - Interview with Vistula (follow-up) coordinator with DELTARES.
- **21 June 2024** - Interview with Arcachon Bay coordinator and stakeholders with DELTARES.
- **September 2024** - Interview with Rhone Delta stakeholder/ WaterLANDS participant on the private sector funding strategy with DELTARES.
- **11 Sept 2024** - Interview Foros Bay coordinator and stakeholders on ideas for NbS business model proposition with DELTARES.
- **4 October 2024** - Workshop with Ebro Delta partners about last information gaps and upscaling strategies/missed opportunities with DELTARES.

**Co-design process for Nahal Dalia, Venice Lagoon and Sicily:**

- **3-6 July 2023** - Nahal Dalia pilot, Israel - engaging IDC/RUNI, INPA, PERNICE and several stakeholders;
- **11 Dec 2023** - Venice Lagoon, Italy - engaging CORILA, MPROV, CMCC, PERNICE and several stakeholders, occurred on the occasion of the CORE-PLAT meeting.

- **July 2023 – September 2024** – Co-design process from business model identification to business plans with 3 pilots (Venice Lagoon, Sicily Lagoon and Nahal Dalia) planned with the three pilot coordinators and their core teas of stakeholders. The process was based on five steps, as follows: Step 1. BP scope, Value Proposition and business model tool selection; Step 2. Compilation of Value Creation/Delivery; Step 3. Compilation of Value Capture; Step 4. Integration in the BP (1st version); Step 5. Validation of the BP (final version). The process used with different engagement methods, including online workshops, questionnaires, interviews and consultations, occurred monthly during the above-mentioned sixteen-month period, as illustrated in Figure 9.

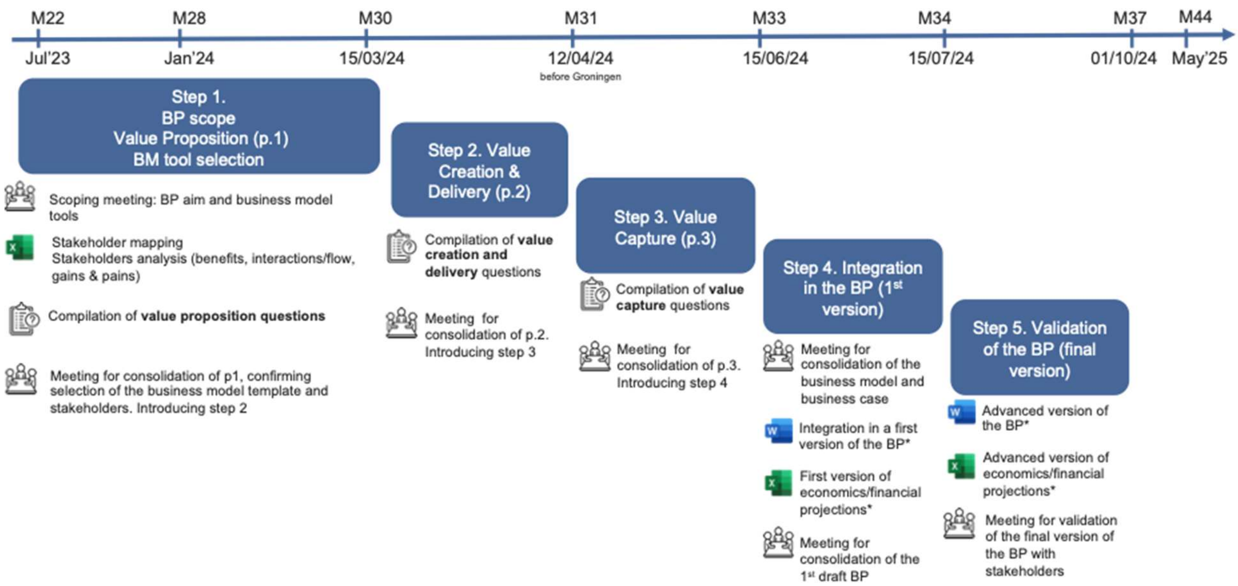


**Figure 9 Methodology for co-developing the business model and business plan in the three pilots: Venice Lagoon, Sicily Lagoon, Nahal Dalia**

In addition, early results were presented at the annual REST-COAST meetings that occurred in Groningen on 17-19 of April 2024 with a presentation on the pilots produced for Venice Lagoon, Sicily Lagoon and Nahal Dalia by PERNICE/ALBIREM and delivered in presence by ALBIREM. DELTARES presented a selection of the other pilot cases including Arcachon Bay, Rhone Delta, Vistula Lagoon, and Ebro Delta.

### Cross-pilot & transversal meetings

WP3 has conducted the activities reported above in collaboration with other REST-COAST work packages and partners, in particular:

- **21 September** 2023 - Kick off of T3.3 in REST COAST GA Gdansk, PL of WP3. (ALL).
- **19 October 2023** - Transversal online meeting with representatives from all pilots to explain the steps of T3.3. (DELTARES and PERNICE).
- **30 Nov 2023** - Transversal online meeting with all pilots to explain the steps of T3.3. Sharing some first results of a few early pilots (Arcachon, Ebro Delta, Eems Dollard). IUCN also joined this meeting (DELTARES and PERNICE).
- **22 March 2024** - Joint meeting with WaterLANDS and T3.3 to exchange knowledge and insights (DELTARES).

- **8 April 2024** - Exchange between WaterLANDS and T3.3 and planning of joint session (18 April in Groningen) (DELTARES).
- **15-19 April 2024** - Groningen WaterLANDS and REST COAST GA meeting, which included a workshop with discussions on WP3 and T3.3. (All) Interaction with IUCN on their policy study (DELTARES).
- **27 September 2024** - REST COAST General Assembly online interaction, presentation of D3.3 results (All).

**Contribution and integration with other work packages**

The findings from **D3.3** contribute to:

- **WP4** – Informing strategies and evaluations for upscaling and implementation.
- **WP5** – Contributing to knowledge co-development and governance transformation.
- **WP6** – Enhancing communication aspects.
- **WP7** – Strengthening institutional relationships and strategy development.

**Messages for upscaling**

- Scale dimensions identified in **D3.3** can be applied to **broader landscape levels**.
- Barriers and opportunities for upscaling are synthesized in **Chapter 2 of D3.3**.

# Part II

## Synthesis and Discussion

# Chapter 3. Cross-comparison of the business models

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## 3.1. Introduction

In this chapter we present an overarching analysis of the findings from the individual case studies through a cross-comparison of the different cases. In doing so, we identify commonalities and differences in terms of the NbS interventions, business models, as well as further opportunities and challenges.

As introduced in Chapter 2 (Figure 2), the work conducted for co-developing business models, business plans, and scalability plans for each case has been structured according to three phases in time, illustrated in Figure 9 and described below. This chapter discusses the findings from **"The starting point"** and **"Extension 1".** "Extension 2" is addressed separately in the next chapter 4.

**"The starting point"** – This refers to our point of departure, or in other words, what has been done in the respective cases so far, during the past (more or less) five years. More specifically, how were the past projects organised and financially structured? For example, were pilot projects conducted to establish an evidence base that can be built on for future business plans? Were restoration activities fully implemented, or only partially implemented resulting from funding and financing gaps? What was the motivation for specific actors to provide funding? And were the results as expected? Such information is an important foundation to build upon in developing business models for the next phases in pilot cases.

*In 7 out of the 9 cases relevant pilot or implementation projects have occurred during the past years for which the existing business models have been inventorized and analysed.*

*10 NbS are considered in the analysis of existing business models, since multiple NbS have been implemented in some of the case studies.*

**"Extension 1"** – Given the starting point, what are the next steps to be taken regarding ecosystem restoration activities in the cases between now and 5 years from now? In some cases, this could be a continuation of what has already been done in the past, whilst in other cases entirely new projects are started up or are being explored. For the interventions that are being planned, and given the results and experiences from past projects, we co-developed business model propositions for the cases. What will the planned interventions cost? How certain or accurate are these cost estimations? What values that *are expected to be generated by the interventions can be used to generate payments? Who is best equipped to do the actual implementation? Who will be responsible for the newly developed assets? These are a few examples of the questions addressed in the business model propositions.*

We call these propositions for two reasons. Firstly, the business models are supportive, meant as inspiration, and are non-binding. Decision-making regarding the preferred funding, financing and implementation strategy lies beyond our (WP3) span of control. Secondly, although parts of the proposed business models are supported by evidence and financial calculations, not all data that is required for a fully bankable and implementable plan is currently available.

*In 9 out of the 9 cases business model propositions have been co-developed.*

*17 NbS are considered in the business model propositions, since multiple NbS are being implemented or are planned to be implemented in some case studies.*

*In 1 out of 9 cases project registration for the voluntary Carbon Market has been done.*

| | "Starting point" *Existing business models* | "Extension 1" *Business model proposition (short-term)* | "Extension 2" *Business model strategies (long-term)* |
|---|---|---|---|
| Time horizon | *Looking back 5 years* | *Looking 5 years ahead* | *Looking 10 years ahead* |
| | *WP3 starting point* | | |
| ***Arcachon Bay*** | Seagrass bed restoration | Additional hectares of seagrass restoration | Integrate seagrass restoration within environmental strategy of the bay |
| ***Ebro Delta*** | Wetland/Lagoon Restoration; dune & beach nourishments | Continuation of restoration and nourishments, and sediment by-pass pilot | "Saving the Delta" – Integrated coastal zone and river system management |
| ***Eems-Dollard*** | Raising agricultural lands; Clay ripening; multi-functional tidal zone | "The Growing Delta" | Integrated, cross-border, coastal zone management |
| ***Foros Bay*** | Seagrass bed restoration | Seagrass bed restoration | Tourism, erosion and wave mitigation, water quality improvements, fisheries nursery |
| ***Nahal Dalia*** | n.a. | Dam removal; dynamic dam relocation; Rewilding fish ponds | Expanding successful NbS interventions rewilding fish ponds |
| ***Rhone Delta*** | Coastal lagoon restoration and revegetation | Creating additional climate buffer area (project level) | Intensification of NbS in Camargue; improve the circulation of the water and restore the wetland ecosystems |
| ***Sicily Lagoon*** | n.a. | Salt marsh restoration, artificial islands, dune revegetation, connectivity | Expand NbS on provincial level |
| ***Venice Lagoon*** | Salt marsh restoration | Increase of salt marsh restoration | Increase of salt marsh restoration |
| ***Vistula Lagoon*** | Artificial bird Island | Floating artificial islands | Ecosystem restoration in the whole lagoon |

**Figure 10 Three-phased structure defining the scopes of analysis used in the 9 cases**

### 3.2. Cross comparison: Starting point (*what happened the past 5 years*)

**The NbS interventions studied here showcase a wide diversity, resulting from different land-use changes, the different economic and climate-related pressures on the ecosystems and the differences in technological readiness levels.** The type, scale, and scope of interventions vary case by case. Not a single case is identical to another. In two cases specific techniques were piloted (tested) whilst in other cases activities can rather be characterized as implementation projects. The two cases where specific technical pilot activities occurred were in Arcachon Bay and Eems-Dollard. In Arcachon, a specific technique (device) for seagrass restoration has been tested, whilst in the Eems-Dollard small-scale experimental projects were set up for the development of technical and practical knowledge regarding the feasibility of different interventions and implementation variations. For example, in a past pilot project, the process of ripening the sediments extracted from the estuary to be used as clay in infrastructure projects was studied. It was found that there are indeed different techniques that lead to the required result, and that these differ in terms of ripening time, space needed, ripening costs, and resulting clay properties. The other cases that were not specifically pilot studies were set up as implementation projects for restoring specific sites through different activities. In the Ebro Delta, Rhone Delta, and Venice Lagoon, for example, wetlands, salt marsh and lagoon restorations were implemented. The specific activities that are needed to restore these areas depend on local conditions and pressures on the ecosystems. In the case of the Ebro, abandoned rice fields were restored, and as such existing infrastructures such as dikes and channels had to be removed or repositioned to recreate the natural dynamics. Similarly, in the Rhone Delta an abandoned industrial zone for salt production is being renaturalized and as such here too the existing infrastructure (which typically leads to a disconnect between land and sea resulting in the lack of natural dynamics) needed to be addressed. In the case of the Venice lagoon, the situation is again different since restoration efforts are firstly focussed on developing a system of protection (borders) around the salt marshes to prevent further erosion before the actual restoration of the marshes can take place. These efforts also include the cleaning up of any non-biodegradable waste found in the marsh borders.

**Table 3 Starting point: Overview of interventions carried out during the past 5 years, the corresponding business models, funding opportunities, and key challenges.**

*****_selection out of many projects that have been implemented. NGO = Non-Governmental Organisation, RI = Research Institute, CSR = Corporate Social Responsibility, ESG = Environmental, Social Governance._

| | NbS | | Business model | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pilot site** | **Intervention** [PIL = Pilot project] | **Costs per ha** | **Services and Benefits generated** | **Funding model** [#of funders] | **Finance model** | **Initiator** | **Land/ Asset owner** | **Implementation arrangement** | **Funding / value capture opportunities** | **Key Challenges** |
| **Arcachon Bay** | **1 ha** of (Active) Seagrass bed restoration with a specific technique [PIL] | €150.000 per ha | Flood risk reduction; Biodiversity improvements; Geodiversity improvements; Carbon sequestration; Food provisioning (fish); Erosion control; Water quality improvements (turbidity); Eco-tourism; Knowledge development (technical, ecological); | Grant-based; Public co-funding (Supranational, national) [2] | None | Private (engineering firm) | Public (National) | Unsolicited proposal with public permit procedure (MPA); Collaboration with knowledge (scientific) partners | Carbon credits; PES (avoided dredging costs); Partial remittance from product sales (seafood); (Earmarked) Tourist taxes | Complex regulatory environment for permits; Singular objectives render NbS unattractive; Public sector reluctance to private sector involvement and funding; Solution potential of NbS for climate adaptation not recognized |
| **Ebro Delta*** | **402 ha** of Wetland/Lagoon restoration | € 11.014 per ha | Flood risk reduction; Environmental resilience; Biodiversity improvements; Carbon sequestration; Food provisioning (fish); Business continuity (salt, rice); Erosion control; Eco-tourism; Knowledge development (technical, ecological); Sediment transportation; Reduced freshwater demand; Salinization control; Education & culture; | Grant-based; Earmarked donations; Public and private co-funding (supranational, national, regional, local, NGO, RI) [14] | None | Private (Research institute) | Public & Private | Collaborative research and implementation partnership; (ex-ante) land acquisition; (ex-post) transfer of responsibility (enabling partial cost-recovery through tourist fees) | Carbon credits; PES payment for flood risk reduction; Partial remittance from product (Food) sales; (Earmarked) Tourist taxes; CSR & ESG related donations | Fragmented, short-term funding; Land is mostly private property; High costs associated to alien species management; Demarcated jurisdictions and responsibilities over coastal zone and delta plain |
| | **89 ha** of Beach nourishment & Dune restoration (183.000m$^3$ of sediment) | € 5,617 per ha | Flood risk reduction; Geodiversity improvements; Carbon sequestration; Erosion control; (Eco-) tourism; Knowledge development (technical); accessibility; | Grant-based; Public funding; (national [1] | None | Public (National G'ment) | Public (National) | Public Procurement, Scientific advice | User fee (toll) for accessibility; Partial remittance from product (salt) sales; (Earmarked) Tourist taxes | (Some) Public reluctance towards sediment by-pass strategy; Demarcated jurisdictions and responsibilities over coastal zone and delta plain |
| **Eems-Dollard*** | **4 ha** of agricultural lands raised by 70cm with excess sediment [PIL] | € 360,000 per ha | Flood risk reduction; business continuity (agri); Knowledge development (technical); Repurposing (waste) sediments; | Program level funding; Grant-based; public co-funding (National, Regional) [2]<br>Project level funding per project; public – private co-funding (national, regional, earmarked funds, port authority and disposal of private land) | None | Public (Regional G'ment) | Private | Collaborative research and implementation partnerships; Public procurement; Partnerships embedded in network organisation; private property at disposal | Carbon credits; PES (avoided dredging costs); Partial remittance from food product sales (seagrass, fish, shrimps); Partial remittance from agricultural yields; Partial remittance from material product sales (bricks, reefblocks, clay); | Short-term funding; program management funding; Mostly private property; Opportunistically driven locational choices; Revenue generation potential prioritized over natural values; Market potential for (clay) products; |
| | **24 ha** of clay ripening zone, (turning raw material into clay) [PIL] | € 308,333 per ha | Knowledge development (technical); Water quality improvement; Repurposing (waste) sediments; | | | | Public | | | |
| | **37 ha** of multifunctional zone in between two dikes. | €870,270 per ha | Flood risk reduction; Biodiversity improvements; Carbon sequestration; Food provisioning (aquaculture); Water quality improvement (turbidity); Knowledge development (technical) Repurposing (waste) sediments; | | | | Public | | | |
| **Foros Bay** | **0.03 ha** active seagrass restoration | €2,200,000 per hectare | Flood risk reduction; Environmental resilience Biodiversity improvements; Carbon sequestration; Food provisioning | Grant-based; Public; | None | Public (Ocean research institute) | Public | Collaborative research, NGO and implementation | Carbon credits; PES (avoided dredging costs); Partial remittance from | Lack of developed PES schemes and carbon credit market; Lack of transferred |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (followed by a total of **17 ha** of passive restoration through further self-colonization) | (or €3,800 per ha after the self-colonizatio n) | (seagrass); Erosion control; Water quality improvements (turbidity/ purification); (Eco-) Tourism; Compost and pharmaceutical materials; Education. sediment capture. | (Supranational) [1] | | | | partnership (diving company) Subcontracting | (eco-labelled) food product sales (Fishing and aquaculture); tourist fees; tourist taxes; Real estate development obligations; Avoided costs from (port) business disruptions; | responsibility to local level authorities; Unclear distribution of responsibilities; Complex regulatory and bureaucratic environment; Lack of transparency in decision-making |
| **Nahal Dahlia** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** | **n.a.** |
| **Rhone Delta** | Restoration of coastal lagoons and vegetation *(Re-naturalization of the former industrial zone* | Unknown | Flood risk reduction; Environmental resilience; Biodiversity improvements; Geodiversity improvements; Carbon sequestration; Food provisioning (fish); Erosion control; Water quality improvement (salinity); (Eco-) Tourism | Grant-based; Earmarked donations; Public and private co-funding [4] | None | Private (Research foundation) | Public (National) and private (Foundation) | Land acquisition, delegated management responsibility to a collaborative (public-private) partnership; Public procurement for implementation works | Carbon credits; Avoided costs for dike maintenance; CSR & ESG related donations | Time consuming to sustain a flow of private donations; Reputational damage through greenwashing practices; Lack of community involvement/ benefit sharing; Lack of formalized responsibility and capacity amongst partnership |
| **Sicily Lagoon** | n.a. | n.a. | n.a. | n.a | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Venice Lagoon** | Salt marsh restoration | Unknown | Flood risk reduction; Environmental resilience; Biodiversity improvements; Carbon sequestration; Food provisioning (fish); Erosion control; Water quality improvement; (Eco-) Tourism; Repurposing (waste) sediments | Grant-based; Public; National and Supranational [3] | None | Public (National) | Public (National) | Public procurement for engineering and construction works | Carbon credits; PES (avoided dredging costs) Tourism user fees; | Low social acceptance for tourism fees; Lack of quantification of ESS; Lack of revenue generation |
| **Vistula Lagoon** | **190 ha** Artificial Bird Island embedded in larger project (new navigational channel/lock system) | € 105.263 per ha | Biodiversity improvements; (Eco-) Tourism; Repurposing (waste) sediments; | Grant-based; Public; National [1] | None | Public (National) | Public (National) | Public procurement for engineering and construction works; contract with NGO for monitoring species | User fees (lock fees) | Lack of clear distribution of responsibilities and prioritization to further address environmental challenges in the lagoon |

**Given the diversity of the NbS interventions, large variations in restoration costs are seen. Comparability between measures is limited since costs are project and context dependent, current cost data does not reflect full lifecycle costs, and not all transaction costs are (equally) included.** The lowest cost per hectare was € 3,800 per ha for seagrass restoration in Foros Bay (conditional on the success of further natural self-colonization) while the highest cost per hectare was €870.270 for the establishment of a double dike with a multifunctional intertidal zone in the Eems-Dollard. In two cases, the Arcachon bay and the Foros bay, seagrass restoration is carried out. In the Arcachon case an area of 1 ha is restored for €150.000, whilst in the Foros Bay an area of 0.03 ha is actively restored for €66.000, with the anticipation that through this initial active restoration an area of 17 ha can be restored through further natural colonization. Although both cases concern seagrass restoration, techniques and costs differ significantly. Such variations naturally arise from the fact that significantly different NbS are being implemented. Besides from the variations in types of NbS carried out and the influence of local (material, equipment and staff) prices, the retrieved project cost varies in terms of four key dimensions, namely:

- **Lifecycle coverage** - many cost estimates reflect short term implementation costs and do not cover maintenance and monitoring costs over the lifecycle. Estimating full lifecycle cost for dynamic and uncertain NbS is challenging. NbS are seen to be implemented in phases, and typically data on implementation costs per phase can be retrieved. As such, the cost estimates only reflect a part of the total costs.
- **Transaction cost coverage** – activities such as land acquisition, stakeholder engagement, permit applications, and funding applications, are not included uniformly and consistently in the available cost estimations. As such, the cost estimates only reflect a part of the costs.
- **Contextual embeddedness** – some of the projects, such as in the case of the Vistula Lagoon (but likewise one of the small-scale projects in the Eems Dollard where also a bird island was created) the project costs cannot be seen in isolation from other (infrastructure) project costs. The occurrence of other developments which include dredging activities, and the consequent existence of a sediment waste streams make the projects possible. As such, the cost estimates cannot be seen in isolation of the context.

At this point, comparing costs between the different measures and cases is like comparing apples with pears. Nevertheless, the large cost-variations do suggest that there are low(er) cost NbS and high(er) cost NbS options to be considered. The findings also emphasize the context dependency of NbS costs, and that a transfer of ‘key figures’ from one context to another is likely to give unreliable cost forecasts. The phased implementation that is seen in the pilot cases, or in other words, a step-by-step approach, leads to cost data that does not reflect full lifecycle costs.

**As is typically the case for NbS, multiple benefits are generated by the NbS interventions in our case studies**. Although many more ESS are provided by the ecosystems in the respective case studies, a selection of them are surfaced in this study, particularly those that correspond to high values, stakeholder (priority) objectives, or those services that can potentially trigger payments. Key benefits delivered by the NbS in the majority (≥5) of the cases are:

**Flood risk reduction** (economic and social) – A reduction of flood risk to infrastructural and economic assets resulting from i) the buffering functions of natural assets ii) wave energy dissipation of natural assets and iii) the reduction in vulnerability resulting from controlling subsidence rates or raising low lying lands.

**Environmental resilience** – Natural assets are also exposed to hazards, including floods, droughts, sea level rise and temperature changes. The NbS interventions lead to improving the ecosystem quality (condition) and extent. The natural assets themselves are better protected, and so are the services that they deliver.

**Biodiversity improvement** and **Geodiversity improvement** – Although closely related to each other as well as to environmental resilience, these benefit categories specifically capture improvement in the 'living' organisms and species (where protected and threatened species are of particular interest) as well as the diversity in the non-living elements such as soils, and rocks. Geodiversity also offers services such as the storage of carbon, or wave attenuation and is supportive of biodiversity.

**Carbon sequestration** – Changes in the land use functions, and restoration of ecosystems result in changes in the amounts of $CO_2$ from the atmosphere that is captured and stored. Increasing the storage capacity of existing and restored ecosystems is increasingly playing a role in fighting climate change. Accumulation and storage (and emissions) is a natural phenomenon, which occurs in different receptacles such as soils, biomass and the ocean. The main process through which sequestration occurs is photosynthesis.

**Food provisioning** – Through the improvement or creation of new (nursery) habitats (shell) fish populations can flourish. Furthermore, through the establishment of aquacultural practices or harvesting of wild plants other food sources can be tapped into, such as seagrass. These are the two main food sources encountered in the cases. Further, we find that in some cases agriculture and aquacultural sectors that are present in the case study regions are threatened by multiple hazards (such as climate change, droughts, salt intrusion, and logistical disruptions). **Business continuity** (and food provisioning) is threatened and NbS interventions can help alleviate the pressure on these existing sectors.

**Erosion control** – Water-triggered erosion processes along the coasts and riverbanks can be (partially) mitigated by the NbS through i) biomass-related stabilization through the (roots of) vegetation in for example salt marshes or dune vegetation and ii) non-biomass related stabilization where the shape of the assets alter the hydro-mechanical flows (e.g. sediments are stabilized by the presence of dunes or perpendicular sandbanks).

**Water quality improvements** - Natural assets are seen to contribute to water quality improvements in different ways, namely through i) filtration of harmful substances such as nitrogen and phosphorus, ii) restoring the natural salinity gradients to the water bodies and iii) the reduction in turbidity resulting from the protective environment that allows sediment in the water columns to settle.

**(Eco-) Tourism** - Many of the NbS interventions occur in regions where touristic activity is already occurring and is expected to increase. In particular, landscape characteristics such as beaches, bays, and lagoons, offer opportunities for active and passive recreation. Enhancing and protecting natural assets contributes to the potential of this sector.

**Knowledge development** – The generation of scientific and practical knowledge related to the performance of interventions and ecosystem functioning. This concerns both technical knowledge (such as the functioning of different techniques) as well as specific ecological knowledge (i.e. the monitoring of species and evolution over time).

**Further, high value benefits associated to sediment, have been identified in several cases** (**Error! Reference source not found.**). We can distinguish between the 'supply' side of sediment and the 'demand' side for sediment. **Regarding the supply side (availability of sediment) we find that in some cases there is an excess supply of sediment (waste stream) which needs to be located elsewhere.** For example, in the Vistula case, an instantaneous availability of large amounts of sediment from the channel and lock construction works as well as a continuous supply of sediment from foreseen future dredging activities in the waterways meant that a site or strategy was required for the deposition of such material flows. Similarly, in the Eems-Dollard case, the continuous supply of dredged materials from the ports and waterways in the estuary requires a deposition location. Given the turbidity problems in the area, regulations are scrutinized and the allocation of permits for the disposal of dredged materials is expected to change, i.e. disposal needs to happen at locations further away (driving up dredging costs). In the case of the Venice lagoon, the re-use of material from dredging activities conducted on behalf of the Venice Port Authority is also foreseen to be the main supply for sediment nourishment to the salt marshes. **As such, it seems that in cases where there is an excess of sediment, there are opportunities to develop NbS especially when alternative disposal strategies are more expensive (and less sustainable).**

**Regarding the demand side (uses) we identify sediment to be a provisioning service, either the mineral substance or the biomass it contains, and is used directly as a raw material input, or indirectly after processing.** This is the case in for example the Eems-Dollard, where the NbS entail the extraction of sediment from the system which is re-used (after processing into clay or bricks) for other purposes. As such, the sediments can be used as a building material, which may or may not be cheaper than alternative comparable materials (from elsewhere). Further, sediment is also directly applied onto land or used to create land, such as the case where bird islands were established in the Vistula, in the Ebro, and in Eems-Dollard. Furthermore, in the case of the Ebro Delta, soils that were obtained from the lagoon excavation were re-used for the restoration of a riparian forest, which was another NbS. The value of the sediment in this case was two dimensional. The volume and constructive characteristics made it particularly useful for creating elevation (sediment as a building material directly used) and the ecological characteristics of the sediment (the biomass) enabled it to function as a ‘natural’ seed bank for revegetation, in particular for tamarisks (sediment as a seed bank). As such, the seed bank function of sediment can provide ways to implement other NbS in a more cost-effective way. The last value related to sediment that surfaced form our cases is the nutritional, or fertilizing value of applying sediment on (agricultural) land.

| **Sediment Availability (Supply) – *example cases*** | **Sediment Uses (Demand) – *example cases*** |
|---|---|
| • As stock in water column - *Eems-Dollard, Venice*<br>• As settled stock in habitats - *Eems-Dollard, Ebro Delta, Foros Bay, Arcachon*<br>• **As excess (waste) stock from regular (port and waterway) dredging** - *Eems-Dollard, Venice*<br>• **As excess (waste) stock from other infrastructural or NbS activities** – *Ebro Delta, Eems-Dollard, Vistula* | • **As a raw material input for building materials such as clay, bricks, or processed soils (sediment as a mineral substance)** - *Eems-Dollard*<br>• **As a raw material directly applied as a building material such as sediment deposition directly on land for elevation or to construct an island (sediment as a mineral substance)** – *Eems Dollard, Vistula, Ebro Delta*<br>• Organic material within sediment stock functioning as a seed bank (sediment as genetic material) – *Ebro Delta*<br>• Organic material within sediment for soil nutrition (sediment as fertilizer)– *Eems-Dollard* |

**Figure 11 Sediment-related benefits encountered in the case studies – Bold items are of high value**

**All the cases rely either fully or for the most part on public (co-) funding, in a few cases private funding was encountered. We further find that program level and project level funding has been treated separately.** In two cases, namely the beach nourishments/dune reconstructions in the Ebro Delta and the case of the bird island in the Vistula lagoon, funding is fully derived from a singular – in both cases national level public – funder. The main objective of these NbS is fully aligned with the constitutional responsibility for coastal flood protection or with a strong political preference leading to this situation of public funding from a singular national level public authority. In the other cases, public funding is typically provided from multiple sources, covering the multiple levels of the public sector, as well as particular investment funds, or earmarked funds. In three cases, public and private co-funding was identified. These are the Ebro Delta (where private co-funding came from an NGO and a Research Institute), the Eems-Dollard (where private co-funding came from the Port Authority and from a private foundation that constitutes a network or commercial engineering organizations) and the Rhone Delta, (where private co-funding came from philanthropic donations). Further noticeable is the clear distinction between funding for program level activities (such as coordination and stakeholder engagement) and funding for individual project level activities, which was the case in the Eems-Dollard.

**Many of the NbS implementation projects in our case studies are planned and funded in phases.** For example, in the Venice lagoon case, the first phase encompasses activities (and costs) associated with the establishment of a border around the marsh areas. Only once that is established, sediment nourishment to feed and restore the marsh areas themselves can be implemented which constitutes the second phase. Similarly, the restorations in the Alfacada and Tancada lagoons in the Ebro Delta are also phased over time, where initial activities such as cleaning of canals, deepening the lagoon, and removal of aerial powerlines are bundled into one project phase, whilst 'parking' other activities, including ecological monitoring, for later phases. Such a phased implementation strategy is aligned with the intrinsic dynamic nature of ecosystem behaviour and principles for ecological engineering. It also facilitates the spreading of costs and as such, the required funding over time, which reduces the relative size of the initial investment required to cover high up-front costs.

**None of the case studies have in the past made use of finance instruments to cover up-front costs,** such as concessional loans, green bonds, or public loans. The required resources to fund the NbS interventions, and as such to cover the (phased) costs could all by mustered up-front. As such, there was no finance gap which needed to be bridged by financing instruments (loans).

**Generally, public parties are the ones to initiate NbS interventions on public land.** Yet, we also see some deviations. In three NbS the initiator was a private party, namely an engineering willing to test a particular restoration technique in the Arcachon Bay, a research institute for the wetland and lagoon restorations in the Ebro Delta and a Research Foundation in the Rhone Delta. In the other cases initiators were from the public sector, mostly national level, but also regional level. Further, we identity that for eight NbS (in some cases we consider multiple NbS, so the number of NbS > the number of cases) the land on which the NbS was implemented was public property. In some areas the transfer of ownership to public parties had occurred in the past, making them public property in the current situation. There are three NbS where we encounter private ownership. First is the NbS 'raising agricultural land' in the Eems-Dollard where sediment from the estuarine system was used to elevate private property. Second is the case of lagoon restoration in the Ebro Delta, where part of the land (and water) is owned by a private foundation with social and environmental objectives. Thirdly in the case of the Rhone Delta, restoration activities are also occurring on private property where the owner is a private foundation with societal and environmental objectives. For the case of Nahal Dalia there is also a situation where property is privately owned for commercial activities, however, data for analysis of the past activities (analysis of starting point) was lacking.

**When it comes to the implementation arrangements, we encounter public procurement procedures, collaborative research partnerships, and an unsolicited proposal procedure**. In five NbS, we encounter public procurement as a form of implementation. This is to be expected, given that in many cases the initiators are also public parties. Typically engineering and construction works during the initial implementation are procured (e.g. Ebro Delta, Eems Dollard, Venice Lagoon, Vistula lagoon). However, we also encounter several cases in which these 'traditional' public procurement forms are combined with or complemented by contracts for other activities such as the procurement of additional scientific advice in the case of the beach nourishment and dune restoration strategies in the Ebro Delta and the procurement of specific parties for (bird) monitoring activities such as in the case of the Vistula lagoon. The other implementation form that we find occurring in the cases is the collaborative implementation partnership, such as the partnership between the NGO and diving company in the Foros Bay, the collaborative research and implementation partnerships in the Eems-Dollard and in the Ebro. Some form of collaborative partnerships, including research, is found in five cases. In one case, namely in the Arcachon Bay, the NbS has been shaped and implemented according to an unsolicited proposal procedure (where the engineering firm proposed an idea or plan directly to public authorities) followed by a public permit procedure.

**Looking beyond the existing business models into funding opportunities that are currently not captured we also identify consistent elements amongst the cases. Revenues through carbon credits, tourist taxes and fees, remittance of product sales and payments for dredging cost reductions are the opportunities reported in the majority of the cases.** In six cases, carbon credits have been identified as a potential source for future revenue generation from the NbS (Arcachon Bay, Ebro Delta, Eems-Dollard, Foros Boy, Rhone Delta, and Venice Lagoon). Further in five cases a (partial) remittance of revenues generated from product sales (aquacultural, agricultural, material) can be further explored to establish feasibility. Revenues generated from touristic activities, either through fees or taxes, was also identified as an opportunity in five cases. Moreover, the potential costs reductions for dredging activities have been identified in five cases. Such values can be (partially) captured if a payment scheme is established between the initiator and the beneficiary (mostly port authorities). Further opportunities identified in a a few single or minority of the cases are a toll system (specific type of user fee), corporate social responsibility related donations, real estate development obligations, and payments for the contributions of the NbS towards flood risk reductions and avoidance of business disruptions.

**Key challenges encountered for funding and financing the NbS in our case studies span a wide range of different topics**. **This illustrates the systemic complexity of funding and financing for NbS.** We highlight a few challenges that occur in at least two cases. In both the Ebro Delta and the Eems Dollard the problem of short term and fragmented funding for NbS was reported. Funding for the longer-term maintenance, or for larger scale implementation is experienced as difficult to acquire. Commitments from stakeholders (either driven by preferences or by legal restrictions) remain short-term oriented, and as such, continuous acquisition efforts are required from initiators. Similarly, in both cases it was reported that much of the land on which restoration activities could (and can) occur in the future is private property. This limits NbS potential and makes publicly initiated activities more costly when land has to be purchased first. Further, consequently, restoration sites could be chosen that are not ecologically optimal, but where there is an opportunity based on available land. Another recurring challenge, reported in the Arcachon Bay and the Ebro Delta is that the current institutional structures, where public organisations working towards achieving singular objectives renders NbS unattractive. The demarcation of jurisdictions and responsibilities leads to difficulties in getting restoration plans approved and in obtaining the required funding. Furthermore, the lack of clarity regarding distributions and responsibility was also reported as a challenge in the Rhone Delta, the Foros Bay, and the Vistula Lagoon. Especially in the Vistula lagoon, the responsibility for ecological improvement of the lagoon is said to be not clearly embedded within the current public sector organisations, and additionally, targetting this challenge will require cross-border collaboration with Russian authorities to jointly adress pressures and distribute the costs of actions. As such, free-riding behaviour from the neighbouring country is around the corner. Further observations and considerations regarding (upscaling) challenges encountered are discussed in Chapter 4.

### *3.3.* Cross comparison: Extension 1 *(what is planned to be done in the coming 5 years)*

For all cases (9 out of 9) business model propositions have been developed together with partners and local stakeholders. These concern a total of 17 NbS interventions (as some cases are implementing more than 1 NbS) that are implemented or planned to be implemented in the coming +/- 5 years. An overview of the interventions, elements from the business model propositions and challenges is presented in Table 4 and elaborated below. As such, this overview provides insights into the funding and financing landscape(s) in which the pilot cases are currently operating and further exploring.

**The NbS interventions analysed here are diverse, varying in ecological and physical characteristics (such as the (part) ecosystem being restored and the techniques used) as well as implementation project characteristics (such as the implementation phase and technological readiness of the interventions).** In three cases, namely in the Ebro Delta, Sicily, and the Venice lagoon, salt marshes and/or wetlands are being (further) restored and monitored. In the Ebro Delta the restoration and monitoring activities are a continuation (dam removal for connectivity restoration), and extension (additional surface area) of past efforts, whilst in the case of Sicily the restoration activities are currently starting up. In the case of the Venice Lagoon, we identify two dimensions in which the partners are building upon previous efforts. Firstly, the extension in terms of surface area, where additional hectares are planned to be restored. Further, the activities also concern a continuation of the ecologically and technically required sequence of activities, namely, only after completion of the protection of the edges of the marshes sand nourishment to the marsh area can be carried out. Further, two cases are engaged with seagrass restoration activities, although they differ in terms of size and techniques used. The Arcachon Bay is targeting an area of 1 ha, whilst in the Foros Bay a surface area of 10 ha is being aimed for. We also identify three pilot projects, where the focus is primarily on testing, analysing, experimenting, and testing feasibility of techniques. The pilot projects are the sediment by-pass trial in the Ebro Delta project (implementation has been postponed until further notice), the development of a climate buffer zone in the Rone delta, and the artificial floating Islands in the Vistula lagoon.

**In several case studies we find that multiple different NbS interventions are being planned and implemented simultaneously, or in phases. This signals that in these cases NbS is moving towards ecosystem restoration at a larger scale.** For example, in the Eems Dollard case, three different NbS interventions are planned to be implemented at the same time. This means that multiple problems can be tackled at the same time (such as the lack of natural transition zones between land and water, turbidity, and subsidence) in a more efficient manner. All three interventions have previously been piloted (tested) individually and are now being implemented jointly and on a larger scale. In the case of Sicily lagoon, ecosystem restoration also requires multiple interventions that are being planned simultaneously, namely restoration of wetlands and salt marshes, creating new habitats (artificial islands), restoring hydraulic connections and the restoration of vegetation and dune systems. In the Ebro Delta the NbS activities are also multiple but separated by geographical (and jurisdictional) zones (the coast for nourishments and dune restorations, the inland coastal zone for wetland and lagoon restorations, and upstream for the sediment by-pass). In the case of the Eems-Dollard an integrated approach is chosen (three interventions as one large project) whilst in the case of the Ebro Delta and Sicily the interventions and activities are planned and implemented as separate projects.

**Table 4 Extension 1: Overview of planned interventions, components from the corresponding business model propositions and key challenges** **based on estimates from previous (starting point) implemented interventions*

| Pilot site | NbS | | Business model components | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Intervention** [PIL = Pilot project] | **Costs** | **Services and Benefits generated** | **Funding model** | **Revenue streams**<br>**Carbon Credits** ***(price per*** $tCO_2e$***)*** | **Revenue streams**<br>**Other** (p.a. = per annum/ per year) | **Finance model** | **Implementation arrangements** | **Key Challenges and risks** |
| **Arcach on Bay** | Seagrass restoration (Zostera); 1 *additional ha* | €100.000 per ha | Biodiversity improvements; Flood risk reduction; Carbon sequestration; (Eco-) tourism; Sediment stabilization; Food Provisioning; Knowledge (ecological, organisational); | Public and private co-funding; Revenue generation | €244 per ha per year; *(€40)* | Payments for reduction of dredging costs; Partial remittance from oyster farming; Tourist fees; (earmarked) Tourist taxes | None | Public ownership over area, future restoration efforts likely to go through public procurement. | Low interest for private partnerships/funding; Siloed organizations; Unstable carbon credit market; Time investment of permits; Bad reputation of carbon credits |
| **Ebro Delta** | Lagoon and wetland restoration; *monitoring, continued and new restoration sites* | € 11.000 per ha* | Biodiversity improvements; Environmental resilience; Flood risk reduction; Carbon sequestration; (Eco-) tourism; Food provisioning (fish); Food security (salt, rice); Erosion control; Knowledge development (technical, ecological); Sediment transportation; Reduced freshwater demand; Salinization control; Education & culture | Public and private co-funding; Revenue generation | €13,80 – €27,60 per ha per year; €6030 - €12030 per year for total surface area; *(€10 - €20)* | Earmarked tourist taxes (€2,250,000 p.a.); Tourist visitor fees (€2,187,500 p.a.); Tourism hunting fees; Payments for flood protection; ESG related environmental credits | None | Procurement strategy with post-delivery activities and continuous collaboration with scientific community; Contract-based payments; Close collaboration with private high interest businesses; delegation of responsibilities to natural park | Credibility problems in voluntary carbon markets; limits to tourist carrying capacity of the delta; lack of political support for sediment by-pass; lack of common vision amongst public stakeholders; limited sediment budget; competition from alternative land-uses |
| | Beach nourishment & Dune restoration; *continuation, monitoring, maintenance* | €3.000.000 (€15-€20 per m3) | Geodiversity improvements; Flood risk reduction; Carbon sequestration; Erosion control; (Eco-) tourism; Knowledge development (technical); accessibility; protecting cultural heritage of shoreline and salt industry | Public funding; Revenue generation | €12,85 – €25,69 per ha per year; €1143-€2286 per year for total surface area; *(€10 - €20)* | | None | | |
| | Sediment by-pass trial [PIL] | € 4.000.000 (total for 5 years) | Flood risk reduction; Knowledge development (technical); sediment supply for erosion control, beach nourishments, and subsidence control | Public co-funding | Not relevant | Payment for reduction in beach nourishment costs; Payment for reduction in (dam) operational costs; Payments from farmers for "liquid gold"; | None | | |
| **Eems-Dollard** | Raising agricultural lands, 39 ha | €300.000.000 in total for 10 years<br>€30 million per year for 10 years<br>Each NbS: €10 million per year for 10 years | Biodiversity improvements; Flood risk reduction; Carbon sequestration; Water quality improvement (turbidity); Business continuity (agri); Knowledge development (technical, organisational); Repurposing (waste) sediments; Preventing Oxidation; | Portfolio approach; public and private co-funding; Revenue generation | €5.128 – €10.256 per ha per year; €200.000-€400.000 per year for total surface area; *(€80)* | Payment for dredging cost reduction (€14.000.000); Payment for reduced material cost for future dike reinforcement (€58.000.000 – 100.000.000); Payment from farmers for land value/business continuity | Registry at National Carbon Market Foundation; Bridging loan for time lag of carbon revenues; Clay offtake guarantee | Private or Public fund structure; Financial intermediary; Intensive interaction with local stakeholders/ individual farmers; / Land re-parcelling operation | Restrictions from Natura 2000 legislation; uncertainty long term ecological improvement; polluted sediments; justification of public expenditures towards small number of farmers |
| | Clay ripening | | | | Carbon credit potential but amounts still unknown | | | | |
| | Natural inland zone with intertidal dynamics | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Foros Bay** | Seagrass restoration (*Stuckenia Pectinata), 10 ha* | €200.000 - €300.000 for 10 ha (€20.000- €30.000 per ha) | Biodiversity improvements Flood risk reduction; Carbon sequestration; Eco-tourism; Water quality improvement; Food provisioning; raw materials; Sediment control; Erosion control; Education; Knowledge (ecological); | Public funding (national) | Carbon credit potential but amounts still unknown | Payment for dredging cost reduction; Sales of eco-labelled products; Tourism user fees | None | | Low awareness benefits NbS; low level of capacity for approaching funders; Lack of environmental strategy (for seagrass restoration) |
| **Nahal Dahlia** | Rewilding of fishponds, 55 ha *Incl. multiple activities such as dam removal /replacement, habitat and hydraulic connectivity restoration* | (Pre-)Planning: €9.338.601<br>Construction: €7.607.344 (€138.315 per ha)<br>Monitoring: €370.000 p.a. | Biodiversity improvements Flood risk reduction; Carbon sequestration; Eco-tourism; Water quality improvement; Water provisioning; Food provisioning; | Public funding (national) | Carbon credit potential but amounts still unknown | Touristic and educational activities (€250.000 p.a); Annual avoided flood damage costs (€15.080 p.a) | None | Private land ownership; Multiple procurement arrangements; Management and collaboration structure based on CORE-PLAT; Restored lands will (likely) become accessible to the public | Lack of social acceptance for charging tourism fees; missing data and modelling on carbon sequestration; lack of revenue generation; financial intermediary noy (yet) present |
| **Rhone Delta** | Creation of climate buffer area [PIL] | Feasibility study: €950.000 for 5 years | Biodiversity improvements; Flood risk reduction Carbon sequestration; Eco-tourism; Salt intrusion control; Food Provisioning; Knowledge (ecological); Erosion control; | Public- private co-funding (regional, national, supranational); grant-based and donations | Not relevant in this phase of feasibility studies | Cost reduction for dike maintenance; Earmarked tourist taxes; | None | Activities to be included in public authorities' land management plan and coastal strategy after feasibility studies | Lack of awareness and conviction amongst local land owners; private engagement potentially seen as greenwashing; time investment in private partnerships; |
| **Sicily Lagoon** | Restoration of salt marshes (32 ha) and wetlands (28 ha) | €236.000 (€3.933 /ha) | Biodiversity improvements; Environmental resilience; Flood risk reduction Carbon sequestration; Eco-tourism; Erosion control; Sediment stabilization | Public- private co-funding; grant-based and donations | Carbon credit potential but amounts still unknown | Tourism fees for guided tours (€2.000 p.a.); Birdwatching related tourist fees (€61.500 p.a.); educational activities (€105.000 p.a.); Cost reduction of flood and erosion damage costs; Payments for cost reduction water purification (farmers) | None | Public procurement, contract-based payments; continuous academic support | Low interest for private partnerships/funding; Social acceptance |
| | Creation of artificial islands (25ha) | €106.000 (€4.240 /ha) | | | | | | | |
| | Creation of ponds/hydraulic connectivity | €57.000 (total) | | | | | | | |
| | Vegetation and sand dune restoration | €32.000 (total) | | | | | | | |
| **Venice Lagoon** | Salt marsh restoration (138 ha) | Protecting edges (phase 1): €362 /meter; Nourishments (phase 2): €19 p. m3; Monitoring: €2.900 p. ha | Biodiversity improvements; Flood risk reduction; Carbon sequestration; (Eco-) tourism; Water quality improvement; Erosion control; | Public co-funding; grant-based | Carbon credit potential but amounts still unknown | Tourism fees; Eco-labelled products; Avoided costs flood damage and subsidence | None | Collaboration amongst broad stakeholder group required, (top-down) decision-making by singular institution (water authority) | Changing regulations (new Sludge Protocol); staff/administration changes causing delays; Low social acceptance for tourism fees; financial intermediary noy (yet) present; lack of revenue generation |
| **Vistula Lagoon** | Artificial floating islands [PIL] | Unknown | Biodiversity improvements; Carbon sequestration; Eco-tourism; Water quality improvement; Food Provisioning; Knowledge development; | Public co-funding (national and supranational); grant-based | Not relevant for specific NbS | Earmarked tourist taxes | None | Unique skills regarding techniques would have to be bought; regional development planned to address scale of problems | Performance knowledge gaps; Transboundary issue of eutrophication; High investment costs; Colonization by (undesirable) cormorants |

**Given the diversity of the NbS interventions again we see large variations in restoration costs. A comparison of costs between the different measures and cases is (still) like comparing apples with pears.** The only two cases that seem reasonable to compare are the Arcachon Bay and the Foros Bay, as both these cases implement seagrass restoration projects. In Arcachon Bay, 1ha of seagrass is being restored for €100.000 (which is a reduction of €50.000 p.ha compared to the previous restoration project and a further reduction is expected towards the future when restoring additional hectares). In the Foros Bay an area of 10 ha is to be restored for a cost of €20.000-€30.000 per ha. Besides from the plausible influence of local (material, equipment and staff) prices, a possible explanation may be the dependency on natural recolonisation or in other words, the intensity of active restoration (planting seedlings) relative to a more passive renaturalisation approach. Another possible explanation for differences in cost (besides from variations in prices) may result from economies of scale, where larger surface areas can become cheaper to restore per unit (ha) than small surface area because fixed costs and transaction costs (such as contract negotiations and the mobilization of equipment) are made only once for a larger projects.

**Although the comparability of costs data between the cases is limited, we do find cost related particularities within the cases, namely the focus on construction activities, as well as the role of costs in decision making and coalition building.** The primary focus regarding cost estimations within most case studies is the construction costs. Whilst these costs typically do constitute the largest cost component, it is not a sufficient representation of the expected lifecycle costs, which also includes pre-construction activities such as planning and stakeholder engagement and post-construction activities such as monitoring and maintenance. Regarding the latter (post-construction), these cost components are challenging to estimate since the performance and maintenance needs are uncertain and dynamic. The Nahal Dalia case and the Venice case do have explicit yearly cost estimates for monitoring (respectively €6727 p.ha and €2900 p.ha). Although maintenance and monitoring is included in the activities for several other NbS, these have not been made explicit (so far). Further, although costs estimates are informed by practical experience (in some cases informed by pilot results) and standardized calculation processes, we also find that cost projections for the longer term (such as 10 years in the case of the Eems-Dollard) are still full of uncertainty, and cost estimates are partly shaped towards a 'publicly' acceptable, or reasonable (yearly) amount. If costs estimates are too high, there will be more resistance (less willingness to collaborate), regardless of the many benefits generated. Here, a phased implementation may be a coping strategy. Some for the cost uncertainties in the case of the Eems-Dollard can be dealt with (mitigated) through their integrated portfolio approach, which allows for some flexibility in windfalls and setbacks. Further, the Eems-Dollard case demonstrates that a rough but realistic cost estimate is necessary to make progress in coalition building, planning, and funding commitments. The level of accuracy of cost estimates also evolves over time, when implementation decisions regarding practical details are made. As such, defining the expected project costs is a balancing act between availability of actual cost data and what is (politically) acceptable.

**Not surprisingly, similar ecosystem services, and corresponding benefits, are identified when comparing the NbS that have been implemented during the past five years (Starting point; section 3.2) and the NbS that are being implemented or planned for the coming 5 years. Related to the multiple benefits generated by the NbS, ample opportunities to generate revenues or trigger payments have been identified in the case studies.** An overview of these is provided in Figure 12**.** Biodiversity improvements and carbon sequestration are identified in each case, and flood risk reduction and the potential for eco-tourism were identified as important benefits in eight out of nine cases. In all cases biodiversity or geodiversity improvements and environmental resilience are being targeted by the NbS. Whilst many NbS of the NbS directly target a certain habitat or species type, other NbS have a positive effect on the ecosystem in an indirect manner, such as improving the turbidity levels (e.g. Eems-Dollard, Foros Bay) or restoring hydraulic connectivity (e.g. Sicily, Ebro Delta). Particularly related to biodiversity improvements is the potential te generate revenues from sales of environmental credits or CSR related donations. This market is expected to increase as business are increasingly assessing and addressing their environmental impacts. Further, in 9 NbS (covering 8 out of 9 cases) flood risk reduction as a result of the NbS is foreseen. This is achieved via different routes, namely i) the enhanced protection through wave energy dissipation resulting from the biomass or natural structures, ii) the functioning as a buffer zone between the pressures of the sea and the economic, infrastructural assets being exposed iii) reducing the vulnerability of low lying areas and iv) providing material input for dike construction or reinforcements.

**Carbon sequestration is identified as a relevant environmental co-benefit in each case study. Further research and data is needed to turn this benefit into revenue generation.** This benefit reflects the service of climate regulation provided by the natural habitats in question. Further research and data are required to for the further quantification and monetization of the service. In particular a clear identification of the changes in carbon sequestration, carbon storage, and avoided emissions resulting from the NbS in comparison to not implementing the NbS (business as usual). Further, the expected emissions resulting from the constructional activities of the NbS, such as dredging and sand nourishments also need to be considered to establish a NET emission or Sequestration rate. Such data is needed - in each case study - to capitalize on the potential of this benefit.

**Preliminary calculations show that the revenue generation potential from carbon credits is very low when compared to the costs of the NbS.** Specifically, in the Arcachon Bay, the Ebro Delta and the Eems-Dollard the level of information available allows for preliminary calculations regarding the amounts of carbon sequestered and potential revenues that could be derived from selling carbon credits. The results are summarized in Table 5. Firstly, we see that the carbon credit price on the voluntary markets varies significantly between countries, where the highest price of €80 per $tCO_2e$ is seen in the Netherlands and the lowest price of €10 per $tCO_2e$ is found in Spain. Carbon credits associated to ecosystem restoration typically sell for a higher than average price. Secondly, regardless of these price variations, we see that yearly carbon credit revenue generation covers only a small portion of the yearly costs, maximum of 4% in one case but lower in the others. These calculations are based on yearly cost approximations for a period of 5 years (and in the Eems-Dollard a period for 10 years). More detailed Net Present Value calculations considering a longer lifetime may lead to higher cost coverage estimates, since the revenue streams will last for a longer period of time. **Although these amounts may seem insignificant in comparison to the NbS costs, they can play an important role in diversifying funding streams for NbS and for financial engagement (and awareness raising) of a broader group of stakeholders. Further, the funding stream may be less vulnerable to politicking. Once established, a steady income stream from carbon credits may reduce the continuous acquisition efforts, and may be sufficient to cover funding gaps for particular cost types such as monitoring costs.**

**Table 5 Preliminary calculations: Cost coverage potential from Carbon Credit Revenues**

| Case | NbS | yearly cost covered by yearly carbon credit sales | Price of carbon credit on voluntary market |
|---|---|---|---|
| Arcachon Bay | Seagrass restoration | 1,22% | €40 per $tCO_2e$ |
| Ebro Delta | Wetland and lagoon restorations | 0,63% - 1,25% | €10 - €20 per $tCO_2e$ |
| Ebro Delta | Dune and beach restorations | 0,19% - 0,38% | €10 - €20 per $tCO_2e$ |
| Eems-Dollard | Raising agricultural lands (avoided emissions from peatland oxidation) | 2% - 4% | €80 per $tCO_2e$ |

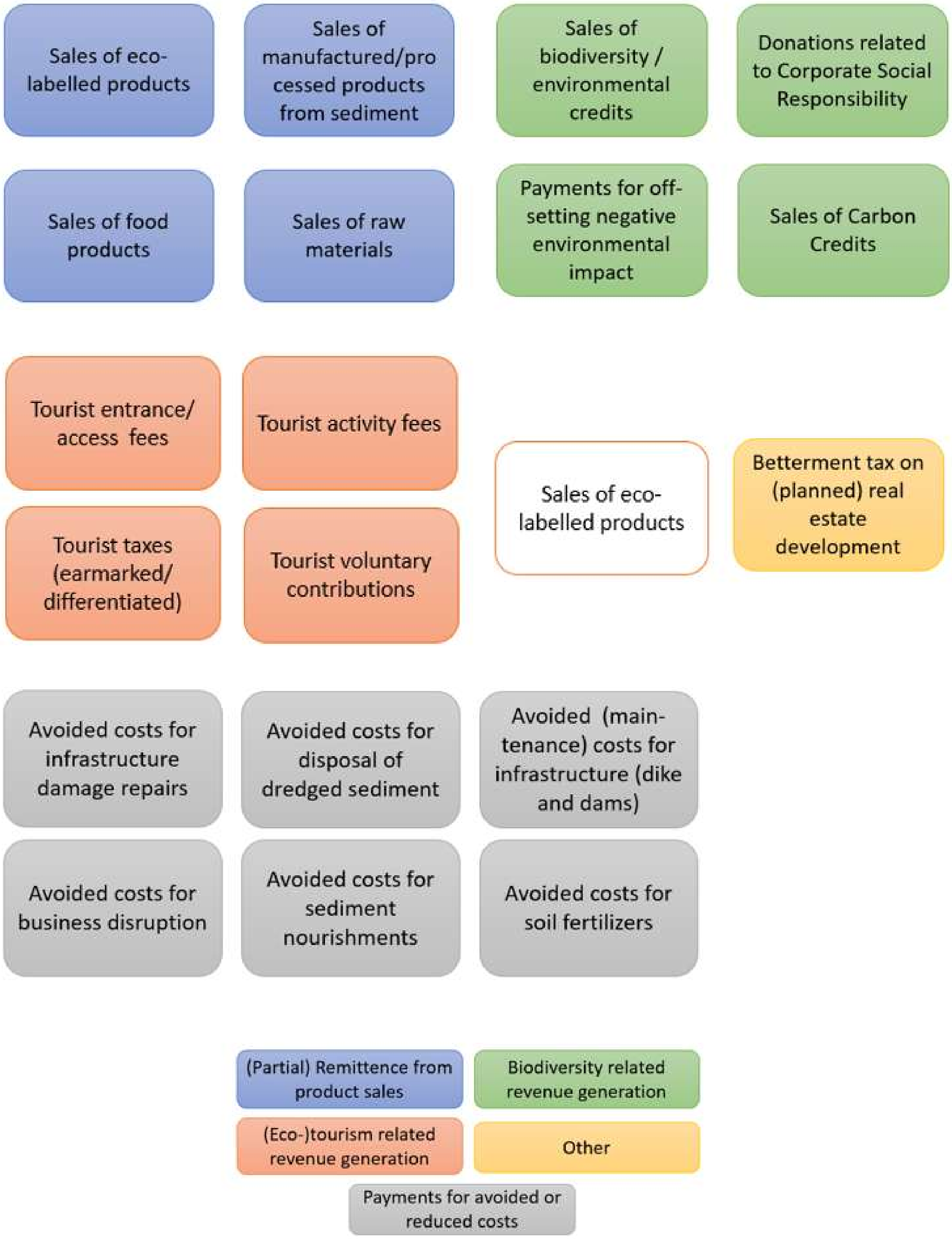


**Figure 12 Overview of revenue generation mechanisms identified in the cases**

**Many of the NbS contribute directly to enhanced opportunities for eco-tourism and several of the interventions occur in regions where touristic activity is already occurring and is expected to increase. As such, there seems to be a potential for revenue generation which can be structured to flow back into the NbS interventions.** Natural assets, in particular landscape characteristics such as beaches, bays, forests, and lagoons, offer opportunities for active and passive recreation. One recurrent type of recreational activity is birdwatching, but also the local gastronomy, which is heavily influenced by the ecosystems present (such as oysters in the Arcachon Bay), plays a role in becoming an attractive touristic destination. In one case, the Ebro Delta, tourist fees in relation to particular sites and activities are already being collected. Revenues flow back into the maintenance of the sites and the necessary touristic facilities and staff members. In eight out of nine cases the touristic sector has been identified as a potential source for revenue generation. Five generic instruments through which this can be achieved seem relevant for several cases. We first identify two types of tourist fees, namely tourist fees that grant access to certain areas (such as natural parks) and tourist fees that are related to engagement in particular activities (such as hunting, which is seen in the Ebro Delta, the Rhone Delta and the Venice lagoon or diving and boating which is seen in the Foros Bay). Further, in many regions in our case study areas, tourist taxes are already charged to visitors. An initial calculation for the case of the Ebro Delta shows that there is a significant revenue generation potential given the half a million tourists that are expected to visit the area on a yearly basis. However, such taxes are a means for revenue generation for the public sector, and as such, for such revenues to flow back into NbS such tax systems need to be further investigated and restructured. Collecting tourist tax is a mechanism that needs regional scale coordination, falling outside of project-level influence. Particularly in the case of the Venice Lagoon, a low willingness amongst the general public to charge fees to tourists was identified. A system that allows tourists to make voluntary contributions, especially where many tourists are present, could be another strategy for some revenue generation from the tourist sector. Finally, a fifth instrument that is related (but not limited to) the tourist sector is the selling of eco-labelled products, where the tourists and visitors are a particular market segment, next to other (export) consumer segments.

**Of interest for revenue generation is also the category of avoided costs or a reduction of costs. In particular the costs related to the disposal of dredged material** (relevant in the cases Arcachon Bay, Eems-Dollard Estuary amd Venice Lagoon) **and the costs related to dike (or dam) maintenance** (relevant in the cases, Ebro Delta, Eems-Dollard Estuary and the Rhone Delta). Such costs typically involve instantaneous or periodical transactions (transfer of money from one party to another) and as such these types of cost savings are traceable and are felt by those paying for the activities. Consequently, a payment from the beneficiary, reflecting either the full cost reductions or the partial cost reductions, to the NbS (initiator) is quite feasible. In the case of the Eems-Dollard, a payment of €14.000.000 from the port authorities towards the NbS as a result of saved dredging costs has been confirmed. The **avoided future costs, or reduced future costs, from flood damages has also been identified in several cases** (Nahal Dalia, Sicily Lagoon, and Venice Lagoon)**.** Although a very relevant economic argument (or justification) for investing in NbS such benefits are less "concrete" than operational cost reductions since they are dynamic, uncertain, and stochastic in nature (in the case of no flood event there are no benefits)**.**

**Given the numerous benefits delivered by the NbS and the revenue generation mechanisms that have been identified in the nine cases, 6 NbS interventions expect to implement a funding model based on public and private co-funding where both grants and donations are combined with revenue generation.** In most cases that are expected to rely on a public funding model (either from a single public funder, or via multiple level public co-funding) future revenue generation is anticipated, in the least through carbon credit sales. Each case still relies for a large part on public funding. Although there are several ways identified in which the funding models can be diversified, many of the benefits delivered are in fact public goods, and so, the role of public funding remains fundamental.

**In the case of the Eems-Dollard Estuary, the level of data availability, analysis and financial preparation has allowed for three different finance models to be deployed, namely the registration for future sales on**

**the voluntary carbon market, a bridge loan, and an offtake guarantee for the clay production.** To deploy the instrument of carbon credits, further calculations, verification and validation is needed. However, the project has been registered at the National Carbon Market Foundation to avoid future problems of additionality. Within two years after registration further, more detailed calculations and evidence needs to be provided. A loan to bridge the time lag between the implementation and the revenue generation from Carbon Credits has been discussed and contacts have been established with European Investment Bank to explore potential instruments to cover this. Finally, the revenue generation that is anticipated from the use of clay in the future dike project is substantial (€58.000.000 – 100.000.000); and an intention agreement or offtake guarantee is under negotiation to mitigate market risks for the project.

**When it comes to the implementation arrangements we observe four flavours of implementation arrangements, depending on the distribution of responsibilities and ownership as well as the level of 'implementation readiness'.** The first is the well-known form of public procurement, where the land and responsibilities lay with public authorities, who establish public procurement to purchase the desired activities. We see this in the cases of Arcachon Bay, Nahal Dalia, and Venice Lagoon. There is ample opportunity for engagement and communication with stakeholders (often by making use of the REST-COAST CORE-PLAT) yet no formal transfer of ownership, responsibility or decision-making power occurs. The second flavour is similar but includes in the procurement also the purchasing of services such as academic (scientific) advice and post-delivery services such as monitoring and maintenance (the case of the Ebro Delta). In both these arrangements collaboration with multiple stakeholders, especially academic partners and NGO's, is emphasized. The third type we encounter is the establishment of a separate entity for project coordination, implementation, and management. In this case (the Eems-Dollard Estuary) a separate public or private or private fund structure is considered for the implementation of the long-term project. An intermediary for financial management (risk management, cashflows, further acquisition and revenue generation) is also considered here. As such, a new coalition is formed. The last flavour identified is the one where the NbS activities are on their way to become embedded into the existing management plans and strategies (such as coastal zone strategies, water framework directive plans, N2000 management plans…) for which institutional structures and protocols often already exist (Rhone Delta and Vistula Lagoon).

**Key challenges and project risks that are seen in the cases, including those directly but also indirectly related to funding and financing the NbS span a variety of different topics.** A few of the common issues encountered are the lack of social acceptance for charging fees to tourists (Venice, Sicily, Nahal Dalia), unstable or unreliable carbon credit markets and the negative reputation associated to carbon credits (and private sector involvement in NbS in general (Arcachon Bay, Ebro Delta, Rhone Delta), and missing data for establishing the carbon sequestration (revenue) potential (Ebro Delta, Sicily lagoon, Nahal Dalia). Further, we encountered challenges associated to sediment re-use, which is especially relevant in the case of the Eems-Dollard Estuary and the Venice Lagoon. Sediment pollution is seen as a project risk (with potential negative environmental consequences and increased transaction and project costs) and there is uncertainty with regards to changing regulations for sediment deposition. Furthermore, transboundary collaboration (Eems-Dollard Estuary, Vistula lagoon) was identified to be a challenge, which is also relevant for further upscaling. Further observations and considerations regarding (upscaling) challenges encountered are discussed in Chapter 4.

# Chapter 4. Cross-comparison of "scalability" results (Extension 2)

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This chapter will summarise the findings from the pilots and provide an overview of the key challenges and barriers to upscaling. In this chapter, we will first present what the pilots defined as upscaling. Then we will present barriers and opportunities to upscaling.

## 4.1. What does upscaling to the landscape scale mean?

Upscaling entails going from a pilot approach at a smaller project scale to a landscape scale and sometimes transboundary scale (e.g. Eems Dollard, Vistula Lagoon). We have collected what the pilots interpret as landscape scale in table 6 below. Throughout this process of transformation, interventions must be redesigned to fit the increasing complexity. This is often encountering resistance from the current (economic) governance setup and design related to the concept of the pilot paradox, explained in the methods section (chapter 2.4), also defining landscape scale.

**The pilots presented different understandings of how they saw upscaling, which was often defined by pressures and bio-physical dynamics, but often constrained by the current governance system.** Important criteria were influenced by the main pressures on the ecosystem, such as past and present inflows from eutrophicated and polluted waters (e.g., Vistula Lagoon, Foros Bay, Rhone Delta). Factors like bird population dynamics and migration were also defining this boundary (e.g., Vistula, Sicily Lagoon). For instance, artificial (floating) islands in Vistula Lagoon could provide a safe haven for birds that have lost their habitats due to land use changes. This bird-centered approach to upscaling complements the common understanding of the river basin as a crucial unit. In the Eems Dollard pilot, one of the upscaling conditions related to how much sediment is planned to be captured, providing yet another kind of dimension. Although several pilots identified the river basin as important, it was often deemed too large for upscaling interventions. In all cases, the dimensions of upscaling actions were very much influenced by socio-economic priorities and constrained by the governance system. See Table 6 for a summary of the upscaling definitions in the pilots.

It is important to note that the pilots in the REST-COAST project vary in size and maturity, also affecting how they view upscaling and what their constraints and opportunities are. For example, the Nahal Dahlia pilot is relatively small, and a private landowner has an important role, while the Eems Dollard pilot on the Dutch side operates at a landscape level with both public and private landownership. Here, planning and implementation cover a large part of the coastal zone, with ongoing sector integration activities and the development of funding mechanisms for pooling different projects. Therefore it is difficult to compare the pilots, but instead the differences can contribute to display and showcase a breath of barriers and opportunities.

**Table 6 How different pilots view upscaling**

| Pilot site | **How the pilot coordinators defined upscaling.** Timescale is 5-10 yrs if not stated |
|---|---|
| Arcachon Bay | The whole of Arcachon Bay, where seagrass is possible to be restored and where it is not competing with other important land uses. A vehicle for upscaling is the restoration strategy for the Bay. With 1 hectare of seagrass restored per year; the goal is to restore 50 hectares (ha) in the next 10 yrs. |
| Ebro Delta | Upscaling refers to “Saving the Delta” where multiple interventions are aligned and combined, including (but not limited to) wetland and lagoon restorations, beach nourishment, dune restorations, sediment by-pass, natural park management, environmental flows, and riparian forest restoration. A programmatic approach coordinates financial inflows (from funders and revenue streams) and outflows (to implementation and management activities). Surface area is the Double Delta ca 33,000 ha. |
| Eems-Dollard | The Growing Delta – a portfolio approach (incl. raising agricultural lands, clay ripening, and establishing natural sedimentation zones) with a time horizon of 10 years. For longer term and larger scale integrated coastal zone management, with a shared (multi-sectoral) vision was identified, including multiple societal objectives including (but not limited to) ecological restoration, flood protection and liveability. The total area includes 39 ha of agricultural land, total amount of 200 M clay extracted from system, size if natural zone is unknown. |
| Foros Bay | Upscaling would need to tap into various measures and NbS including floating artificial islands to address water quality issues, such as eutrophication, pollution, turbidity benefiting e.g. tourism in an area of around 80,000 ha. However, the main culprit is perceived to be the Bay is upstream areas which covers a much larger area. Additional scope for a business plan could be erosion and wave impact relevant for PES schemes with e.g. real estate, industrial and port actors. |
| Nahal Dahlia | Planning of other similar restoration projects in the area (southern Difle). Expanding successful NbS interventions rewilding fishponds (150 ha). Addressing environmental, social and economic challenges at a larger scale from a geographic point of view, or in terms of project management and collaborations with other projects at the regional level. Time horizon +5 years. |
| Sicily Lagoon | Province scale with other potential sites in province (in total 161 ha) e.g. Riserva Fiume Ciane/Saline (SR) (48 ha), plus Saline Priolo (SR) (13 ha), Pantano Gariffi (100 ha). The three potential restoration sites are located in the Southern-Eastern part of Sicily and present some heterogeneity of environmental / bio-physical setting. Moreover, their socio-economic context and the related regulation and governance aspects present differences from the Cuba-Longarini restoration site (current and extension #1). |
| Rhone Delta | In Rhone Delta, two alternatives were described: |

| | |
|---|---|
| | - Intensification where they already work, including 12 restoration projects in Camargue (6,000 ha); improve the circulation of the water and restore the wetland ecosystems knowledge development on coastal restoration. Time horizon: the next 5-10 yrs.<br>- Upstream upscaling is not perceived as feasible, as agricultural land use still is a strong socio-economic priority. However, measures to reduce pesticide inflow while manage salinization has been discussed for areas upstream of Camargue. |
| Venice Lagoon | Intensification of restoration of artificial and natural saltmarshes and mudflats (> 1600 ha - "the entire" Venice Lagoon). Time horizon: 5-10 years. |
| Vistula Lagoon | Reduce eutrophication within Vistula lagoon (33,632 ha). River basin blocked by barriers, so less relevant scale. Instead, bird population dynamics is relevant, when they migrate from areas inland undergoing land use change from agricultural land use to forest. Addressing water quality in the Baltic Sea is relevant for solving them in Vistula. Time horizon 30-40 years. |

## 4.2. Overview of barriers and opportunities to upscaling

**Our results suggest that upscaling barriers depend largely on the lack of systemic approaches to planning and implementation as well as the lack of developed markets for ESS.**

In the following sections, we will describe the different upscaling barriers and opportunities that were identified in the pilots and will be explained according to the following typologies*: Technical, financial, awareness, regulatory, institutional, planning and (cross-cutting) transaction costs*. Table 7 gives an overview of these elements that are interconnected, making it necessary to address upscaling systemically.

**Table 7 Type of upscaling barriers and opportunities**

| Type of upscaling barrier | Upscaling barriers | Upscaling opportunities |
|---|---|---|
| **Technical knowledge** | Lack of data and of technical knowledge. (Sicily)<br>Low sediment availability; limited data availability (Venice) | Knowledge sharing between countries to agree on joint strategies (Eems Dollard). |
| **Financial** | Lack of value capture mechanisms (all)<br>Low return on investment (Vistula)<br>Long time horizon of restoration efforts; (Vistula)<br>Lack of developed markets (carbon sequestration, dredging, erosion) (Arcachon + )<br>Need robust estimates before can enter the market (carbon sequestration) (Arcachon)<br>Resistance to market-based schemes by non-profit actors (Arcachon, Sicily)<br>Lack of secure funding; (Sicily, Venice)<br>Large investment costs; high costs (Venice) | Markets are developing –carbon credit methodology for Seagrass has already been developed in France and approved by the government (Arcachon).<br>Making carbon credits more uniform would consolidate trading activity around a few types of credits and also promote liquidity on exchanges (e.g. Arcachon).<br>PPPs to further explore how to bridge the gap of private financing/funding (e.g. ports, Foros Bay).<br>CSR can provide substantial private sector support to upscaling, where trusted relationships is key (Rhone).<br>Reducing the risk for investors by applying smart contracts or Environmental Impact Bonds, or setting up a dedicated fund etc.<br>Reuse of sediments for NbS reduce costs for transport and disposal (Venice). |

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| | | Pooling of projects/bundling and pooling of funding (Eems Dollard, Ebro, Venice). |
| **Awareness** | Little understanding of ecosystem benefits; (Foros Bay)<br>Institutions need to stick to what they know works and keeping the people safe (erosion, flooding) (Arcachon)<br>Lack of awareness of restoration as solution for coastal protection. (Rhone Delta)<br>Conflicts between nature conservation and local population. little understanding of ecosystem benefits; (Rhone Delta)<br>Lack of awareness of the local population that there is a problem in the estuary (Eems Dollard) | Many guidelines available on how tourism can support local sustainability.<br>Seeing is believing. It is important for people to see the practical result. (Pilot demos in general).<br>Involving local people – to create awareness and also to learn from them in a two-way exchange (Eems Dollard).<br>The cultural landscape is valued highly by the local community. Awareness campaigns could tap into such non-monetary values (e.g. Ebro Delta). |
| **Regulatory** | National level strategies are not translated to local level action (green resilience) (Foros Bay).<br>Time intensity of obtaining/adjusting permits (Arcachon).<br>Natura 2000 regulation as barrier (Eems Dollard)<br>Lack of harmonization of policies and legal system and (Vistula; Eems Dollard)<br>different cultures of decision-making (top-down vs very extensive deliberations) (Eems Dollard)<br>Lack of decentralization and low institutional power for local authorities; unclear roles and responsibilities; lack of transparency; high bureaucracy (Foros Bay)<br>Poor policymaking is preventing upscaling; (Sicily)<br>Bureaucracy (Foros Bay) | Support mechanisms to translate national green strategies – and available scientific knowledge to local measures (e.g. Foros Bay).<br>Agreeing to change Natura 2000 legislation if all parties agree they can do so (Eems Dollard).<br>Regional framework agreements (Vistula / HELCOM)<br>A plan to investigate needed changes in regulation and governance structures (Eems Dollard).<br>Collaboration on joint strategies, and knowledge exchange in projects like REST-COAST (Eems Dollard). |
| **Institutional** | Siloed organizations with low interest in integrated solution; conflicting interest (Sicily; Eems Dollard)<br>Delay due to institutional framework (Venice); low institutional trust (Venice).<br>Limited authority of restoration initiator (Nahal Dalia)<br>Need for a figurehead as leader to inspire and communicate in the media and convince people (Eems Dollard)<br>Fear you have to pay for the other sector (Eems Dollard)<br>Institutional mandates and business as usual barrier for experimenting, taking risks | Need a coordinating actor who has the mandate and knowledge to do the needed NbS measures and listens to the problems of others and facilitates collaboration, taking joint decisions on alternatives (Eems Dollard).<br>The pilot phase has demonstrated it was possible to integrate sectors (Eems Dollard).<br>People with a certain personality who drive things forward. (Eems Dollard, Rhone Delta) |
| **Planning** | Lack of long-term development strategy (Vistula)<br>Lack of vision for coastal planning (Sicily)<br>Not yet a spatial planning for the whole area; (Eems Dollard) | Spatial planning: integrating pillars from different sectors. By planning together and re-designing the approach, it becomes a common problem. An intention declaration for the 10 yr planning – seen as first step in scaling up (Eems Dollard). |

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| | Does not want to pay for other sectors (Eems Dollard) | Need to go from planning for a line to a coastal zone with many sectors co-existing (Eems Dollard) |
| **Transaction costs – cross cutting** | In the pilots there was a lot of transaction costs and opportunity costs and risks associated with adopting NbS.<br><br>Lack of existing examples and forerunners, need to start up PES schemes etc. and find partners, taking time for coordination, and still, there's uncertainty. Adopting NbS is not considered familiar, not clear who bears the risk if something goes wrong (all pilots). | A broker/institutional mechanism that was suggested, is an opportunity that could help reduce transaction costs of stakeholders for upscaling (all pilots, see table 8).<br><br>Supporting and nudging investors in choosing NbS alternatives by providing subsidies and taxes, and other instruments is especially important where competing land uses are developing. |

### 4.2.1. Technical knowledge barriers and opportunities

**Lack of data and technical knowledge was reported as a barrier for upscaling in Sicily and Foros Bay.** Developing procedures and technical specifications to support NbS implementation can help overcome related hurdles. For example, in Foros Bay, a planned intervention in the starting point with a bird platform ran into problems with public procurement since this would be one of the very few procedures ever to have been carried out (pilot coordinator had found only one more example on the internet) and the responsible for the procurement was not happy with the resulting technical description and also, they ran out of time. **The support from a** multidisciplinary (scientific) community was identified as key to setting long-term overarching goals and visions and giving input into the political process in Vistula.

Knowledge barriers are often related to the fact that NbS often introduce technological innovations and require the technical competence needed to construct, operate, maintain, and address any issues as well as sufficient technical references, design standards and guidelines (EC, 2020). This is compounded by limited data available, for example regarding the quantification of benefits and co-benefits of NbS ESS (Sánchez-Arcilla et al., 2022).

**Transboundary knowledge sharing between countries was seen as an upscaling opportunity**, enabling joint strategies to manage joint resources. For example, in Eems Dollard, a sediment strategy supports the harmonisation of management approaches in the Dutch and German areas. In Vistula Lagoon, knowledge sharing had been ongoing with the Russian counterparts but was since the beginning of the invasion of Ukraine completely prohibited. Bridging knowledge gaps is important in transboundary governance as the lack of it can hinder agreements at a political level. For example, there may be disagreement regarding the problems to be addressed and the need for solutions, inhibiting the development of a policy agenda. Knowledge gaps can also add to mistrust or otherwise become politicized. Further, knowledge gaps may inhibit the political support of domestic (national and sub-national) stakeholders who influence national decision-makers (Milman et al., 2020).

### 4.2.2. Financial barriers and opportunities

**In two pilots (Ebro and Eems Dollard), as upscaling progresses, pooling of resources becomes important and is discussed with involved parties. In all pilots, it is also evident that there is a lack of approaches to broaden the funding base beyond public funding, although CSR is strong in one pilot (Rhone Delta).** To broaden the funding base, Corporate Social Responsibility (CSR) initiatives exist, which other pilots could get inspiration from, and different Payment for ESS were proposed. The most developed opportunity was carbon capture, although it has not yet been operationalized. Other identified opportunities include tourism, erosion control, and flood risk reduction. These opportunities would complement existing and potentially increasing public funds and grants, which will likely remain the largest source of restoration funding. Potential increases in public funding or initiatives to enhance various financial arrangements for restoration need to be considered in the context of the newly adopted Nature Restoration Law.

### Financial pooling of resources.

**The financial pooling of both public and private finance was discussed in several pilots to enable the bundling or pooling of project resources to a larger pool.** For example, in Eems Dollard, different alternatives for organising the streamlining of public and private co-funding and revenue generation, payments for example for loss of land. A private fund structure, a public fund structure or a financial intermediary such as National Groenfonds have been discussed. In Ebro Delta, the need to create a platform, or a mechanism, in which funding contributions and revenue streams (inflows) for restoration projects (outflows) can be coordinated and managed at a larger scale, was pointed out. Blended finance combines public and private funding to support restoration projects. This approach helps mitigate risks for private investors while ensuring that public funds are used effectively. This report argue for business model innovation to attract diverse funding sources, including impact investments and public-private partnerships, and other sources discussed in the following sections. However, it was also clear that none of the pilots have access to larger regional impact capital investors.

### Private contributions as Corporate Social Responsibility (CSR)

**As described the Rhone Delta represents an impressive case of private ownership and funding.** The main part of this funding is a legacy of individual champions in restoration resulting in the setup of the MAVA and a successor, the Pro Valat Foundation. The contribution of individuals as driving forces for change is noted in the literature. In addition to the Pro Valat foundation, the contribution from other private actors as CSR is around 20%. Such contributions provide a very promising benchmark. If private partners could contribute this much to restoration in other places, then this would provide a substantial boost for restoration in general and upscaling in particular.

The lessons from Rhone Delta show that this engagement by private actors is made possible through a deliberate strategy and a dedicated partnership Director, and providing added value to the funder through site visits and seminars. The most important element is the trust capital that Tour de Valat has built up throughout the years by demonstrating that they are a trusted and professional partner. However, this does require a different expertise to funding applications and significant time investment. It is also interesting to note that the funding for Tour de Valat is not conditioned upon a quantification of the Ecosystem Services or their values.

### Carbon credits

**In general, the pilots reported a lack of developed markets for carbon sequestration.** A majority of the pilots identified carbon sequestration from the NbS intervention (Arcachon Bay, Ebro Delta, Eems-Dollard, Foros Boy, Rhone Delta, and Venice Lagoon), but in none of the cases, carbon credits are currently used to fund restoration activities. In many of the countries this is not yet developed for coastal ecosystems. Instead, forests are prioritized for developing a carbon sequestration market (France, Bulgaria). In some pilots, there was no carbon sequestration market at all (e.g. Israel). Establishing top-down frameworks for financial mechanisms such as carbon credits can create support for the involvement of the private sector. With an established methodology the private sector has easier access to purchase carbon credit offsets for corporate social responsibility certification for emission reduction. Additionally, it reduces the capacity requirements for setting up this mechanism for initiators of NbS. An example of this scheme is the French “Label Bas Carbone” which can help to couple private-sector companies that seek to reduce their $CO_2$ footprint with carbon sequestration projects. France has developed the first carbon credit accounting methodology in Europe for protecting seagrass beds allowing French companies to use the credits to offset emissions. The seagrass carbon credits system has also gained the approval of the French Directorate General for Energy and Climate (DGEC). This was the result of a public-private partnership where a private consultancy leveraged technical expertise. In a similar vein, the private company in Arcachon, Seaboost aims to support the government-led Seagrass intervention (Carbon Credits, 2023).

*Our findings confirm that establishing top-down frameworks for financial mechanisms such as carbon credits can create support for the involvement of the private sector*

**In Arcachon, one barrier to rolling out carbon sequestration for seagrass and entering the voluntary carbon markets was the need for robust estimates.** There is still uncertainty about the amount of carbon sequestered in the short and long term. In the coming time, the pilot coordinators hope to produce such evidence and use it in the dialogue with the local MPA manager. They are aiming to present different scenarios of Seagrass restoration for various locations (e.g. where to restore Seagrass, and with what effect on ESS) to give input into discussions on long-term strategies. They were hoping that this could open for adopting their approach for restoration which could be scaled up at bay level. This is related to an already known barrier, that each credit has attributes associated with the underlying project, such as the type of project or the region where it was carried out, affecting the price. An opportunity therefore lies in making carbon credits more uniform which would consolidate trading activity around a few types of credits and promote liquidity on exchanges (Blaufelder et al., 2021). However, this would have to consider the different calculations used for carbon sequestration which differs between for example woodlands and seagrass. This requires a standardization of the measurement protocols to better compare the efficiency of carbon sequestration across habitats. Thus, consolidation and standardization can enable upscaling (Stafford et al., 2021).

**In the pilots, the contributions of carbon credits are relatively small per restoration initiative**. This has been described as a financial barrier and in the literature a known barrier referred to as “small ticket size” (Favero & Hinkel 2023). This means a lot of transaction costs to develop a relatively small number of offsets. Consolidation and standardisation could as such help better pool the contributions of carbon with other kinds of PES schemes in the same location or across different locations.

**In some pilots we see resistance to market mechanisms.** For example, in Sicily, the initiator, a non-profit organisation, is not interested in implementing revenue-generating value capture mechanisms, if these are meant for third-party profit. Also, in Arcachon, there is currently low stakeholder support especially with the environmental sector and the MPA manager, for the involvement of the private sector within the area. This resistance is known as a general scepticism to markets in ecosystem restoration, where some see the expansion of markets into conservation as part of the wider process of neo-liberalisation (McCarthy & Prudham, 2004), and worry that instead of contributing to environmental conservation, the use of market logic could ultimately harm reaching the desired outcomes of the conservation movement (Sagoff, 2005). On the other hand, more market-oriented ecologists argue that the trend towards market-based conservation is an asset for the environmental movement because it provides policymakers with economic arguments for conserving nature (Balmford et al., 2002; Blanchard et al., 2015; Constanza et al., 1997).

**In spite of these reservations, the future is looking promising for carbon credits.** The Taskforce on Scaling Voluntary Carbon Markets (TSVCM), sponsored by the Institute of International Finance (IIF), estimates that demand for carbon credits could increase by a factor of 15 or more by 2030 and by a factor of up to 100 by 2050. Overall, the market for carbon credits could be worth upward of $50 billion in 2030. Given the demand for carbon credits that could ensue from global efforts to reduce greenhouse gas emissions, it’s apparent that the world will need a voluntary carbon market that is large, transparent, verifiable, and environmentally robust (Blaufelder et al., 2021).

*Estimates of ecosystem service value for coastal protection are significant and should be included in Cost Benefit Analysis in regional planning.*

Other PES schemes: eco-tourism, eco-labelling, dredging

**Several other ESS were identified as having opportunities for improved value capture by different PES Schemes**, for example in sectors such as tourism, dredging and coastal safety. Just like in the case of carbon sequestration, a challenge in demonstrating ESS values is the need for modelling and quantification tailored to specific localities. In REST-COAST pilots there is modelling taking place which is in many cases aiming to feed decision-making.

**Many pilots demonstrated sediment capture as an important ESS.** For example, sediment capture of seagrass such as in Arcachon or Foros Bay can reduce the costs of hiring private dredging companies, and the payment mechanisms could be contributing to upscaling, if implemented. However, currently, there is no funder or financier for any suggested payment schemes. In general, the value of seagrasses as an ecosystem is often not considered in marine management decisions and rarely incorporated into NbS projects (Lima et al., 2023). The European Union could play an important role in investigating the best mechanism to support implementation of NbS where feasible, by incentivising different actors such as dike agencies or ports.

**An enabler for upscaling is that the needs for risk reduction is increasing in public investments. For example, reducing** flood risk and controlling erosion by restoring seagrass, kelp forests and coastal wetlands (Hudson et al. 2023).

**In Arcachon, actors perceive the need for incentives (in combination with PES) to implement seagrass as an alternative or supplement to a seawall.** Implementing NbS for coastal safety could be incentivised by reducing the risk for investors and applying for example Environmental Impact Bonds (EIB) and smart contracts suggested in Favero et al. (2022). Other good practices also exist. For example, Canada established in 2021 a dedicated fund to support natural and hybrid infrastructure projects for DRR (UNDRR, 2024). In the Netherlands, it would not be safe to remove dikes, but more nature-friendly dikes are possible as the Eems-Dollard pilot shows. But in other places, the bio-geo-physical realities are different which makes NbS defences more feasible.

**Future climate change, including sea level rise and increasing storms, will require new innovative efforts in financing NbS solutions that mitigate wave energy reduction, and erosion control to safeguard beaches and coastal real estate.** Port operations may be interrupted, which is very costly, and mitigating erosion damage to port infrastructure, and reducing/avoiding dredging costs will be increasingly worth the effort of implementing NbS. Estimates of seagrass value for coastal protection from the literature are significant (Up to €40.000 /ha/yr) and should be included in Cost Benefit Analysis by coastal scientists, regional planning authorities, port authorities and enterprises. In addition, increasing tourism in the future (Foros Bay) or already high levels of tourism (Venice, Arcachon) will place increasing value on beautiful beaches and good water quality for bathing and boating. As such, tourism, coastal development, nature restoration and disaster risk reduction are sectors that have many similar goals and could benefit from working together under a broader strategy/institutional umbrella and coordination which can help develop instruments to create more revenue for NbS restoration.

**Public Private Partnerships (PPP) can be one way to explore how to do value capture and learn how to push a wider uptake of NbS.** Such initiatives could increase the recognition of the value of NbS and speed up the slow uptake. This has been attributed to traditional cost-based assessment models, procurement methods and legislations that are not adapted for NbS. The NL2120 consortium is an example of a PPP, driven by a major €110M investment from the Dutch government to help upscaling of NbS, driven by a rising demand for sustainable practices. The partnership includes key stakeholders in the dredging industry, including Van Oord, and Boskalis, associated with NL2120, that will help provide valuable insights into the complexities and obstacles of NbS adoption and strategies to address them.

In Arcachon, they also suggested the idea of a **Private-Private Partnership** with local oyster farms to reduce costs and improve support. Such collaborations could also increase understanding of each other's interdependencies and opportunities for further win-wins (e.g. ecolabelling).

**The domination of economic priorities is a big barrier to upscaling in many pilots**. For example, in Vistula, any investment in the region will be mainly directed towards building the local economy. In addition, the perceived low return on investment for NbS projects is a hurdle in combination with a long-time horizon for the interventions to take effect. For example, investing in measures to address eutrophication will not immediately lead to good bathing waters that can help boost the local economy. However, several pilots also illustrated how coastal restoration can provide win-win with economic goals. For example, in Venice Lagoon, the reuse of the sediments for NbS (saltmarsh refilling), dredged from the Venice lagoon channels, reduces the costs which otherwise would be transported to a landfill and disposed of causing further emissions. In Vistula Lagoon, the creation of an artificial island, also illustrates how NbS projects are coupled with wins for the local economy. In Eems Dollard, the capturing of sediment from the estuary is being piloted for use in dike construction.

#### 4.2.3. Awareness as a barrier and opportunity

**In several pilots, it was an issue that local communities did not understand the benefits provided by NbS and perceived it as a risky alternative compared to traditional grey infrastructure.** This was seen as a lack of understanding and awareness of the role of restoration for coastal defence (Rhone Delta, Arcachon Bay, Ebro Delta). People prefer dikes as it is perceived as 100% safe. In Ebro Delta, the public desires to 'keep the shoreline fixed' and 'not move further back one meter" which contrasts with a dynamic coastline with NbS. An important enabler for upscaling therefore seems to be awareness raising of why the NbS solutions are effective, for example, that the integrity of shorelines, deltas and estuaries depend on enabling important sediment flows, creating the coastal buffer zones and mitigating risks.

**Several pilots reported the lack of awareness of restoration actions and the critical role of ESS for the economy and society** (e.g. Foros Bay, Eems Dollard, Rhone Delta). For example, in Eems Dollard, there was a lack of awareness among the local population that there is a problem in the Eems estuary. In the Rhone Delta, there were conflicts between nature conservation and the local population, partly because they could not see the benefits of ecosystem restoration. The historical legacy also plays a role, with the closing of the local salt mine, and the loss of many jobs, which many community members associate/blame the restoration activities. Access to the restoration areas for the local communities had also become more limited.

**Seeing is believing and therefore several of the pilots Ebro Delta and Rhone Delta can provide valuable demonstration sites** that people can see in real life. In these two pilots the approach was to abandon dikes as a solution to safety, to instead enable natural sediment dynamics, which in the long run build up the coastal zone. Involving local people was also seen as an opportunity, not only to make people more aware but also to learn from them in a two-way exchange and benefit from local knowledge (Eems Dollard). Globally, there exist many different examples of where upscaling has worked and international platforms for learning and sharing, with opportunities for site visits, can here play an important role, within and beyond the REST-COAST consortium. For example, project calls could include elements of peer-to-peer learning between project participants and relevant decision-makers.

**In many of the pilots, increasing tourism is a pressure on the ecosystem (Foros Bay, Arcachon Bay).** According to the Ocean Foundation, one barrier here is the lack of awareness of companies active in the area to support PES schemes (in tourism). The tourism industry has been described as "self-consuming", exerting significant pressure on ecosystems and leading to biodiversity loss and pollution. Coastal and marine tourism accounts for over 50% of the global tourism industry and plays a fundamental role in the economies of coastal communities. Awareness creation plays an important role in creating a change within the relevant companies. For example, according to the latest "Business for Ocean Sustainability" report by One Ocean Foundation, less than 25% of tourism-sector companies studied acknowledge the pressure that the industry places on coastal and marine biological integrity and diversity. There are many initiatives and guidelines that support tourism companies to engage in local sustainability, such as installing wastewater treatment devices. In turn, restoration activities could engage with ecotourism to include educational entertainment initiatives that intertwine the preservation of natural resources with the creation of enjoyable experiences for tourists.

In Ebro Delta the cultural landscape is highly valued highly by the local community which could be influencing decion-making processes for upscaling and be a resource for awareness creation/campaigns. By resonating with values and feelings, an approach often used in marketing, the citizens and decision-makers can be targeted better than scientific articles and data.

#### 4.2.4. Regulation barriers and opportunities

**In many of the pilots, it is also evident that although they have national level strategies for promoting NbS or "green resilience" these are not translated to local level action.** For example, in Bulgaria, there are national strategies in place to implement green resilience building, targeting erosion control and climate change actions, with considerable investments by European actors. However, as illustrated by the Foros Bay pilot, this does not yet trickle down to the local level where the grey methods are preferred by local authorities, although seagrass is an NbS with a demonstrated effect on erosion and flood mitigation (Forrester et al., 2024). One barrier is the traditional mandate given to disaster risk reduction agencies or contingency agencies to deal with these issues, sectors that normally do not apply NbS as solutions. This is partly because NbS are not mentioned in their statutory guiding documents and regulations, that focus on preparedness, response and recovery actions. NbS is rather a solution which is framed under the policy agenda of sustainability and to some extent adaptation. In both Arcachon Bay and Rhone Delta, erosion and flooding are mandated to sectors that are not traditionally active in restoration. However, in the Rhone Delta, the restoration is contributing to coastal protection, which is in line with plans for a "softer" protection. Support mechanisms to translate national green strategies remain an opportunity for the future. In this context, there is a need to integrate and mainstream NbS for Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) into policies and regulations (EEA 2021).

**In a few pilots, the restoration activities and plans encountered barriers from environmental regulation and bureaucracy.** For example, in Arcachon, there was a cumbersome process to apply for new permits to experiment with NbS. In Eems Dollard, and Foros Bay the restoration activities at the pilot scale are allowed in the Natura 2000 area, but the upscaling phase which underway requires exemptions. However, in Eems Dollard, this was not seen as a serious hurdle, as the (multi-level) governance parties who decide on the interpretation of the legislation, all agreed that this was a barrier that needed to be overcome.

**The pilots illustrated how the different levels of centralisation vs decentralisation played a role in stakeholder involvement**. For example, in emerging economies like Foros Bay, it was expressed that the (too) centralised governance with too little stakeholder involvement from the local level, resulted in that plans and actions not being designed considering local actors' needs. In addition, the unclear roles and responsibilities are a great barrier, as it requires the need for actors to engage very widely with decision-making actors to stay informed and involved, with a lot of transaction costs for the local actors.

**Some pilots also mentioned the challenge of upscaling due to a lack of harmonization of different provincial regulatory frameworks,** or just poor policymaking (Vistula, Sicily). Others mentioned the need to align several sectoral policies and regulatory instruments in the upscaling process, even at the transboundary level, to enable integration and coordination (Eems Dollard, Vistula). For example, the lack of harmonization of policies and the legal system (with Russia) was perceived as a barrier in Vistula. Regional framework agreements by the HELCOM were mentioned as relevant to achieving consensus in the Baltic Sea region relevant for Vistula Lagoon. For example, the policy development on fertilizer application and discharge was mentioned as important to provide a management framework.

These examples illustrate the important role of the EU and European Commission, in supporting member states in creating an enabling environment in terms of policies and regulations, and guidance for how they can be implemented and at the same time not creating too bureaucratic or static processes.

#### 4.2.5. Institutional barriers and opportunities

**All pilots reported on the challenges of integration. This concerned considering a variety of (conflicting) stakeholder interests and managing trade-offs.** In Eems Dollard, the tendency of different sectors to mainly prioritise their own interests, and fears that your budget will go to the other sector, was seen as an upscaling challenge. "*Now each institution is concerned about their issue they work with. All have their own tasks, their own goals. And now we must bring it together*. "(Interviewee in Eems Dollard). However, in Eems Dollard, the pilot phase has meant that they have been able to test the integration in a smaller project. This involved collaboration between several organisations that had to step out of their comfort zone, which now is a support when they are going to scale. A lack of collaboration within public departments is often mentioned as a reason for the lack of public funding for NbS (Dorst et al., 2022; Droste et al., 2017; Kabisch et al., 2016; Mayor et al., 2021; Toxopeus & Polzin, 2021). The shortage of collaboration, or information sharing, within organizations is often referred to as a silo mentality (Mayor et al., 2021).

**Not surprisingly, NbS was primarily promoted by environmental actors in the institutional landscape. However, as NbS provides multiple services, relevant for other sectors, these are not easily adopted by them.** This creates "lock-ins" for NbS in the environmental sector. For example, in Arcachon Bay, the stakeholders have their own separate interests, with limited common environmental targets. Biodiversity management falls under the responsibility of the MPA manager, who operates under the French Office for Biodiversity and follows national policy. The primary objective is to manage and restore local biodiversity. However, erosion and flooding, which are relevant ESS for seagrass (Forrester et al., 2024) are not within the MPA manager's scope. Conversely, SIBA (the organization of local municipalities) is responsible for erosion and flooding but does not include biodiversity in its targets, and it generally prefers seawall solutions. However, for the Disaster Risk Reduction (DRR) community to adopt new innovations such as NbS is not straightforward. There are too many political and professional risks to change strategy. It also involves many transaction costs to evaluate the alternatives and find partnerships, which makes it not worthwhile, if there is no carrot or stick (regulation, taxes or subsidies). In addition, in an emerging economy (Foros Bay) with unclear roles and responsibilities, these transaction costs may be even higher, as it is not clear who bears the risk or has control or ownership if something goes wrong.

**Integrating sectors starts with collaboration. However, in some pilots, the sentiments between stakeholders created challenges for engaging and forming partnerships.** For example, in Arcachon, the attempts by a private company to join existing governance committees and engage in the decision-making process have been met with reluctance from local actors. Instead, the company has shifted approach to work bottom up to reach the local stakeholders via building trust with the MPA manager and through the pilot results.

**In many pilots, other sectors had a high socio-economic importance and priority, which was seen as a related barrier.** For example, in the Rhone Delta, agricultural land use upstream discharges pollution/pesticides to the downstream pilot site, and allocates water in such a way it is affecting the natural area dynamics downstream. For Rhone Delta to engage upstream, there would be high conflicting interests, so they basically chose not to and chose instead another strategy of intensification.

**A related issue is institutional trust**. In Venice, limited societal trust in governmental institutions and politics strongly influences the public opinion regarding restoration, this disconnect is fed by the limited dissemination of scientific findings towards the general public.

Upscaling can also require **transboundary collaboration**, as in Eems Dollard, and Vistula Lagoon (if there is no conflict with Russia). This can also expose the challenges of collaboration due to different working cultures, knowledge development and decision-making, although commonalities may prevail.

*All pilots mentioned the importance of an umbrella institution to support visioning, planning and dialogue with stakeholders to balance ecology, economy & society.*

**To help bring in stakeholder views, an institutional mechanism was often mentioned as a way forward, although there were many times no such institution in place.** Such an entity could help facilitate the public consultations and dialogue between the different stakeholder interests and sectors, looking at the big picture. This organisation needs to be sitting in between government, science and NGOs, and respected equally by all parties, and be non-bureaucratic/flexible and science-based. For example, the Eems Dollard pilot coordinators, are working towards further upscaling, including the search for an organizational entity that can support the management of the coastal zone listen to the problems of others and collaborate. In addition, they are looking for new leadership that can provide the big picture of the upscaling vision to local communities and the media ("the Growing Delta"). Win wins are desirable, but often there are certain sectoral interests that must stand back for common interests, meaning trade-offs, and need for compromise, i.e. there is an opportunity cost.

**However, new institutional arrangements can provide barriers in terms of delays.** For example, in Venice, the introduction of a new Lagoon Authority was slow and before it was operational this process delayed the work and the decision making.

**Table 8 An overview of different institutional arrangements already existing or needed in the pilots.**

| Pilot site | Suggested function/role of the institution |
|---|---|
| Arcachon Bay | A platform exists for stakeholder interaction, but interests are siloed. One tool that was identified was an upscaling strategy that could include restoration plans. This platform could also explore financing from the private sector for example via a pooling system/ subsidised by public funding. |
| Ebro Delta | A public institution is set up to further develop and manage the voluntary carbon market plus a market where green projects supply and demand meet. Partnerships with universities and knowledge institutes are present for science-based approaches and monitoring. New institution or clear delegation of responsibility to existing institution is required for an integrated approach for protection and restoration of the Delta, including financial coordination. |
| Eems Dollard/Wadden Sea | The upscaling plans included to find an organization that is going to be responsible for the execution of the measures for the whole area. The main challenge for this organization will be to manage ecology and economy in balance, looking at the big picture including all perspectives. In the past the province has worked with a similar organization assigned to every Dutch province. |

| | |
|---|---|
| Foros Bay | A coordinating institution is needed to bridge the gap between government, science, and NGOs, earning equal respect from all parties. This institution should facilitate the implementation of necessary measures through a non-bureaucratic, flexible, and science-oriented structure. It would moderate the exchange of ideas and opinions, assess feasible and efficient actions, and develop an action plan. This plan would include various actions and interventions, inviting participation from different actors |
| Nahal Dalia | A recent idea has emerged to establish a management entity that would facilitate tourists' access to the Difle. |
| Rhone Delta | An organization would be needed to step up the stakeholder engagement and make a link between environmental management and socio-economic benefits for the local stakeholders. |
| Sicily Lagoon | Better coordination among different actors was seen as a potential enabler for upscaling. |
| Venice Lagoon | A new authority will be established for the Venice Lagoon. It will be promoting studies and research aimed at safeguarding Venice and its lagoon and fostering activities in applied research, information dissemination, and education. |
| Vistula Lagoon | A multidisciplinary scientific community could contribute to help set long-term overarching goals and give input into the political process. However, this requires some kind of coordination, but there is no institution that is currently in position to take such a role. |

#### 4.2.6. Planning barriers and opportunities

**A central tool for integrating of the whole coastal zone is spatial planning.** In the Eems Dollard pilot departed from an integrated regional planning approach, designed to address a landscape with different interests and stakeholders. A dual goal of economy and ecology in balance has supported good relations with stakeholders. Rhone Delta is a very successful case of restoration but is more challenged in terms of stakeholder engagement. This can be traced to the starting approach which is purely focusing on an area for restauration.

**Several pilots reported that a lack of vision and goals for the areas where restoration was taking place was a significant barrier to upscaling (e.g., Sicily, Ebro, Vistula).** This issue was partly due to the different strategic pathways available in these areas. For example, in the Ebro Delta, the absence of a unified vision for coastal defence and management strategy was identified. Instead, two alternatives were considered: the first involved expansion through sand nourishment, while the second proposed moving inland via wetlands, lagoons, and dunes. However, the second option, which is cheaper, faces more resistance from local inhabitants because it requires more land to be 'sacrificed' to create the natural buffer zone.

**In Foros Bay**, it was perceived that local communities' voices were not included in the visioning. This should have scientific support but also identify research and data gaps that need to be filled for the scientific community. In other pilots, actors were aiming to influence the existing restoration planning. For example, in Arcachon, the pilot actors aimed to integrate their upscaling technology into the current long-term strategy through discussions with the local MPA manager who in turn could raise this with the other stakeholders.

In the pilot Eems Dollard, the **Eems-Dollard 2050 program** (ED2050), has developed a long-term vision for the coastal zone. This is a result of a broad collaboration between governmental and provincial authorities, companies and nature organisations who work together to improve the water quality, and natural systems and prepare for climate change. The goals need to be reached by 2050. It needs to balance ecology and economy which means creating synergy with other issues like water safety, climate adaptation, regional economic development and quality of life. This integrated vision is also program is part of an explicit strategy to broaden the funding base and get more restoration activities going by creating win-wins. Although ecological restoration is at the core, it also recognizes that to scale up restoration, other priorities also need to be considered and sometimes there is a trade-off. The program is supported by the REST-COAST project and other bio-physical modelling scenarios and analyses. With such evidence-based planning, traditionally "nature is static" views have to give way for an understanding of dynamic sediment flows that do not stop at the border, and inflows from upstream areas. In addition, considering future climate change, current plans for sediment removal from the system might be counterproductive, and planning needs to consider different (adaptation) pathways (in WP4). In Eems Dollard, there is also an open planning process, including dialogue with citizens. Here, not all issues were up for discussion (some are non-negotiable) but many issues were possible influenced by the planning.

*There is transformative potential in reducing the transaction and opportunity costs for society – to consider ecosystem approaches as the most rational choice*

#### 4.2.7. Cross-cutting barrier and opportunity: Risks and transaction costs involved with introducing new solutions like NbS

In the pilots, there were a lot of transaction costs and risks associated with adopting NbS. Such transaction costs involved for example:

- Failed efforts to initiate measures due to lack of existing examples and forerunners (Forors Bay)
- No readily available funding, so need to start up PES schemes etc. to capture value which takes a lot of time to find (new) partners/resources.
- A lot of time needs to be invested in coordination and partnership and still, there is uncertainty about implementation or funding.
- Adopting NbS is a new measure and is not considered familiar or part of the institutional KPI and is therefore a risk where efforts can more easily fail (Arcachon).
- Uncertainty in mandate and responsibility: not clear who bears the risk if something goes wrong.

A broker/institutional mechanism that was suggested, is an opportunity that could help reduce transaction costs of stakeholders for upscaling. Such an entity could not only help mitigating conflict, but also help brokering and as increase efficiency in finding partnerships etc. This insight complements existing literature on transaction costs (e.g. Favero & Hinkel 2023).

In addition, many areas also reported strong drivers of (socio-economic) coastal development which would compete with NbS land use. This included in Ebro Delta for example the development of golf courses, greenhouses, windmills and solar panels. Such land uses typically are more attractive to financiers since revenue generation is easier. Therefore, natural and social values need extra attention to compensate for the opportunity costs (foregone profit) to drive upscaling of restoration.

# Chapter 5. Lessons learnt and conclusions

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This chapter does two things. First it presents and discusses the author's reflections on the methodological challenges and limitations faced while implementing Task 3.3, drawing together generic lessons learnt that will be valuable for any new project that embarks on the task to develop business models and business plans for NbS. Second, from the work conducted in the pilots, we draw some general conclusions on how to scale up funding and financing for NbS. In the final deliverable of WP3 (Deliverable D3.4), more attention will be given towards drawing recommendations and overall conclusions, also drawing upon other workstreams of WP3 and the other WPs. As such this chapter can be seen as an initial stock tacking of the insights from the nine pilot case studies.

## 5.1. An overly ambitious description of work

One important lesson learnt from this work, is that that what we promised in the description of work (DoA) with respect to the business plans was overly ambitious. At the time of proposal writing, we expected that we would be able to develop business plans in a form ready to submit to potential funders and financiers. Business plans provide a detailed description of proposed economic activities including quantitative details on the cash flows the activities create (cost, revenue and finance streams over time) under different assumptions of how markets develop. As such business plans are targeted towards the specific kind of needs different funders or financiers have (e.g., charities, firms, banks, venture capital, etc.) to evaluate the risk of putting money into the activity.

During project implementation, it turned out that achieving this level of business readiness was impossible for most of the Pilots for several reasons. As the team drafting Task 3.3 on business model development was Dutch, the level of ambition was mainly informed by the Dutch pilot. This pilot, however, was, in hindsight, the most advanced one in terms of its investment readiness. Quantitative information on ESS and potential revenues created from them was available or could easily be generated. Most of the other pilots, however, were on a much lower investment readiness level. Data on potential revenue streams was generally not available and difficult to raise. Consequently, the team had to develop new methods to overcome this data challenge, which required additional time. Quantifying and monetizing ESS is generally difficult, especially with coastal ecosystems, as the latter are more dynamic than terrestrial ones. In addition, the time was not always right to produce these plans, which needed to be embedded in local governance processes, and these, driven by local actors, were not possible to speed up. See the remainder of this Chapter for more details on this.

Our recommendation for the design of similar projects in the future would be that the level of ambition related to developing business plans should be tailored to each pilot or case study involved. Towards this end, preliminary conversations should be held with representatives of each of the cases or pilots in order to better estimate what level of ambition can be reached in terms of developing investment-ready business plans. In addition, the project's methodology should involve a stepwise process for building awareness and capacity for new business models and business plans with local key actors, acknowledging the need for local ownership and adapting to local governance processes.

## 5.2. Methodological challenges and limitations

The following constraints posed by the project design methodological challenges and limitations have been encountered:

- **Data availability**: The original project design intended for other work packages to provide data for quantifying ESS values, aiming to monetize them and offer insights into relevant costs and benefits for funding opportunities. However, the pilots often lacked the required data. Quantifying ESS remains relatively difficult, particularly with coastal ecosystems, which tend to be more dynamic than terrestrial ecosystems.
- **The required enabling environments needed to put in place financial arrangements take time to change**. The interaction between governance and finance was evident in various cases and therefore made it challenging to innovate on the finance side without enabling governance conditions.
- **Project expertise**: Within various pilots, the coordinators were not specifically engaged in or lacked expertise in financial aspects. As a result, their involvement in this deliverable received less priority, time, and contributions.
- **Time constraints**: The priority given to business models and plans were not high among the project partners, who instead were mainly focusing on implementing other WPs and wanting to develop the business models themselves when the timing and opportunity were more suitable.
- **The task involved the need to engage with the core-plats**, but this was often limited to engaging with the coordinators of the projects, due to time constraints and also as the core-plats were not sufficiently developed.
- **Perceptions on the business plan that it only is purposed to commodify and commercialise nature.** The work conducted with each pilot team revealed that the use of the term “business plans” triggered associations which were not in line with the work to reduce and remove the drivers and pressures of ecosystem degradation, and build resilience and the foundations for ESS. The **interpretation** of the concept and role of the business plan in the three pilots (Venice Lagoon, Sicily Lagoon and Nahal Dalia) was very different depending on the stakeholder that was engaged in the work of developing the business plan. More opportunities for collaborative sessions among stakeholders (especially the members of the CORE-PLATs) for further discussing the role of the business plan and the possibilities of engaging potential investors would therefore be recommended.
- Other reflections about the methodology. **The full ESS valuation was not possible given the time constraints and data availability.** However, in some cases such as the case of Rhone Delta, the ESS quantification was not necessary for receiving funding. In other pilots, for example, Arcachon, a quantification of the carbon credits was underway and would feed into the development of such a mechanism locally. The question is whether quantification to reach an exact measure is always necessary, or if indeed (as discussed in Chapter 4) a generic assessment can be used as a proxy to facilitate scaling up.

- **To further simplify the analysis the classification of the ESS in ownership categories could have been omitted as it did not add much value to the analysis** (cf NAIAD, cf Part 1, Frameworks section 2). It was firstly not always straightforward how to define the ESS. While the economic nature of the asset itself, for example, an ecosystem - may be a common good and it would make sense to keep this asset under public ownership, the services it provides could be considered a private or toll good and it could be decided that temporally the rights to operate this asset could be given to a private party or community through concession rights.

- **There is an interest or demand for indicators** (for example, WP4 regarding adaptation pathways and quick scan tool) **that allow for comparison between the cases and between multiple Nature-based Solutions.** From our analyses and efforts dedicated to business model development, we find that such comparability is limited. This results from the significant differences between the NbS in question and their respective particular environmental and institutional contexts. In many cases, a comparison is like comparing apples with pears. The establishment of the Net Present Value of the different NbS or of particular ecosystem services could allow for more sound comparison, but due to data and time limitations, this has not been possible (yet). Reflecting on the cross-comparison, qualitative data is relevant to identify patterns and trends. Further, quantitative data has been collected and calculated to allow for a limited degree of comparison between cases and measures. These are data related to
    - Costs - Although there are variations regarding the lifecycle coverage, cost types in- and excluded and appropriate metrics (cost per meter, cost per hectare…)
    - Surface area for the upscaling intervention – although not all objectives are expressed in terms of surface area (e.g. tons of sediment to be extracted or transported)
    - Estimations of potential revenue generation
    - Carbon credit prices value capture (how ESS can be financed).
    - And the number of funders or funding sources involved or anticipated to be involved.

## 5.3. Conclusions on how to scale up funding and financing NbS?

Transformational changes are needed to fundamentally re-structure and shift away from many underlying drivers and enablers for unsustainable and risk-cumulating practices towards sustainable, low-carbon, and climate resilience (Blythe et al., 2018; IPCC, 2012). With current under-financing and consequently the inadequate implementation of coastal restoration, one of the key changes needed in this transformation is to understand how the financing of NbS at a landscape scale can be done. One of the main problems is that value capture is very narrowly defined for nature: With limited public funds, actors struggle to finance smaller pilots of restoration, de-coupled from a broader appreciation and mechanisms for value capture that these NbS provide as Ecosystem Services and biodiversity for society.

With this background, the main research question we aimed to answer with this study was: How do we achieve a broader value capture of NbS and ESS while scaling up? We hope to have given some answers and contributed to the knowledge on how to move forward in enabling more financing to NbS and coastal restoration.

The following insights from the variety of pilot cases within REST-Coast are highlighted to draw lessons for funding future coastal NbS:

**A diversity of NbS was found in the pilots**, with very different costs and benefits of restoration. Such knowledge can provide valuable information for future investments in NbS (The World Bank, 2022).

**The main services delivered by NbS are public goods, and as such justify public funding models:** within the pilot cases, the beneficiaries of the ESS provided by NbS are often public institutions. Therefore, a public funding model is often most applicable, since it is hard to capture value for private parties. However, this does not mean that current NbS projects that are publicly funded have an optimal funding structure. Within current projects, the (public) value is often not captured with taxes, tariffs or cost reductions. NbS value capture mechanisms can provide support for public funding (from multiple parties) by showing benefits to specific stakeholders.

**In the pilots, we found a diversity of governance contexts and levels of social acceptance that influence the ability for value capture and thus financial arrangements in different ways.** In one part of the spectrum, there is a siloed approach, with a single focus on environmental targets such as biodiversity. In the other part of the spectrum, there is a broader, multiple stakeholders organised under a program with a vision for restoration, aiming for a balance between economy and nature conservation.

**We find that quantification and monetization of ecosystem services is still methodologically challenging and there is limited capacity to do so.** The quantification is needed to monetize the value of NbS. This can attract additional funding by showing identified beneficiaries (e.g. public institutions) the value of for example cost reduction. Quantification is generally required for obtaining funding from voluntary carbon credits, otherwise, carbon sequestration remains a co-benefit without any value capture.

**Carbon credits were not rolled out in any pilot, but show much potential, but are likely to only fund a (small) part of coastal restoration activity**: Within various pilot cases, carbon credits were identified as a potential addition to funding and markets are developing. However, the current quantification of several cases shows that this would only support a part of the funding for restoration activity (max 2-4%). Additionally, carbon sequestered by marine ecosystems remains more difficult to estimate compared to terrestrial ecosystems. Making carbon credit estimates more uniform is one way forward for upscaling.

**Private funding** is identified for several cases, and CSR can provide a substantial support, where trust is key, however this does come with some time-investments in communication and relationship management. On a smaller scale, institutions often do not have the capacity or knowledge to approach private foundations. Additionally, social acceptance from local communities for the involvement of private actors can be low, which requires careful communication for successful NbS funding and implementation.

**Eco-tourism** is mentioned in nearly all of the cases as a potential sector or value capture mechanism. The restoration activity often takes place in an area where tourism is an important socio-economic sector which is maintained or improved by nature restoration. It remains difficult to specifically capture the value of the added tourism by the NbS. Earmarked tourist taxes or tourism user fees can provide an opportunity for supporting restoration activities or for example maintenance. However, this often requires judicial change and could face challenges such as low social acceptance.

**Low return on investment or long time horizons make it difficult to create value capture mechanisms:** with large environmental issues due for example legacy pollution, the benefits require significant investment and time to materialize. This makes it difficult to create value capture mechanisms that allow for flows back into the restoration activities. Instead, blended finance and pooling mechanisms for several projects were seen as key for upscaling and coordinating the integrated funding of larger landscape restoration.

**NbS are not always considered as a strategy for climate adaptation or Disaster Risk Reduction (DRR):** knowledge of the security and benefits of NbS often lacking within several key stakeholder groups. Limited direct effectiveness, low trust and high perceived risk and transaction costs can reduce support, funding and implementation of NbS. PPPs, demo sites, awareness campaigns and other innovative learning partnerships and tools are seen as one way forward in understanding how to adopt NbS by DRR and climate adaptation sectors.

**Top-down frameworks can support capacity issues with bottom up feedback mechanisms in place:** obtaining funding from for example carbon credits requires knowledge and capacity which is often costly for initiators of NbS. Therefore, top-down regional, national or supranational frameworks can reduce capacity constraints and improve funding applications. In general more effort at pan-European level to support and fund pilots to upscale was identified as needed. National strategies related to green and blue economy and resilience need also to link to the local level, and encourage local planning that mirrors national strategies. However, the input from local level about constraints provided by national strategies and procedures needs to be considered and adopted to facilitate implementation.

**Siloed governance can lead to incomplete value capture of ecosystems:** the focus of REST-COAST is to transform towards the valuation of a broad range of ESS. As such, many pilots identify a lack of institutional structures that could enable a broader value capture for the ESS, such as erosion control and flood risk reduction. In many cases, the lack of cross-sector synergies is counterproductive. For example, in Arcachon Bay, seagrass is competing for attention and priority of local agendas with other economic interests such as oyster farming navigation, and fishing; sectors which (indirectly) benefit from the presence of seagrass beds. The literature on Ecosystem service valuation supports our findings. It shows that most of the ecosystem's value is outside the market and best considered as non-tradable public benefits (R. de Groot et al., 2012).

**An integrated environmental strategy can support NbS implementation on a regional level** and the different values provided**:** This study highlights that innovations in financing NbS by implementing new business models are tightly linked to the governance system's ability to enable the value capture of a wider range of ESS. NbS is in principle considered and valued only for biodiversity, which reduces its value and leaves the restoration largely under-financed. However, governance systems change very slowly, which also calls for increased attention from the EU level top down to address governance/ institutional structures. A pilot phase has showed to be helpful in supporting small-scale integration between sectors in projects (e.g. agri-watersafety- ecosystem management) which later on can be upscaled to a coastal zone.

**To remedy this situation, this report has highlighted the need for a specific kind of institution for managing a portfolio of restoration projects**; and enabling financing for implementation. This, in combination with the development of a diversity of policy tools that can create collective action to encourage, engage, exemplify and enforce, NbS alternatives can overcome the current barriers providing a multitude of transaction costs and turn these into societal benefits.

*Sandy shores, milk spice. Photo credit: Gerrit Hendriksen*

# Part III

## Case Study Results

***Business Models,***
***Market Analysis,***
***Business Plan propositions, and***
***Financial Scalability Plans***

# Chapter 6. Arcachon Bay Pilot

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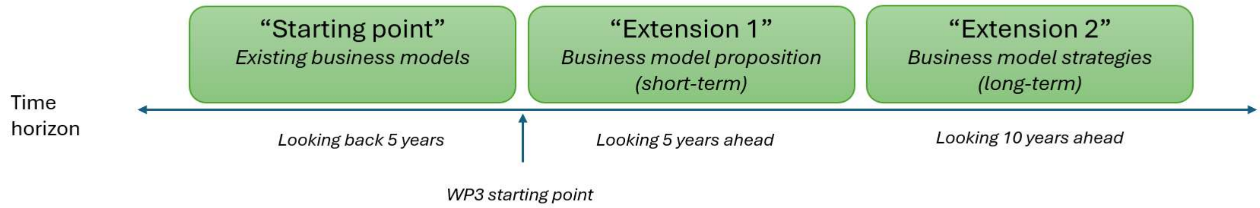
**Readers guide:**




**7.1 Introduction**

- **This section provides a general introduction to the Eems-Dollard case**

**7.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - *restoration of 1 hectare of Zestora seagrass in Arcachon bay*

**7.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - *The NbS:* additional restoration of *Zestora* seagrass within the Arcachon bay

**7.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - *upscaling seagrass restoration in Arcachon bay with around 1 hectare per year. This while using a common pool funding structure where multiple public and private stakeholders can invest. While public parties focus on biodiversity and sediment stabilization and private funders can obtain blue carbon credits.*

## 6.1. Introduction to the pilot

Arcachon Bay, located 55 km southwest of Bordeaux on the Atlantic coast, is a seaside resort and a major hub for oyster farming in France. These two sectors, tourism and aquaculture, are the primary economic drivers of the region and have a complex, often synergistic relationship. Oyster farming serves as a significant tourist attraction, while tourism offers shellfish farmers and fishers opportunities to boost their income. Over the past decade, aquaculture-related tourism has flourished, with local restaurants featuring oysters and seafood, and tours organized by shellfish farmers allowing tourists to visit farms and learn about the industry. In 2018, the Bay of Arcachon was the second most visited area in Gironde, after Bordeaux, attracting 10.8 million overnight stays and generating 76 million euros in revenue (Guyot Tephany, 2022). However, the surge in tourism and the creation of secondary residences have exerted pressure on real estate and local development. The area serves as a crucial bird habitat, with over 500 species mainly from the North of Europe using the bay as a winter migration stop. The Bay also serves as a haven for various marine mammals, including dolphins, seals, and whales, which can be spotted within the Marine Natural Park. A visualization with relevant economic and environmental sectors of the area are depicted in Figure 13.

The governance context of Arcachon Bay involves a diverse range of stakeholders with varying objectives. The local area management is led by Marine Protected Area (MPA) managers from the French Biodiversity Office, supported by regional governance government actor SIBA (Arcachon Basin Intercommunal Union). Key socio-economic groups, such as local oyster farmers, are represented by regional committees like the CRC (Regional Committee for Oyster Farming). Private stakeholders include companies like Seaboost, a subsidiary of EGIS, an international engineering firm and initiator of the REST-Coast project. Additionally, research institutions such as Ifremer and the Gladys Institute contribute expertise on ecosystem restoration in the Bay.

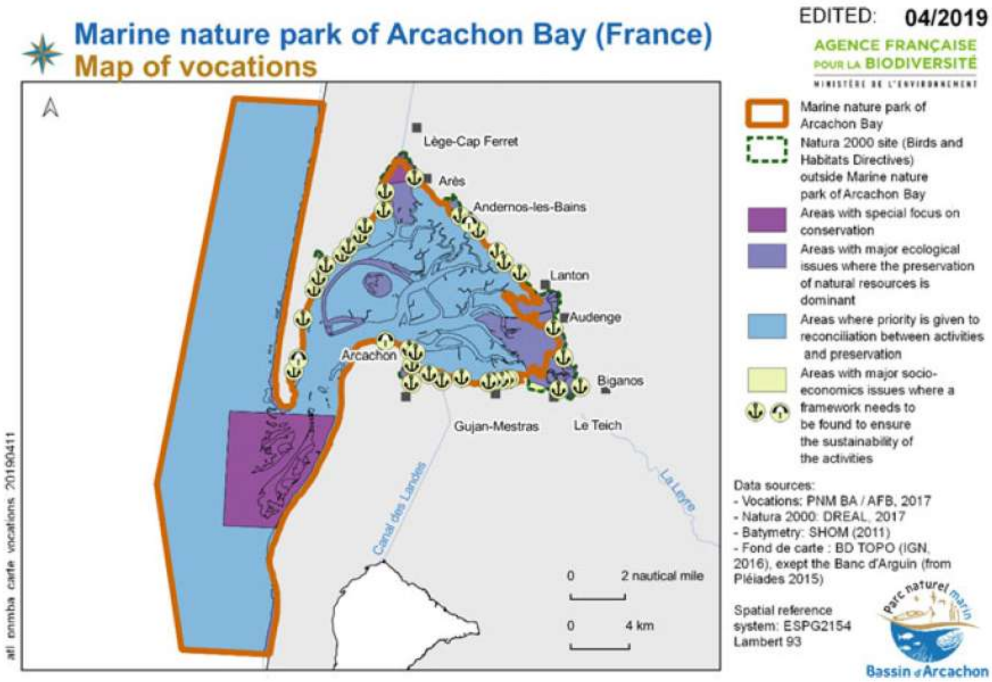



**Figure 13 Localization of Arcachon Bay and the environmental factors (Roth et al., 2020).**

The Arcachon Bay is home to one of the largest Zostera seagrass meadows in Europe. Increased urbanisation and tourism have had significant impact over the last decades on seagrass due to physical damage by for example anchoring. Additionally, increased water temperature and water turbidity due to climate change have a negative impact upon seagrass ecosystems. This is a self-amplifying process since seagrass decline increases currents and wave impacts, resulting in more sediment which in turn reduces water clarity. This results in reduced photosynthesis of seagrass which causes more ecosystem decline.

## 6.2. Starting point: Current Business Model

The Arcachon Basin hosts one of Europe's largest *Zostera noltei* seagrass meadows. Unfortunately, these meadows have been in decline for decades (as shown in Figure 14) due to various human activities that alter water flow and temperature. Increasing urbanization, agricultural practices, and the development of coastal tourism infrastructure have contributed to the degradation of seagrass habitats through mechanical damage (such as dredging and anchoring) and changes in local environmental conditions, such as water temperature and turbidity.

Although oyster farming is crucial for the local economy, it negatively impacts sedimentation rates, composition, and water flow changes within the bay (Ferretto et al., 2022). These changes can reduce water clarity, which is essential for seagrass photosynthesis. Additionally, global warming and the resulting rise in water temperatures, along with increased turbidity due to seagrass loss, further threaten this delicate ecosystem.

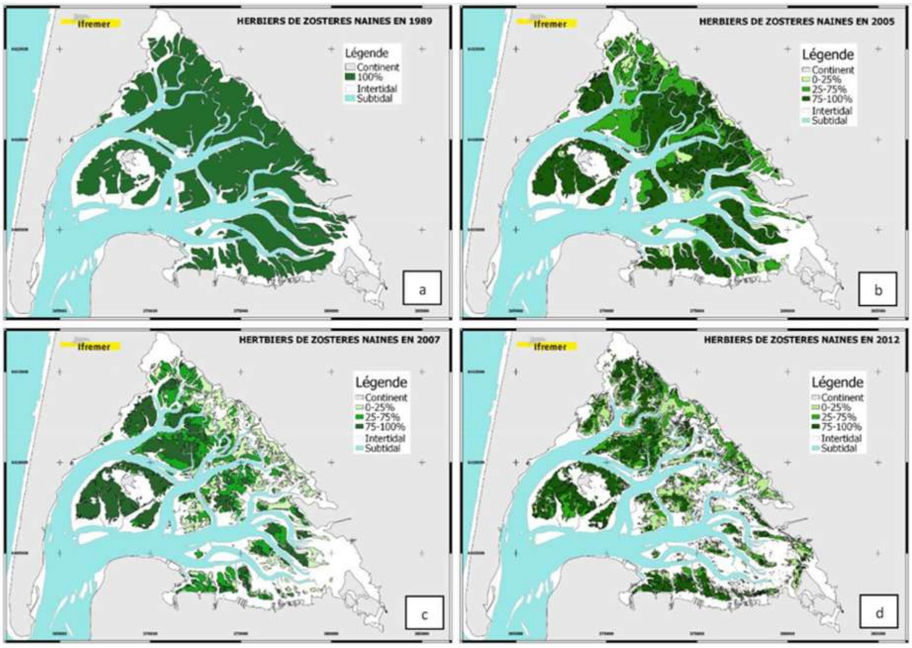



**Figure 14 Regression of Zosteres Seagrass within Arcachon bay from 1989 to 2012 (Rigouin et al., 2022).**

### 6.2.1. <u>Coastal restoration activities</u>

Seaboost, a private company and pilot partner in the REST-COAST project, is undertaking a significant coastal restoration initiative in Arcachon Bay. Their focus is on restoring Zostera seagrass to the area, potentially achieving the coverage that existed in the 1980s. The initial scope of the REST-COAST project is to restore 1 hectare of seagrass to understand the effectiveness of the devices used for restoration. These results will inform large-scale restoration efforts by providing evidence for an additional tool local stakeholders can use to enhance biodiversity and ecosystems.

A key component of this initiative involves placing roselière devices to create optimal conditions for seagrass growth by improving hydrodynamic conditions that mimic natural ecosystems and reduce currents, allowing seagrass to thrive. Roselières consist of reed beds made into ropes that are adaptable in length, with coconut wicks fixed onto them, which can be adjusted in density and length (shown in Figure 15). The devices are installed by fixing the ropes onto existing supports via drilling, sealing, and spits. They have a lifespan of over

5 years with no maintenance required and are resistant to UV, chemical aggression, and demanding hydrodynamic contexts.

This approach leverages a positive feedback loop: as more seagrass is restored, the improved hydrodynamics further facilitate seagrass rehabilitation. In 2023, Seaboost installed roselière devices at a pilot location. By autumn 2025, they will have completed a two-year monitoring period, allowing them to accurately assess the success rates of their restoration approach.

**Figure 15 Photo of the restoration area of REST-Coast pilot Arcachon bay & Rosiliere (Dalle & Cognat, 2024).**

The pilot project is experimenting with different shapes and sizes of these devices to determine which configurations best support seagrass growth, considering factors like tidal range. They have tested various sizes, such as 10-meter devices, to find the most effective design that achieves good results with minimal modules. After initial testing, the devices will be relocated nearby to continue promoting seagrass growth. Throughout the REST-COAST project, Seaboost is closely monitoring these areas to track seagrass progression and restoration. While it is too early to fully assess the success rate, the collected data will provide valuable insights into the effectiveness of their methods. Additionally, modelling efforts on the impact of seagrass restoration on coastal erosion, carbon sequestration, and coastal flooding can inform future scenarios within the bay, aiding upscaling efforts and local stakeholders.

### 6.2.2. ESS and Economic good typology

Wetland habitats such as seagrass can remove and store large amounts of carbon-dioxide from the atmosphere into its vegetation (Macreadie et al., 2013). Due to the strong burying rate of carbon up to 35 times faster than tropical rainforests it can be an essential ecosystem to aid in climate change mitigation. Additionally, seagrass provides other ESS such as water quality improvement, coastal protection and providing habitat for various species (Valdez et al., 2020). Figure 16 summarizes on an aggregate level the ESS affected by the intervention and the type of economic good they constitute.

| | **Rivalry in consumption** | |
|---|---|---|
| | High | Low |

| Excludability | | | |
|---|---|---|---|
| | High | Private<br>*(1) Oyster farming*<br>*(2) Fish* | Club<br>(7) Intellectual interactions<br>(8) Eco-tourism |
| | Low | CPR | Public<br>(3) Water quality improvement<br>(4) Erosion control<br>(5) Carbon sequestration<br>(6) Flood protection<br>(9) Habitat size and quality<br>(10) Geodiversity |

Descriptions

*(1) , (2) Seagrass can serve as a habitat for fish species and water quality improvement can improve oyster quality*

*(3) Seagrass reduces water turbidity and improve water quality.*

*(4) The increase in vegetation of seagrass and other colonization of plants have a reducing effect on wave energy resulting in a reduction of (sediment) erosion.*

*(5) Carbon is captured and buried by Zostera noltei seagrass meadows*

*(6) The increase in seagrass vegetation and colonization of other plants have a reducing effect on wave energy resulting in a reduction of flood (impact)*

*(7) Scientific research/knowledge development on seagrass restoration and quantification of ESS (mainly carbon sequestration)*

*(8) Improved water turbidity and biodiversity can promote eco-tourism (boat tours, oyster excursion etc.)*

*(9) Seagrass provides habitat for biodiversity and increases ecosystem functioning.*

*(10) Promotion of geodiversity within the Arcachon bay area*

**Figure 16** Seagrass restoration in Arcachon Bay, ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification

#### 6.2.3. Funding: granting

As shown in Table 9 below, the project receives joint funding from the European Union's Horizon 2020 program and the French Biodiversity Office.

**Table 9 Overview of division funding sources of seagrass restoration Arcachon Bay**

| Funder | Activities | Type of funder | Type of funding |
|---|---|---|---|

| | | | |
|---|---|---|---|
| European Union (Horizon 2020) | Restoration activities, monitoring | Supranational | Co-funding, grant |
| French Biodiversity Office (OFB) | Restoration activities, monitoring | Public, national government | Co-funding, grant |

### 6.2.4. Funding: value capture

The restoration of Zostera Seagrass provides several value capture mechanisms. However, the current revenue created by restoration efforts do not flow into further restoration activities. This is mainly due to the uncertain relationship with current restoration activity and ecosystem service output. The value is currently not being captured by tariffs, sales or other instruments however future potential funding contributions have been identified in Table 10.

**Table 10 (Future) potential funding contributions through value capture seagrass restoration Arcachon Bay**

| Category | Funding type | | Actor |
|---|---|---|---|
| Reduction in costs | Restoration efforts reduce maintenance needs of navigation channels and dredging, therefore reducing costs of responsible governmental parties. | Tariffs/ fees | Local government (SIBA) |
| Recreation and tourism | Restoration can improve profits for local recreation and tourism companies. This increased economic activity results in revenue generation through taxes/recreational fees for local municipalities of Arcachon Bay | Taxes | Local government (SIBA) |
| Product sales | Sales of local products such as oysters | Sales | Local entrepreneurs and businesses |
| Climate change mitigation | The carbon sequestration by seagrass can help aid corporate or individual goals of climate change mitigation. | Carbon credits | Private companies or individuals |

### 6.2.5. Finance

Financial instruments, such as loans or bonds were not required or used to cover the restoration costs. The resources within the (co-) funding arrangements were made available from within existing and/or earmarked budgets.

### 6.2.6. Procurement arrangements

The pilot seagrass restoration is managed by Seaboost (EGIS), which oversees planning, designing, constructing, and monitoring (flood/erosion protection). Seaboost is also the initiator of the REST-COAST restoration project. The French Biodiversity Office (OFB) and the local government (SIBA) support and plan the restoration effort. Additionally, several research institutes, including Gladys and IFREMER, contribute to the activities through hydraulic works, monitoring, and modelling.

### 6.2.7. Critical funding and financing challenges

- The current regulatory structure with low flexibility requires extensive administrative work permits for the marine environment restoration efforts. Minor changes in these efforts require redoing the process, leading to high time investment and increased costs.

- The local governance structure is currently a barrier to further development. Stakeholders have specific goals and KPI's, resulting in little interest in integrated solutions that combine funding for multiple environmental targets, which lowers funding potential. Additionally, there is little interest from stakeholders to incorporate private sector as a funding source.
- Nature based solutions are not considered by local municipalities for addressing environmental issues such as flooding and erosion. Instead, stakeholders responsible for these issues prefer conventional grey infrastructure solutions such as dykes, making it unlikely for restoration efforts to receive funding from these actors for these purposes.

## 6.3. Extension 1: Business model proposition and Business plan

### 6.3.1. Executive Summary

The pilot partner Seaboost is currently in dialogue with local government representatives and all local stakeholders to define the environmental management plan for Arcachon Bay. This is while using the insights gained from the monitoring and modeling of the REST-COAST project. Although Seaboost is not part of this consortium, it provides input via the local MPA manager from the French Biodiversity Office (OFB). The goal beyond REST-Coast is to restore an additional hectare of seagrass, providing ESS such as carbon sequestration, sediment control, and improved local biodiversity. Therefore, the project remains similar to the original REST-Coast project. However, the aim is to secure public funding from multiple institutional sources for the integrated benefits of seagrass restoration. Additionally, the potential revenue from voluntary carbon markets is being analysed as an extra funding stream.

An overview of the business model canvas for seagrass restoration in Arcachon is provided below.

| | | | |
|---|---|---|---|
| **Value proposition** | **Problems addressed**<br><br>Water quality<br>Flooding<br>Coastal erosion<br>Sea level rise<br>Loss of biodiversity/habitat | **Benefits produced**<br><br>Environmental benefits: Increased water quality; sediment stabilization; flood control; biodiversity improvement; habitat provision; carbon sequestration<br>Economic benefits: Reduction of flood damages; reduction of dredging costs, ecotourism; aquaculture production and yield;<br>Social benefits: Safer life; Space of quality<br>Cultural benefits: Maintain cultural identity of the bay | |
| **Value creation** | **Key partners**<br><br>Local MPA Manager<br>French Biodiversity Office (OFB)<br>Cooperation of municipalities (SIBA)<br>Oyster farmers, Private companies | **Regulation and Governance**<br><br>Governance structure is established with individual KPI's. There is limited interest in restoration with more than one environmental target. General legislation framework exists but are time intensive to work with for restoration activities. | |
| | **Key resources**<br><br>Knowledge/Technical expertise of seagrass restoration | **Customer segments**<br><br>Tourists, Local municipalities (SIBA) | **Stakeholders**<br><br>8 stakeholders: 3 are governmental organizations, 2 research organizations, 3 organizations from the private sector. |
| | **Key activities**<br><br>Seagrass restoration (Zostera) in Arcachon bay by improving hydrodynamic conditions and placing seedlings. | **Customer relations and channels**<br><br>Raising local stakeholder awareness of seagrass benefits through scenario development/modelling; Providing input for MPA manager and municipal environmental strategy for Arcachon Bay; Create awareness of impact of physical disturbance seagrass to users of bay | **Beneficiaries**<br><br>Municipalities<br>Public authorities<br>Citizens<br>Tourists and visitors<br>Companies<br>Oyster Farmers |
| **Value capture** | **Costs**<br><br>€ 100.000 for restoration of additional ha. (*costs expected to decrease by factor 2 or 3 in the future*) | **Revenue streams**<br><br>Carbon credits (€244 per ha per year)<br>Payments for reduction of dredging costs<br>Payments from Eco-tourism related revenues<br>Payments from Oyster farming | **Financing and funding**<br><br>Public funding, grants, private funders (voluntary carbon market) |
| **Transversal categories** | **Impact indicators**<br><br>Indicators for ESS on carbon sequestration and erosion control; Indices of increased BDV ; knowledge development (scientific publications); Revenues from eco-tourism | | **Risks**<br><br>Anthropogenic pressures (anchoring) can physically damage seagrass beds and disrupt growth; Lack of stakeholder and funding support can reduce further restoration efforts; Increase temperatures of water can affect growth rates of seagrass |

**Figure 17 Business Model Canvas for seagrass restoration in Arcachon Bay**

### 6.3.2. Mission and Objectives of the Restoration Initiator

The objective is to restore seagrass beds within the Arcachon Bay. Currently, a significant portion of the bay is unsuitable for seagrass restoration due to unfavourable hydrodynamic conditions, as shown in red in Figure 18 below. However, these regressed areas could become suitable for restoration if the currents are controlled by the Rosilieres devices. This results in a potential restoration area of 320 hectares, while Zostera seagrass currently covers around 373 hectares. Seagrass restoration can break the degradation feedback loop and, over time, provide ESS.

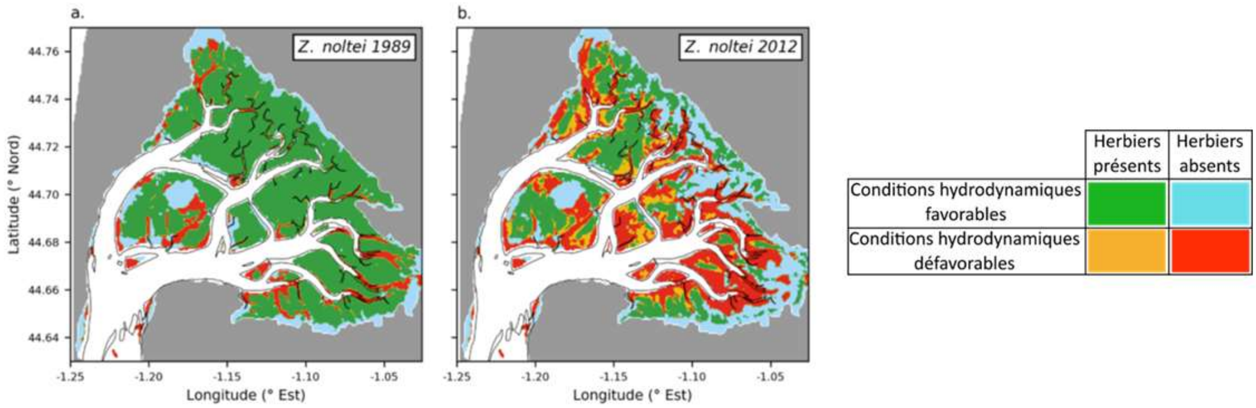



**Figure 18 Environmental factors and biomorphodynamic interactions on the spatio-temporal evolution of eelgrass beds in a mesotidal lagoon (Cognat, 2019)**

### 6.3.3. Stakeholder overview

The stakeholders relevant to the restoration activity are identified in Table 11 Overview of description of stakeholders categorized according to legal status and actor category. Seaboost (EGIS), a private company, is the initiator of the extended business model proposition, aiming to restore additional seagrass in the Arcachon Bay and enhance knowledge development. The restoration also involves the local MPA manager (Parc Marin du Bassin d'Arcachon), a branch of the French Office of Biodiversity (OFB). Additionally, the SIBA (Syndicat Intercommunal du Bassin d'Arcachon) represents the cooperation of all municipalities around the Arcachon Bay.

The CRC (Regional Committee for Oyster Farming) represents the oyster farming industry. Oyster farms in Arcachon Bay are currently struggling with seagrass growth in their production areas due to increased sedimentation, which creates suboptimal conditions for oyster farming. However, since seagrass is a protected species, farmers cannot remove it. Local inhabitants, property owners, and the recreation industry are direct and indirect beneficiaries of seagrass restoration through flood and erosion control, water purification, food provisioning, and tourism. Additionally, there are scientific stakeholders interested in seagrass development, such as Ifremer, which has led research on the Arcachon Bay and local seagrass for decades, and the Gladys Institute, which brings specific hydrodynamic knowledge. These scientific stakeholders also benefit from the knowledge development of ecosystem restoration.

**Table 11 Overview of description of stakeholders categorized according to legal status and actor category**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| **1** | Seaboost (EGIS) | Initiator and possible contractor of seagrass restoration | Private | Company |
| **2** | Parc Marin du Bassin d'Arcachon | Local área manager (MPA) | Public | Regional |
| **3** | French Office of Biodiversity OFB | Head of MPA manager | Public | National |
| **4** | Syndicat Intercommunal du | Committee of representatives of | Public | Regional |

| | | | | |
|---|---|---|---|---|
| | Bassin d'Arcachon (SIBA) | municipalities of Arcachon bay | | |
| **5** | Regional Committee for Oyster Farming (CRC) | Representatives for oyster farming within bay area | Private | Regional |
| **6** | Ifremer | Marine research institute focused on coastal areas, fishery and marine ecosystems. | Public | National |
| **7** | Gladys Institute | Research institute | Public | National |
| **8** | Other sector committees | Representative committees | Private | Regional |

### 6.3.4. Business model proposition

This section presents the business model proposition for upscaling restoration in the Arcachon bay.

#### Value proposition

The following values are created through the restoration activities:

- Carbon sequestration: Carbon is captured and buried by *Zostera noltei* seagrass meadows.
- Erosion control: seagrass roots stabilize sediments, thereby reducing coastal erosion as well as the need for dredging channels in the Arcachon bay.
- Flood regulation: Increased seagrass and plant colonization reduce wave energy, lowering flood risk and enhancing resilience to future sea level rise.
- Water quality: seagrass filters pollutants, captures nitrogen and traps sediments which reduces water turbidity and algal blooms.
- Food provisioning: such as oyster farming and fish species, seagrass can serve as a habitat for fish species and water quality improvement can improve oyster quality.
- Seagrass provides habitat for biodiversity and increases ecosystem functioning. Increased restoration can improve size and connectivity of habitats in Arcachon Bay.
- Eco-tourism can indirectly benefit from the restoration effort due to improved water quality and biodiversity.
- The restoration of seagrass provides opportunities for scientific knowledge development on the use of Rosilieres devices for seagrass restoration. Furthermore, the quantification of ESS (mainly carbon sequestration) can provide input for further upscaling, academia and related research institutions.

The following values are currently being monitored:

Carbon sequestration: The carbon capture and storage are currently being monitored and modelled after Zostera restoration. There is high variability in carbon sequestration from seagrass in literature. Currently, modelling reliable long term carbon sequestration seems difficult, but projections are soon to be created.

Erosion control: seagrass roots stabilize sediments, thereby reducing coastal erosion as well as the need for dredging channels in the Arcachon Bay.

Flood control: current model observation shows that seagrass restoration has a limited influence on water level in the basin, in the magnitude order of 1 cm between restored / non restored seagrass at basin scale.

For food provisioning: there are currently no modelling outputs available; the assessment relies solely on existing literature and data, making the results less reliable.

The following Table 12 summarises the four types of environmental, economic, social and cultural **benefits** provided by each type of NbS restoration intervention.

**Table 12 Types of environmental, economic, social and cultural benefits provided by NbS seagrass restoration Arcachon bay.**

| ESS, BdV | ESS /BdV output level | Benefits | | | |
|---|---|---|---|---|---|
| | | Environmental | Economic | Social | Cultural |
| Sediment control | Cost of hiring dredging companies | \ | Annual costs saved by SIBA & Local ports | \ | \ |
| Carbon sequestration | CO2 stored/hectare | Climate change mitigation | Carbon credit revenue | \ | \ |
| Flood regulation | Decrease probability of flood | \ | Reduction of flood damage | Reduction of stress due to flooding | \ |
| Water Purification | Total Suspended Solids (TSS)/ Nephelometric Turbidity Units (NTU) | Allowing outlet for sediments and decrease in organic matter accumulation on the bed. | Lower cost of fish effluent treatment. | \ | \ |
| Food Provisioning | kg of fish production (due to increased habitat) | \ | Increased fish quantity/qualit y | \ | Maintaining local aquaculture heritage. |
| (Eco)-Tourism | Number of tourists/Annual tourism revenue within municipality | \ | Increased number of tourist | \ | Increased number of tourism jobs |
| Biodiversity | Indices of increased BDV, such as the Shannon-Weiner Index/Fish Index (EFI+) | Increase in BDV by creating habitat and increasing water quality. | \ | Educational opportunity to learn about species in the ecosystem. | Human-nature experience. |

Market analysis (demand and supply) and legal requirements

The targeted beneficiaries (customers) related to the seagrass restoration consists of the following parties:

**Local municipalities (SIBA):** Dredging companies are hired by local ports and/or the SIBA, the organization of local municipalities. Increased sediment capture by seagrass can reduce the costs of hiring private dredging companies. These local public stakeholders are interested in reducing dredging costs, increasing seagrass cover for biodiversity, and controlling the development of wild oyster banks.

**Private Sector (Industries):** The voluntary carbon market involves private companies purchasing carbon credit offsets for corporate social responsibility or contributing to sustainable development goals (SDGs). This market is generally divided into buyers interested solely in carbon removal and those interested in co-benefits like biodiversity (Forest Trends Ecosystem Marketplace, 2024). Certification, such as the French

"Label Bas Carbone," is required to sell carbon credits. Selling carbon credits on the voluntary market is an option for seagrass restoration within Arcachon Bay. Possible directions include obtaining a Label Bas Carbone certificate or exploring local opportunities within Arcachon Bay (a regional voluntary carbon market).

The price of voluntary carbon credits varies significantly based on geographical location, demand, methodology, and additional benefits. The market can also be extremely volatile; in 2023, the market saw a 61% reduction in volume. On average, the price of voluntary carbon credits has been around $6.50 per ton of $CO_2$ equivalent (Forest Trends' Ecosystem Marketplace, 2024). Prices from Blue Carbon projects have been slightly higher, at $8.33, covering only a small portion of the total market (1% in 2023). To date, there have been very few projects solely dedicated to seagrass conservation through Payments for ESS (PES) or Carbon Credits. Case studies from Yokohama and Fuaka in Japan have established blue carbon credits at around 50 euros per ton of $CO_2$ sequestered (Kuwae et al., 2022).

For revenue estimations through carbon credits, the French label Bas-Carbone is used as a reference. This official French standard for voluntary carbon offset provides a regulatory framework. While the main restoration efforts of Label Bas Carbone target forest restoration within France, methodologies for Posidonia oceanica are established, and a framework for Zostera noltei is being developed. Based on this method, project proposals for sequestering carbon over multiple years can be initiated and approved by the Ministry for Ecological Transition (Ministère de la Transition Écologique). These projects can obtain upfront financing from funders, who, in return, receive carbon credits generated by the restoration effort over multiple years.

#### Value creation & delivery

Seaboost, the initiator of the restoration effort, is currently in dialogue with government representatives to discuss and provide input on the overall strategy for Arcachon Bay. This process involves all local stakeholders and is facilitated by the local MPA manager from the French Biodiversity Office (OFB). Seaboost is currently developing scenarios to estimate the value of ESS provided by seagrass, particularly carbon capture. Although the main restoration objective remains the same, the goal is to explore how restoration activities can attract funding beyond public sources and traditional financing arrangements, such as carbon credits. These scenarios can feed into the development plan of the bay, leading to additional seagrass restoration. An overview of the stakeholders, potential beneficiaries, and types of demand for the NbS is shown in Table 13 below.

**Table 13 Overview of stakeholders, beneficiaries and potential customers**

| Stakeholders | Potential Beneficiaries | Type of demand |
|---|---|---|
| Seaboost (Egis) | OFB, National government | Seagrass restoration, improve marine protected areas. |
| Parc Marin du Bassin d'Arcachon | National government | Improved ESS within the bay area. |
| French Office of Biodiversity OFB | National government | Biodiversity increase |
| Syndicat Intercommunal du Bassin d'Arcachon (SIBA) | Local citizens | Sediment stabilization, flood control |
| Regional Committee for Oyster Farming (CRC) | Citizens | Improved water quality, eco-tourism |

#### Implementation arrangements

The MPA manager within the Parc Marin du Bassin d'Arcachon has full authority over the area. Currently, there are no implementation arrangements in place for restoration activities, as Seaboost and the MPA manager are still in the planning phase.

If future restoration efforts are publicly funded, the MPA manager can open a tender for construction. It is likely that Seaboost (EGIS) would carry out the work, given their expertise in planning, designing, constructing, and monitoring seagrass restoration with Rosilieres devices. Additionally, research institutes such as Gladys and IFREMER could contribute through hydraulic works, monitoring, and modeling. These contributions, however, are unlikely to be funded by local public parties unless they require additional information beyond what the current REST-Coast project provides. Thus, combining public funding with research grants can support further knowledge development of seagrass restoration and the ESS provided.

Anthropogenic pressures, such as pollution, physical disturbances, and climate change, pose threats to potential restoration efforts. Educational or awareness-raising activities, such as training for local businesses, fishermen, and tourists, could potentially mitigate these risks. However, this also requires additional funding and effort from the restoration initiator.

#### Value capture

There are two potential value capture mechanism for seagrass restoration within Arcachon bay:

Voluntary carbon credits which provide revenues through private or public parties that aim to reduce their carbon footprint.

Revenue obtained due to the reduced dredging costs by sediment stabilization (for SIBA)

Currently, there is no funder or financier for additional ecosystem restoration within the area. The modeling and monitoring outputs on ESS from the initial REST-Coast project are being used to explore upscaling opportunities with the local MPA manager. These outputs can motivate the pooling of funds and the incorporation of the private sector to potentially offset their carbon emissions. The main potential investors are the Parc Marin du Bassin d'Arcachon / French Office of Biodiversity (OFB) and the Syndicat Intercommunal du Bassin d'Arcachon (SIBA), who will benefit from reaching various environmental targets and reducing dredging costs through seagrass restoration.

#### Economic and financial projections

The restoration cost of one hectare of seagrass was previously around €150.000 for one hectare. By training local stakeholders for deployment, reducing local anchoring, and creating a hands-on restoration schedule, the costs per hectare can be reduced by a factor of 2 to 3. This results in a total cost of €50.000 to €75.000 for future restoration activity. However, it is realistic that in the current situation and restoring an additional hectare would cost around €100.000.

Currently, the modelling of Seagrass carbon sequestration within Arcachon Bay is taking place, accurate estimates can change financial projections of the area in the future. However, quantifying carbon sequestration through modelling remains complex and can change significantly based upon geographical and hydrodynamic conditions (Macreadie et al., 2013). Carbon sequestered by eelgrass species is estimated to be around 1,66 tons of carbon per hectare per year (Röhr et al., 2016). This converts to around 6,1 tons of carbon dioxide equivalent per hectare per year. When using the voluntary carbon market price of the French label Bas-Carbone of €40 in 2023 (L'Hôte, 2023). This would result in a yearly "carbon revenue" of around €244 per hectare per year. A financial break-even point is not currently applicable in the near future. However, funding through carbon credits could provide upfront funding for the project. There is an increased need for additional quantification of ESS to make a compelling business case to potential public investors.

#### Financial instruments

Carbon credits have been identified as a financial instrument (in Fausto & Hinkel 2023) and have been explored further in this section. There is also an interest of the pilot partner and the potential due to existing frameworks in France (label Bas-Carbone). The potential financiers are the (local) private sector who can buy voluntary carbon credits that can improve their corporate social responsibility (CSR). The European Union's Corporate Sustainability Reporting Directive (CSRD) can create additional opportunities to create revenue via the voluntary carbon market (Cornillie, 2022). This mandate requires reporting on corporate activities that impact on the environment including a company's total emission and offset via projects outside the company's value chain. Applying voluntary carbon credits can diversify the funding structure of future restoration projects and allows for more revenue for the restoration project. However, it also implies additional barriers since there is currently low stakeholder support for the involvement of the private sector within the area.

Currently, a framework for *Posidonia oceanica* seagrass is established for national label Bas-Carbon, while the framework for *Zostera noltei* is being developed. Resilience, social and environmental co-benefits are taken into account into the methodology; and a lack of these dimensions results in a carbon discount of the project, reducing potential revenue. This results in less carbon offset (and revenue) registered for a specific project and its lifecycle.

### 6.3.5. Risk and contingency plan

Anthropogenic pressures such as pollution, physical disturbances and climate change pose threats to potential restoration efforts. Educational or awareness raising activities through for example trainings targeting local businesses, fisherman and tourists could potentially reduce this risk.

There are currently institutional siloes within Arcachon bay, with each entity focusing on their own environmental targets. This results in low support for common pool funding for restoration efforts targeting multiple ESS. Some parties are solely in biodiversity, while others are only interested in erosion control. There is little interest in funding a project jointly or securing funds via the private sector. This issue will be further discussed in the upscaling chapter.

The public reputation of carbon credits has declined due to media coverage of unsuccessful, inefficient and even unethical carbon sequestration projects. Furthermore, some projects have been found to apply methodologies that potentially overestimate the amount of carbon captured. Therefore, establishing a robust methodological framework for the label Bas-Carbone is essential in order to ensure carbon capture and maintain revenue streams of the potential voluntary carbon market.

### 6.3.6. Critical funding and financing challenges

The current regulatory structure requires extensive administrative work to obtain licensing for the implementation of restoration efforts in the marine environment. Small changes in the restoration efforts cause redoing the process which causes high time-investment and low flexibility.

The local governance structure is currently a barrier for further development. Stakeholders have specific goals and KPI's. This causes low interest in an integrated solution with funding from and for multiple environmental targets, which lowers funding potential. Additionally, there is little interest in incorporating the private sector as a funding source.

NbS and seagrass restoration are not incorporated as a measure for several environmental problems such as flooding and erosion. Therefore, it will not get funding from these sources and is not considered as an adaptation method.

There is still uncertainty about the amount of carbon sequestered in the short and long term. Modelling seagrass estimates remains complex compared to, for example, forest restoration projects. Robust estimates are required for the entrance of voluntary carbon markets.

These critical funding and financing challenges account for both the extended business model proposition and upscaling within the area. Therefore, these issues are further explored within the financial scalability plan (4.4).

## 6.4. Extension 2: Financial scalability plan

This section presents a broader assessment of funding, revenues streams and financing needs at landscape scale for the next 5 to 10 years, also based on inputs from other WPs.

### 6.4.1. Introduction: What does upscaling mean to the pilot

A feasible approach for upscaling is to restore seagrass in areas without significant economic activities, such as coastal development, oyster farming, navigation, and fishing. Restoring seagrass to its state in 1980 is considered unfeasible due to anthropogenic activities. Therefore, a reasonable goal for upscaling could be the restoration of approximately 50 hectares of seagrass. Currently, there is no upscaling strategy for seagrass restoration in place. Implementing a 5-10 year strategy by the local MPA manager would be a successful outcome and continuation of REST-COAST.

The seagrass restoration in Arcachon Bay is expected to be a long-term process with an iterative approach, which is necessary for monitoring activities, risk management and stakeholder engagement. A realistic restoration rate is around 1 hectare per year. By the end of REST-COAST, a defined restoration strategy, endorsed by at least the local MPA manager, would create support in the area. This strategy could be validated by the end of 2026, initiating a 5-10 year period of restoration, with likely reevaluation during the process. Additionally, exploring funding structures to attract multiple sources of funding could make restoration efforts and costs more feasible, though this remains challenging due to the institutional structure and actors within Arcachon Bay.

Figure 19 illustrates the upscaling potential of seagrass restoration in Arcachon Basin, highlighting the regression of seagrass over the years. A significant area of Arcachon Bay is currently unsuitable for seagrass restoration due to unfavorable hydrodynamic conditions, shown in red in Figure 19. However, the regressed areas (320 hectares) could be suitable for restoration if the currents are controlled by Rosilieres devices. The northern area, primarily used for oyster farming, will likely remain untouched.

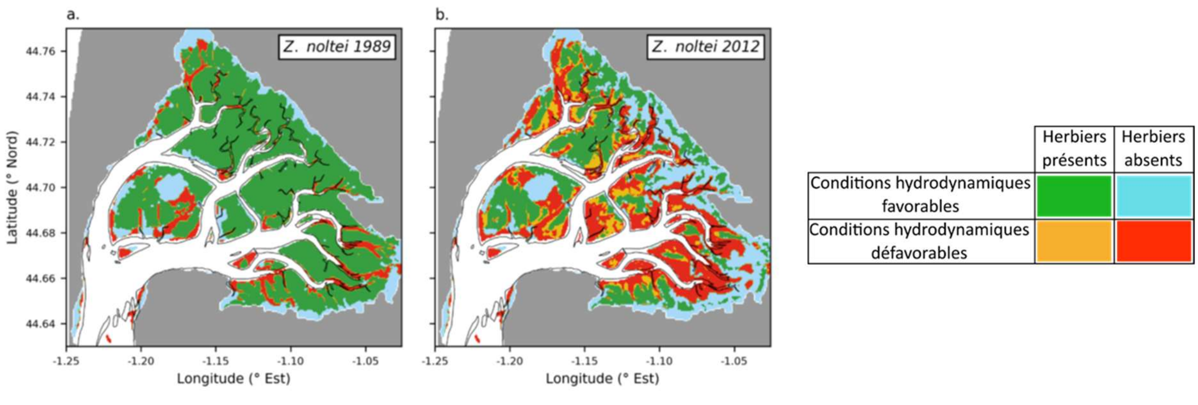



**Figure 19 Map containing the environmental factors and bio-morphological factors across spatial-temporal scales in a mesotidal zone (Cognat, 2019)**

Seaboost (EGIS) is currently developing various upscaling scenarios for the entire Arcachon Bay, focusing on different ESS. For erosion, scenarios are modeled for 2050 and 2100, considering different sea level rise projections and varying extents of seagrass restoration (1/3, 2/3, and full area). These models demonstrate the reduction in sediment volumes for entrance, primary, and secondary channels, which can inform local municipalities (SIBA) about potential cost reductions in dredging due to seagrass restoration. Estimates regarding flood impacts indicate that seagrass restoration has a limited influence on water levels in the basin, with a difference of approximately 1 cm between restored and non-restored seagrass at the basin scale.

The carbon sequestration potential is being measured, and this data is used to build projections for carbon capture and storage. A large amount of the carbon is buried and sequestered in the sediments, which are sensitive to disruptions, making it harder to assess than terrestrial ecosystems where carbon is mainly stored in vegetation. Input from local stakeholders is used to identify restoration areas that are most suitable in terms of land use and other activities within the basin. This input will be used to refine the scenarios by increasing understanding of local uses, such as tourism, coastal construction plans, and oyster farming areas. The scenarios can inform specific actions required for restoration, costs, and ESS provided. This will be in both quantitative and qualitative terms, such as gaining more water clarity or reducing water flow from the river. Further development of the models is needed to improve the estimates that can serve as input for upscaling potential.

#### 6.4.2. Overview of barriers preventing upscaling

**Troublesome permitting procedures for implementing restoration**

The regulatory framework and permitting process present significant barriers, as they involve time-consuming administrative work to implement restoration approaches in the marine environment. Seaboost requires permits that take approximately 1 to 2 years to obtain for the project. Each time a device is moved, a new explanation and justification is needed to comply with procedures, making it a time-intensive and expensive process. Additionally, changes in the MPA manager teams necessitate new investments in building connections and transferring knowledge to new members.

**Siloed management results in siloed funding**

The scopes of governance stakeholders vary significantly, with limited common environmental targets among them. Biodiversity management falls under the responsibility of the MPA manager, who operates under the French Office for Biodiversity and follows national policy. The primary objective is to manage and restore local biodiversity. However, erosion and flooding, which are relevant ESS for seagrass, are not within the MPA manager's scope. Conversely, SIBA (the organization of local municipalities) is responsible for erosion and flooding but does not include biodiversity in its targets. This creates a challenge for integrated solutions like seagrass restoration, which aim to address multiple goals.

A project covering multiple objectives with different sources of funding has not been implemented, and there is limited interest from both the OFB and SIBA. No overarching organization currently exists to bridge these gaps, and most entities remain focused on their individual scopes of work, resulting in split funding.

**NbS are not considered an alternative to grey infrastructure**

Currently, seagrass is not considered a climate adaptation option, with grey infrastructure remaining the norm in the region. Quantifying the ESS provided by seagrass restoration can highlight its potential benefits to local stakeholders, such as improved water quality, reduced erosion, and enhanced biodiversity. This, in turn, can demonstrate the cost-effectiveness of seagrass restoration compared to traditional methods, encouraging its inclusion in planning processes.

**Reluctancy to work with outside private actors.**

Seaboost, an external private company with no jurisdiction in Arcachon Bay, faces challenges in influencing local governance. Despite their efforts to present results in local committees, Seaboost's influence is considered relatively low. Attempts to join existing governance committees and engage in the decision-making process have been met with reluctance from local actors, who are hesitant to involve a private company. Consequently, Seaboost has shifted its focus towards understanding the necessary inputs to demonstrate the potential of large-scale seagrass restoration. This reluctance to collaborate with private actors also extends to funding opportunities. Although Seaboost is exploring additional funding sources, such as carbon credits, there is limited interest in involving the private sector in financing ecological restoration.

#### 6.4.3. Potential institutional and financial arrangements (enablers) for overcoming key barriers (needed at the landscape level for upscaling and at higher policy level (discussion)

**Knowledge development & quantification**

Seagrass restoration is currently carried out with the purpose of improving or conserving biodiversity. However, there are many more values to seagrass (see section 4.3.4.1 Value Proposition). Therefore, increased local quantification knowledge on the reduction in dredging needs, carbon sequestration, and the efficiency of biodiversity restoration can provide drivers for upscaling.

Local cities and municipalities allocate budgets, around 10 million euros, to address erosion and flooding as part of their responsibility to protect local inhabitants, real estate, and infrastructure. These funds are typically allocated to constructing grey infrastructure such as dykes, breakwaters, and sand nourishment.

One of the main obstacles to implementing nature-based solutions is the lack of public trust in their effectiveness. Even though seagrass is recognized for its benefits to biodiversity and fisheries, it is not considered a reliable erosion control method, unlike familiar grey infrastructure. Therefore, quantification can also help obtain funding from these sources.

Even though there has been significant knowledge development of seagrass restoration and carbon sequestration, as seen in the United Kingdom, there is still high variability in carbon sequestration estimates (Garrard & Beaumont, 2014; Gouldsmith & Cooper, 2022; Green et al., 2018). On a local level, there are insights into the current carbon stocks and lost stocks of seagrass (Ribaudo et al., 2016), but they differ from new carbon sequestration by additional restoration projects.

Seaboost is working on both monitoring current carbon sequestration and developing scenarios (target areas to restore) showing the co-benefits of seagrass for flood and erosion control, alongside biodiversity. This aims to create support with the local MPA manager and SIBA. The evidence base and strategy can change the financial structure of future restoration activities considered and allow for shared funding in collaboration between the MPA manager, SIBA, and potentially the voluntary carbon market.

**Top-down frameworks to create support for restoration activities**

Due to the low interest in working with private actors and private funding, top-down frameworks can help create support and accelerate upscaling. The development of the Bas-Carbone label methodology for Zostera noltei can facilitate support from both the private and public sectors and ease the acceptance of carbon finance to bolster the upscaling strategy.

Partnerships and knowledge exchange with countries and projects experienced in seagrass restoration can enhance acceptance. Additionally, sharing knowledge with stakeholders and securing funding for projects can provide further methods to approach upscaling. Examples of relevant organizations include the Marine Conservation Society, The Ocean Conservation Trust, and Seawilding. At the EU level, efforts can potentially influence the OFB at the national level, which in turn can persuade MPA managers to consider broader financing options.

**Opportunity of participation of local oyster farms**

Oyster farms are currently struggling with seagrass growth in their areas due to increased sedimentation, creating suboptimal conditions for oyster farming. However, since seagrass is a protected species, farmers cannot remove it. An potential way to increase support and reduce costs for the restoration effort is to compensate oyster farmers for transplanting Zostera seedlings from their farms to other locations in need of restoration. This would enhance restoration potential, garner support from oyster farmers, and mitigate issues with seagrass in oyster farming areas. It is also a cost-efficient solution since farmers are on-site for most of the year. Therefore, collecting and transplanting seedlings would require minimal effort compared to NGOs or Marine Protected Area (MPA) teams, which can face logistical issues such as timing visits with tidal levels.

This partnership approach of paying local oyster farmers to collect and maintain Zostera seedlings can boost the potential for future large-scale restoration projects by improving the logistical chain and reducing costs. Additionally, there can be a commercial advantage, as farmers can market their oysters as environmentally friendly, creating an additional selling point. However, since Zostera is a protected species, this approach is legally complex. Further research is needed to determine what is required to authorize the collection and relocation of Zostera seedlings. Currently, the MPA manager does not wish to involve oyster farmers in the restoration process, highlighting the need for further dialogue.

# Chapter 7. The Ebro Delta Pilot

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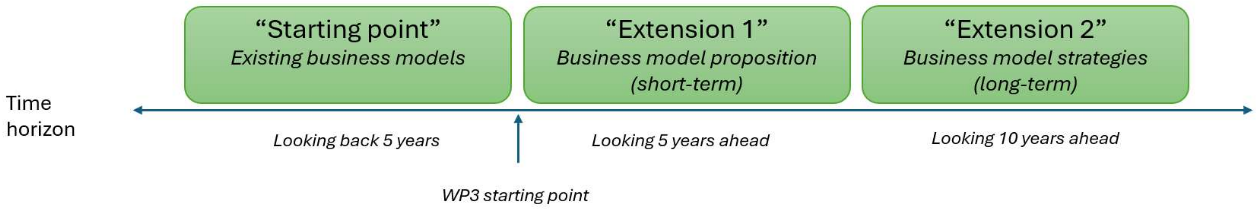
**Readers guide**




**8.1 Introduction**

- **This section provides a general introduction to the Ebro Delta case**

**8.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - Lagoon restorations: Alfacada and Tancada
  - Alternative Beach nourishment strategies: Trabucador barrier and Marquesa beach

**8.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Lagoon restorations: Continuation of restoration efforts in Alfacada and Tancada
  - Wetland restoration: Bombita wetland
  - Alternative Beach nourishment strategies: additional nourishments (short and mid-term) and continuous monitoring efforts
  - Sediment by-pass Pilot

**8.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Integrated Coastal Zone and River System Management

## 7.1. Introduction to the pilot

**Figure 20 Satellite image of the Ebro River Delta Plain (Rovira & Ibàñez, 2007)**

**Figure 21 Locally produced organic rice at Riet Vell (photo: 19-07-2023, H. Vreugdenhil)**

The Ebro Delta lies in the southeastern part of the Ebro river basin, which is the largest basin in Spain with 88,835 km$^2$. The Ebro River is fed with water from the Pyrenees, Cantabrian mountains and the Iberian mountains flowing into the Mediterranean Sea. The Ebro Delta covers a surface area of approximately 330 km$^2$ and is around 30 km wide (Figure 20 Satellite image of the Ebro River Delta Plain ). Under natural conditions (in the past) the river would have a discharge of 18,000Hm$^3$ water at the mouth per year, but due to the many anthropogenic alterations, the discharge has been reduced by more than half during the last decade (Cozzi & et al., 2018). The agricultural sector has been confronted for the first time in 2023 with water restrictions of up to 50% of their normal water use. Further, the construction of many dams has resulted in a severe decrease in sediment transport in the river. Less than 1% of sediment now reaches the mouth of the river in the Ebro Delta (Rovira & Ibàñez, 2007).

The delta is home to nearly 60,000 inhabitants. Urban areas cover around 10% of the surface area of the Delta. The main economic activities are in the primary sector, namely agriculture, fishing, salt production and aquaculture. Rice cultivation plays a key role in the economy (and the ecology) (Ibáñez, 2024). 70% of the surface area of the Delta is devoted to rice production and accounts for 98% of the total Catalan and as such, the third most important contributor within the European Union. The Ebro Delta contains a large diversity of habitats and species and is the second most important wetland in Spain (Rivaes & Ibáñez, 2017). There is a (terrestrial) protected natural park of about 8,000 ha. The natural park emerged in the past as a result of a civil movement against ongoing environmental degradation. A very representative sample of the habitats typical to the Mediterranean can be found in the delta. Amongst these are beaches and dunes, coastal lagoons, riparian zones, salt marshes, reed beds, salt pans, the Ebro River, freshwater springs, saline meadows, and of course rice paddies. Anthropogenic pressures and climate change threaten the ecosystems and biodiversity of the Delta.

In terms of governance, the Delta is very complex. Many different agents are involved with resource and spatial management. For one public actors on different levels (State, regional, and local, where the Delta plain is divided into six municipalities). Further, a range of private actors are involved, such as NGOs, research institutes, the irrigation community and individual farmers and fishermen. The Delta faces serious threats resulting from anthropogenic and climate pressures, including coastal erosion, salt wedge intrusion, sea level rise, invasive alien species, subsidence, rising temperatures, and freshwater scarcity (including the required ecological flows). In 2020, the Trabucador barrier was completely breached during storm Gloria, which was a turning point in the flood protection approach of the Ministry. Since around 2000, several restoration interventions have been taking place in the Delta including but not limited to alternative sediment nourishment strategies along the coastline, wetland restoration, riparian forest restoration, threatened species management, pollution reduction measures, and the development of eco-friendly farming practices and eco-tourism (Figure 21).

## 7.2. Starting point: Current Business Model

Several restoration activities have occurred in the past or are occurring in the present. Amongst the many (pilot) interventions, we distinguish two generic types of NbS. Firstly, lagoon restoration activities in the coastal zone (Figure 22). Secondly, (alternative) beach nourishment and dune restoration strategies are being applied, in particular at the Trabucador barrier and at Marquesa beach (Figure 23).

**Figure 22 Lagoon restoration sites Alfacada lagoon (top) and Tancada lagoon (bottom) (Eurecat & UPC, 2023)**

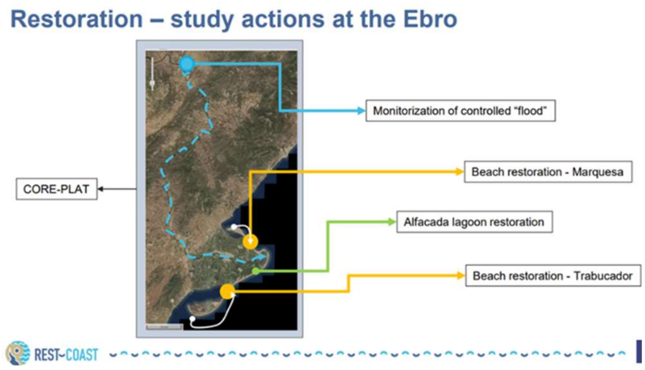



**Figure 23 Alternative beach nourishment strategies at Marquesa beach (top) and Trabucador barrier (bottom) (Eurecat & UPC, 2023)**

### 7.2.1. Restoration activities

In the case of the Alfacada lagoon, interventions adress the hydrological functioning and connectivity of the whole lagoon area and the restoration of an additional area to be restored and added to the lagoon system. This additional area (60 ha) has been restored from previously being used for hunting purposes and part was previously used as rice fields. With the additional area, the total surface area restored is now 255ha. In the case of Tancada the interventions also concerned the restoration of an additional area, which consisted of abandoned aquacultural facilities and old salt pans. The whole lagoon and wetland area of the Tancada is >300ha, but the restored area covers  147 ha  (Prado et al. (2017)). Restoration activities are summarized in

Table 14. In addition to the activities listed below, in the case of the Alfacada, the soil obtained from the lagoon excavation was used elsewhere, namely for the restoration of a riparian forest along the Migjorn river branch. The soil was used for creating elevation and as a 'natural' seed bank for tamarisks.

**Table 14 Summary of lagoon restoration activities at the two different sites and approximate surface areas restored. *Italic activities concern management, maintenance and monitoring activities.* * internal = structures that hinder internal connectivity or that enable 'easy' access for predators, external = structures that separate the lagoon(s) from saltmarshes (sea water connectivity)**

| Restoration activities | Alfacada (255 ha) | Tancada (147 ha) |
|---|---|---|
| Cleaning of existing canals / waterways | X | |
| Creating new canals / waterways for freshwater connections | X | |
| Removal of (parts of) internal/external* dike structures | X | X |
| Deepening the lagoon | X | |
| Creation of small islands (nesting areas for birds) | X | X |
| Reintroduction/transplantation of species (plants/animals) | X | X |
| Specific species management (through gravel filters) | | X |
| Delimitation of natural areas | | X |
| Removal of aerial powerlines | | X |
| Construction of recreational facilities and infrastructure | X | X |
| Water level management (natural fluctuations) | X | X |
| Maintenance of connectivity (filters) | X | X |
| Vegetation management | X | X |
| (Developing procedures for) Ecological monitoring and monitoring of specific species (plants / animals) | X | X |
| Enforcement of regulations & restrictions | X | X |
| Maintaining facilities and infrastructures | X | X |
| Fencing / predator management | | X |
| Emergency restoration measures | X | |
| Promoting and facilitating eco-tourism and education | X | X |

Regarding the **beach nourishment and coastal protection** strategies, storm Gloria in 2020 has been a turning point. Before that incident, efforts were mostly focused on repair and recovery in response to storm impacts. The severe flooding and barrier breaches that occurred in 2020 have led to a search for a more resilience-based approach, rather than repair and recovery. In the case of the Trabucador barrier, a system of alternating dunes along the shoreline was constructed that should allow for overwashing (allowing water and sediment to overflow the crest of the barrier). It entails the recovery of an existing dune system that was present in the past, yet altered in a manner in which sediment capture is expected to be enhanced (Figure 24). At Marquesa beach, 62 dunes are placed perpendicular to the shoreline, with a height no greater than 1.7 meters. As such, a dune field is created which in essence serves as a stock of sediments (Figure 25 Satellite image of constructed dune system at Marquesa (Google (2023) Marquesa beach)Figure 25). The idea was to create a dune field (which existed in the past) to try to give a relatively stable stock of sediments to the beach that would enter into movement only when there were strong winds or waves. In both cases, the sediments for these interventions were taken from the spits and moved to the construction sites. Marquesa beach nourishments used an approximate amount of 33.000 m$^3$ of sediment, and the Trabucador barrier used an approximate amount of 150.000 m$^3$ of sediment (Eurecat & UPC, 2023).

**Figure 24 Drone image of the Trabucador barrier showing the system of alternating dunes (Eurecat & UPC, 2023)**

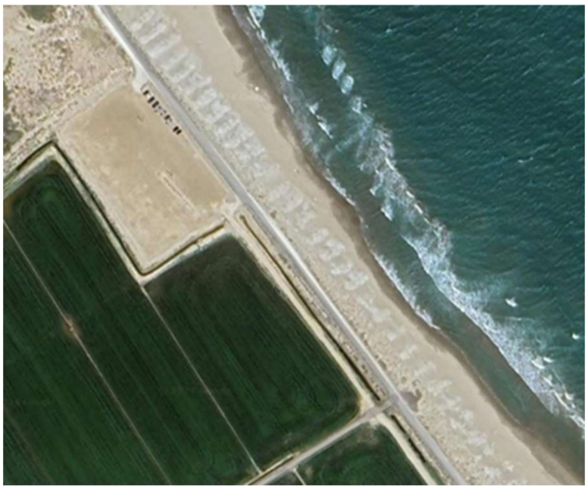


**Figure 25 Satellite image of constructed dune system at Marquesa (Google (2023) Marquesa beach)**

### 7.2.2. ESS and Economic good typology

Although both restoration sites (Alfacada lagoon, Tancada lagoon) are unique in terms of the ESS foregone and gained as a result of the restoration activities and changing land-use functions Figure 26 summarizes on an aggregate level the ESS affected by the intervention and the type of economic good they constitute. The same is done for the two alternative beach nourishment strategies at the Trabucador barrier and Marquesa beach Figure 27.

| | | Rivalry in consumption | |
|---|---|---|---|
| | | High | Low |
| Excludability | High | Private<br>(2) Salt<br>(4) Rice<br>(5) (Shell) Fish | Club<br>(12) Cultural heritage<br>(13) Outdoor activities<br>(14) Intellectual interactions |
| | Low | (1) Fresh water<br>(3) Sediment<br>(6) Genetic material<br>CPR | (7) Water flow regulation<br>(8) Sediment transportation<br>(9) Erosion control<br>(10) Carbon sequestration / storage<br>(11) Natural scenery and biodiversity<br>(15) habitat size and quality<br>(16) gene pool protection<br>Public |

Descriptions

*(1) Reduced demand for fresh water resulting from reduced need for irrigation*
*(2) Small scale salt production and sales (part of experience centre)*
*(3) Sediments and soils become available during restoration works through removal of structures and serves as a building material (resource) or waste product*
*(4) Loss of rice production (resulting from change in land use)*
*(5) Increased fish populations (wild)*
*(6) Soils that become available function as seedbanks which can be used for restoration*
*(7) Coastal protection through water flow regulation and dissipating wave energy by structures (e.g. dikes, islands, sandbanks) and vegetation (e.g. reed beds)*
*(8) Enhanced potential for riverine sediment transportation to vulnerable coastal areas through enhanced connectivity (transportation function of the waterways)*
*(9) Reduced incidence of soil erosion*
*(10) Global climate regulation by reduction of greenhouse gas concentrations through sequestration and storage*
*(11) Natural scenery and biodiversity attractive for (eco-) recreation and tourism (incl. hiking and bird watching)*
*(12) Cultural experiences (traditional fishing, salt production, gastronomy) at experience centre (from hunting activities to other experiences)*
*(13) Outdoor experiences of surroundings through the rental of canoes, boats, stand-up paddle boards, etc.*
*(14) In situ research and scientific investigation, sites used for (voluntary) conservation activities, subject matter for teaching and skill development*
*(15) Enhanced biodiversity and ecosystem functioning through increased size, quality, and connectivity*
*(16) Protection of threatened habitats and species (gene pool protection)*

**Figure 26 ESS derived from Alfacada and Tancada Lagoon restorations and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification**

| | | Rivalry in consumption | |
|---|---|---|---|
| | | High | Low |
| Excludability | High | Private | Club<br>(5) Cultural heritage<br>(6) Outdoor activities<br>(7) Intellectual interactions |
| | Low | (1) Sediment<br>CPR | Public<br>(2) Water flow regulation<br>(3) Erosion control<br>(4) Natural beach scenery<br>(8) Habitat protection<br>(9) Geodiversity |

Descriptions

*(1) Accumulated sediment taken from the spits and used on intervention sites*
*(2) Increased coastal protection through water flow regulation / dissipating wave energy by sandbank structures. Reduced probability of breaching events. Enhanced accessibility function of the Trabucador barrier.*
*(3) Regulation of sediment dynamics influencing erosion and deposition*
*(4) Natural scenery attractive for recreation and tourism (incl. hiking, swimming, surfing and bird watching)*
*(5) Stopping the shoreline from further retreating and breaching safeguards cultural heritage ( e.g. Salt production on the southern spit).*
*(6) Outdoor experiences through the rental of stand-up paddle boards, canoes, surfing equipment etc.*
*(7) In situ research and scientific investigation*
*(8) Protection of threatened habitats and species present in the lagoons behind the northern and southern spits.*
*(9) promotion of coastal geodiversity*

**Figure 27 ESS derived from Marquesa beach and Trabucador barrier beach nourishment strategies and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification.**

### 7.2.3. Funding: granting

**Most of the funding for the lagoon restoration projects has been established through a co-funding arrangement between a collaboration of local and regional public and private (research and NGO) parties, and the European Union (EC, 2023; Rivaes & Ibáñez, 2017) (Table 15). Funding was secured for different lifecycle phases separately. Infrastructure that enabled value capture (such as the visitor centre and bird-watching infrastructure) was also funded separately. Funding for the two beach nourishment strategies was provided through a single institution, namely the Ministry of the Environment and Rural and Marine Environment.**

**Table 15 Overview of funding contributions in the Alfacada and Tancada restoration projects**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| EU through the Program LIFE + | €1.490.084 | Restoration activities (2010-2017) | Public, Supranational | Co-funding, grant |
| Agro-food Research and Technology Institute | €2.905.988 jointly | Restoration activities (2010-2017) | Public, Research institute | Co-funding, grant |
| Department of Environment and Housing – Government of Catalonia | | Restoration activities (2010-2017) | Public, Regional Government | Co-funding, grant |
| General Directorate of Sustainability of the Coast and the Sea, Ministry of the Environment and Rural and Marine Environment | | Restoration activities (2010-2017) | Public, National Government | Co-funding, grant |
| Catalonia Foundation La Pedrera Spain (NGO) | | Restoration activities (2010-2017) | Private, NGO | Co-funding, grant |
| Catalonia Foundation La Pedrera Spain (NGO) | €10.375 | Maintenance, monitoring, and management (2018 – 2022) | Private, NGO | Co-funding, asset management budgets |
| Ebro Delta Natural Park | €20.075 | Maintenance, monitoring, and management (2018 – 2022) | Private, NGO | Co-funding, asset management budgets |
| Amposta City Council | €1.000 | Maintenance, monitoring and management (2018 – 2022) | Public, Local government | Co-funding, asset management budgets |
| Agro-food Research and Technology Institute | *Personnel* | Maintenance, monitoring and management (2018 – 2022) | Private, Research Institute | Time contributions |
| Catalan Institute of Ornithology | *Personnel* | Maintenance, monitoring and management (2018 – 2022) | Private, Research Institute | Time contributions |
| Catalan Water Agency - public entity of the regional Government of Catalonia | *Personnel* | Maintenance, monitoring and management (2018 – 2022) | Public, Regional government | Time contributions |
| General Directorate of Sustainability of the Coast and the Sea, Ministry of the Environment and Rural and Marine Environment – Government of Spain | *Personnel* | Maintenance, monitoring and management (2018 – 2022) | Public, National Government | Time contributions |
| Volunteer Association of the Ebro Delta Natural Park | *Personnel* | Maintenance, monitoring and management (2018 – 2022) | Private, Association | Time contributions |

**Table 16 Overview of funding contributions at Marquesa and the Trabucador for beach nourishment strategies**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| General Directorate of Sustainability of the Coast and the Sea, Ministry of the Environment and Rural and Marine Environment | Approx. €0,5million (based on €15 - €20 per $m^3$ ) | - Construction/ implementation<br>- Monitoring and evaluation | Public, National Government | Single funder |

#### 7.2.4. Funding: value capture

The restoration sites make use of a few value capture mechanisms (Table 17). Not all revenues generated can be attributed fully to the restoration activities, nor do all the revenues generated flow back into restoration (maintenance) activities. No specific value capture mechanisms have currently been identified for the alternative beach nourishment strategies at Marquesa beach and the Trabucador barrier. Yet, naturally, the beaches contribute substantially to tourism in the entire Delta.

**Table 17 Funding contributions through value capture in the restoration projects Alfacada and Tancada**

| Category | Funding type | | Actor |
|---|---|---|---|
| Recreation and tourism | Revenue generation through visitor fees at education/ experience centre and for (areas) of the Park Natural Ebro Delta | Tariffs/ fees | MónNatura Delta de l'Ebre / Catalonia Foundation La Pedrera Spain (NGO) |
| Recreation and tourism | Tourist taxes (non- earmarked) | Taxes | |
| Product sales | Sales of local, eco-friendly (certified) products – including but not limited to rice and salt | Sales | Local entrepreneurs and businesses |

#### 7.2.5. Finance

Financial instruments, such as concessional loans, green bonds, or public loans, were not required. The resources within the (co-) funding arrangements were made available from within existing, or already earmarked budgets, such as money designated for coastal protection measures or for the management of Natura 2000 areas. Further, these resources were made available at the start of the projects, which implied that there was no financing gap which needed to be bridged by financing instruments (loans).

#### 7.2.6. Procurement / implementation arrangements

For the implementation of the interventions a property ownership transfer was needed and a change in land use function. For example, Alfacada lagoon (formerly used for hunting purposes) was acquired by the Catalonian Foundation La Pedrera. La Padrera foundation is a private and independent foundation, founded in 2013, led by a board of trustees comprising experts in the different fields it works in. The foundation focusses on carrying out projects that have a positive impact on people's quality of life. The lagoon was expanded with 62 ha of publicly owned rice fields. This area was owned by Català del Sol Institute. It was originally meant for the promotion of aquaculture, but these plans fell through. The restoration works for the two lagoons occurred in a partnership setting formalized through the grant agreement (EU Program LIFE +) where the Agro-food Research and Technology Institute took up a coordinating role. Maintenance and management responsibilities were then transferred to Parc Natural del Delta de l'Ebre and Fundaci Catalunya-La Pedrera.

Regarding the alternative beach nourishment strategies at Marquesa beach and Trabucador barrier, the restoration works at both beaches were carried out by Tragsa, selected through a public procurement process led by the General Directorate of Sustainability of the Coast and the Sea, Ministry of the Environment and Rural and Marine Environment. Furthermore, Universitat Politècnica de Catalunya (UPC) was contracted as advisors throughout the preparation, implementation, and monitoring, to guide the novel approaches.

#### 7.2.7. Critical funding and financing challenges

Although not limited to the list below, the following challenges have been identified to play a key role in slowing down or preventing the further scaling-up of restoration activities.

- Funding for the longer-term maintenance of the restored wetlands and lagoons is difficult to acquire. Sources are fragmented and often short-term requiring continuous acquisition efforts.
- Much of the land on which restoration activities could occur in the future is private property. This limits the wetland restoration potential and makes publicly initiated activities more costly when land has to be purchased first. Further, as a consequence, restoration sites could be chosen that are not ecologically optimal, but where there is an opportunity based on available land.
- Effectively controlling certain exotic species faces technical difficulties (e.g. Fundulus heteroclitus and the apple snail). Such activities are seen to have relatively high costs.
- Responsibilities regarding ecological restoration and coastal protection are fragmented amongst different public stakeholders. This leads to difficulties in getting restoration plans approved and in obtaining the required funding. Further, it leads to a lack of a systematic approach, acknowledging the interlinkages between sectors.
- Sediment in the Delta is scarce due to the erosion processes and lack of sediment flowing into the Delta through the river system. Much of the sediment is being blocked upstream of the Delta. Given climate change and rising sea-level, there may not be sufficient sediment available any more in the current system (extracted from the spits and re-used along the eroding shorelines) to protect the Delta. An economic valuation of the proposed sediment by-pass strategy (as an alternative strategy to beach nourishments) is difficult to conduct (given the multitude of (natural) values and system complexities), yet may be useful for engagement, collaboration and convincing stakeholders. Further, the uncertainty regarding the effectiveness of the strategy plays a role.

### 7.3. Extension 1: Business model proposition and Business plan

#### 7.3.1. Executive summary

Lagoon restoration activities that have been conducted in the past at the Alfacada and Tancada sites require continuous maintenance and monitoring. Further, other coastal areas, such as the Bombita wetland, are selected to be restored. Similarly, the beach nourishment strategies require continuous monitoring efforts as well as additional nourishments (short and mid-term). As such, these activities require additional resources, including funding and financing and are therefore subject of this *Extension 1: Business model proposition.* Further, an intervention is proposed, namely a sediment by-pass pilot, for which funding had been secured. Yet, due to other (non-financial) objections, this intervention has, at least for the time being, been withdrawn (rejected / disapproved) for implementation. However, we still consider the intervention in this business model analysis.

| | | | |
|---|---|---|---|
| **Value proposition** | **Problems addressed**<br><br>Coastal erosion, Flood risk, Habitats and species protection | **Benefits produced**<br><br>Environmental benefits: Water quality (salinity) improvements, ecosystem quality and extent, protection of species and habitats, carbon sequestration<br>Economic benefits: enhanced food provisioning, agricultural business continuity, connectivity, eco-tourism,<br>Social benefits: Agricultural sector job security and prospects for future generation, liveability of the region, recreational opportunities<br>Cultural benefits: (scientific) knowledge development, protection of cultural heritage | |
| **Value creation** | **Key partners**<br><br>Multiple government authorities, research institutes, farmers, Engineering companies and entrepreneurs | **Regulation and Governance**<br><br>Multiple environmental laws and public procurement regulations | |
| | **Key resources:**<br><br>land, knowledge capacity, funds | **Customer segments**:<br><br>companies looking for carbon credits, tourists, consumers of eco-friendly products | **Stakeholders:**<br><br>Public and private institutions and organisations. Individual farmers and land owners, NGO's. |
| | **Key activities:**<br><br>Wetland and lagoon restoration, sediment by-pass trial, beach nourishment and dune reconstruction | **Customer relations and channels:**<br><br>Guided tours and recreational facilities, Garnering public support through site visits, Intensive engagement with property owners, Carbon credit certification process and market utilization. | **Beneficiaries:**<br><br>Local community, visitors and tourists, scientific community |
| **Value capture** | **Costs**<br><br>Sediment by-pass trial (€ 4 million)<br>Nourishment strategy (€ 2.25 million – €3 million) | **Revenue streams:**<br><br>Tourist taxes (€2,250,000 p.a.)<br>Tourist fees (€2,187,500 p.a.)<br>Carbon credit sales (€7173 -456 - €12,911 p.a.) | **Financing and funding:**<br><br>Intensive engagement with property owners; Further monitoring and measuring sequestration rates |
| **Transversal categories** | **Impact indicators:**<br><br>Amount of sediment - used for coastal nourishment, transported through by-pass system; Surface area wetlands restored; Emission reduction ($tCO_2$ /ha /y) | | **Risks:**<br><br>lack of land available, too little sediment available, expense justification from public authorities, credibility of carbon credits, tourist carrying capacity |

Figure 28 Business Model Canvas for NbS in the Ebro delta

### 7.3.2. Mission and objectives of the restoration initiator

Given our study scope and the range of different interventions being implemented or are planned to be implemented, there is not one single initiator. Several of the wetland restoration projects a collaboration is initiated by Eurecat (research institute), whilst the coastal activities are initiated by the Ministry of for the Ecological Transition and the Demographic Challenge (DG for the Coast and the Sea). The table below summarizes the main objectives of three different restoration and protection strategies and the main challenges for the Delta as a whole.

**Table 18 Overview of objectives for the Delta as a whole and for the individual intervention types.**

**Ebro Delta.** All stakeholders agree that action is needed to **"Save the Delta".** The low lying-delta is increasingly under threat by sea-level rise and coastal storms causing high flood risks (Figure 29), a process aggravated by high erosion rates along the coast resulting a decreasing shoreline (Figure 30). As such, people, infrastructure assets, businesses and natural assets are all exposed to these processes. Everyone more or less accepts that action is needed, but there is no consensus on what to do. Other important (connected) challenges that the region faces are subsidence, declining availability of fresh water, salt wedge intrusion and mineralization, invasive alien species, and loss of (protected) habitats and species.

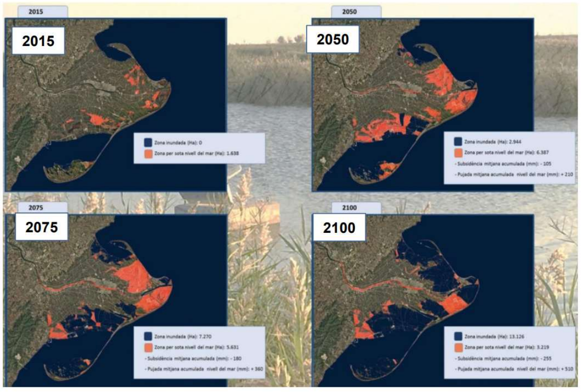



Figure 29 Habitats and livelihoods under threat form increased risk of flooding (Institut Cartografic i Geològic de Catalunya, 2016)

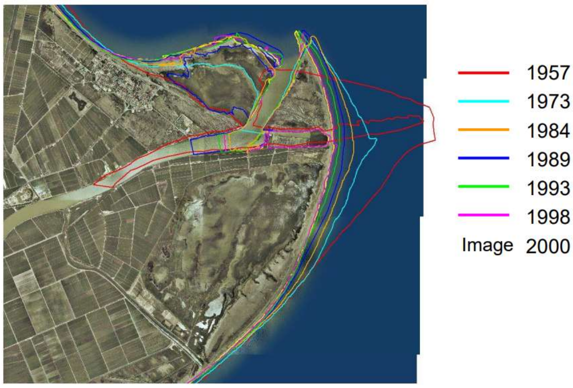



Figure 30 Coastal retreat at the Ebro River Mouth (higher than 10m/y) (Eurecat & UPC, 2023)

| | | |
|---|---|---|
| **Lagoon and wetland restorations.** Restoring lagoon habitats (Alfacada and Tancada) and marsh habitats (Bombita Wetlands) are activities that are designed and implemented to restore the river to coast connectivity, the connectivity between different Deltaic habitats, **restoration of habitats, protection of species**, As such, **natural dynamics return** to the salt marshes and lagoon. Furthermore, the monitoring of the restoration actions in the lagoon and marshes is continued in these areas. | **Beach and dune nourishments.** Resilience-based approach, rather than repair and recovery. Trabucador: a system of alternating dunes along the shoreline that should **allow for overwashing.** It entails the recovery of an existing dune system that was present in the past, yet altered in a manner in which **sediment capture** is expected to be **enhanced.** Marquesa: a dune field is created to try to give a relatively **stable stock of sediments** to the beach that will enter into movement only when there are strong winds or waves. Overall, these interventions are meant to enhance the dissipation of wave energy, to promote local coastal geodiversity and to maintain connectivity/accessibility. | **Sediment by-pass pilot.** A pilot trial to explore a specific system generating a sediment bypass, where upstream captured sediments can by-pass the dam and be transported downstream by the river. There are sediment transport models, but the models cannot be calibrated properly. The pilot would help in **assessing the effectiveness and feasibility** of this strategy. The strategy as a whole would contribute to sediment availability downstream for the protection of the Delta. |

### 7.3.3. Stakeholder overview

The stakeholder playing field in the Ebro Delta is complex, resulting from interactions between multiple levels of governments, water management authorities, research institutions, private (multinational) businesses operating in and upstream of the delta, NGO's, and citizens. Key stakeholders, or groups of stakeholders, are presented and briefly described in Table 19. The ordering in the table does not have any explanatory significance.

**Table 19 Overview of key stakeholders in the Ebro Delta**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| 1 | Ministry for the Ecological Transition and the Demographic Challenge | Within the Spanish government this ministry is responsible for amongst others, the fight against climate change, pollution, protection of heritage, biodiversity, forests sea and waters and demographic challenges. *Includes the secretariat of State of Environment* (DG water; DG for the Coast and the Sea; Office for climate change; DG biodiversity, forests, and desertification) and the *Secretariat of state for Energy* | Public | National Government |
| 2 | Government of Catalonia | Regional Government responsible for implementing national policies and regional planning | Public | Regional Government |
| 3 | Municipalities Amposta, Camarles, Deltebre, Ampolla, La Rapita, Sant Jaume, D'enveja, L'Aldea | Municipalities in the Ebro Delta responsible for the implementation of higher level government policy, administrative function with regards to social services for the population within their jurisdictional boundaries, responsible for local land use planning | Public | Local Government |
| 4 | Ebro River Basin Confederation | Spain's water resources are managed by river basin districts. These are the entities responsible for the management of the district. | Public | (Inter)regional |
| 5 | Catalan Water Agency | | Public | (Intra)regional |
| 6 | Catalan Institute of Ornithology | Not-for-profit association for the study of birds in Catalunya. Expertise for setting up large-scale monitoring. Responsible for management and coordination of scientific bird-ringing delegated on behalf of the Ministry. | Private | Regional |
| 7 | Catalonia Foundation La Pedrera Spain (NGO) | Independent foundation (founded in 2013) which focusses on carrying out projects that have a positive impact on people's quality of life. | Private | Foundation |
| 8 | Irrigation Community | Community of Farmers with Irrigation Rights | Private | Local |
| 9 | Infosa | Owner of the Salt pans. Salt extraction and harvest company located in the Ebro Delta | Private | Local |

| | | | | |
|---|---|---|---|---|
| | | Natural Park. Traditional salt processing enabling the important micro habitat. | | |
| 10 | Universitat Politècnica de Catalunya (UPC) | Public university located in Barcelona. Provide academic, scientific advice and research. | Public | |
| 11 | Eurecat - Centro Tecnológico de Cataluña | Research institution in Catalonia. Has an office and its feet in the Delta; provides (scientific) research, tries to facilitate the process, by developing plans and bringing stakeholders together. Acts both strategic and opportunistic | Private | Regional & Local |
| 12 | Endesa | Owner / operator of the two hydropower dams Mequinenza and Ribarroja upstream of the Delta. Endesa is one of the three large companies in the electricity sector in Spain, which together with Iberdrola and Naturgy, dominate around 90% of the national electricity market | Private | Multi-national |
| 13 | Iberdrola/Endesa | Joint owners of the Ascó Nuclear power plant located upstream of the Delta. | Private | Multi-national |
| 14 | Individual land owners / entrepreneurs | Farmers, aquaculture, hunting activities, and eco-tourism facilities | Public | National |
| 15 | European Commission | EU's politically independent executive arm, responsible for drawing up proposals for new European legislation, and implements (makes sure EU laws are properly applied, and manages EU spending programmes) the decisions of the European Parliament and the Council of the EU | Public | Supra-national |
| 16 | Agro-food Research and Technology Institute | Research institute owned by the Government of Catalonia (ascribed to the Department of Agriculture) | Public | Regional |
| 17 | Swarovski | Multinational corporation with a focus on three markets/branches namely, i)luxury jewelry products, ii) optical instruments, and iii)instruments and tools. They sponsor some of the birdwatching facilities and equipment used. | Private | International |
| 18 | The Catalan Climate Change Office (OCCC). | Technical and administrative support for Interdepartmental Commission on Climate Change, manages regional climate fund and registry of voluntary carbon markets | Public | Regional |

#### 7.3.4. Business Model proposition

##### Value proposition

Value propositions based on the delivery of ESS and corresponding benefits for the different measures are listed in the tables below (Table 20,

Table 21,

Table 22). Brief explanations and where relevant examples are provided. The ordering of the values in the table does not have any relevance.

**Table 20 Value propositions for Lagoon and Wetland restorations**

| Value propositions (Benefits of ESS) | Description |
|---|---|
| Biodiversity | The additional interventions, such as the removal of the dike at the Alfacada is expected to enhance the biodiversity benefits further by facilitating the recovery of the natural salinity gradient and by enhancing ecosystem resilience through restoration of the river to coast connectivity, the connectivity between different Deltaic habitats, restoration of specific habitats, and through the protection of specific species. |
| Food Provisioning | The restorations lead to improved connectivity and conditions for nursery habitats. As such different fish populations are expected to increase (or at least not further decline). This concerns “wild” fish types, rather than reared aquatic animals. |
| Biodiversity, Ecological - Knowledge | The (continued) monitoring and evaluation of interventions will add to the knowledge base concerning ecological restoration and management techniques. |
| Fresh water supply and control of salinisation processes | The restoration of wetlands does not directly lead to the provision of fresh water, it does affect the available fresh water supply in two ways. Firstly, it functions as a buffer zone, limiting the intrusion from saline waters from the sea. Increasing salinity levels are expected to cause a significant decline in agricultural (rice) production (Genua-Olmedo et al. 2016). Secondly, the land-use function of wetlands is less consumptive of fresh water (lower demand) than the original (previous) functions such as rice production and hunting activities. For example, water extraction has been negotiated by the community of farmers with irrigation rights (27.64 m3 /s for the General Community of Farmers with Rights to Irrigate using the canal on the right of the Ebro and 25 m3 /s for the Comunitat de Regants - Sindicat Agrícola de l’Ebre using the canal on the left of the Ebro) (Oficina Catalana del Canvi Climatic 2018). During the drought period in 2023, the amounts extracted had to be cut by 50%. Transforming rice fields to wetlands reduces the pressure of water demand for irrigation. |
| Erosion control | Wetland and lagoon restorations in the coastal zone support the process of erosion control through the dissipation of wave and current energy or by binding and stabilizing the soil. |
| Subsidence control | The coastal lagoons and wetlands can provide a lee zone and structures in which sediments transported through riverine flows can be deposited and settle. Subsidence is of great influence on salinity levels in the Delta. |

| | |
|---|---|
| Flood risk reduction (through exposure and vulnerability) | Besides from the regulating functions, the exposure and vulnerability of assets at risk will decrease. Wetlands and lagoons, although exposed to flood hazards, are less vulnerable to shocks caused by flooding events (if they are in good conditions). As such, changing the land -use functions from vulnerable rice production to less vulnerable nature can reduce the overall impact from flooding events. |
| Eco-tourism | The restored areas are natural assets for eco-touristic, educational and cultural activities. |
| Carbon sequestration | Global climate regulation through the reduction of greenhouse gas concentrations through sequestration and storage |

**Table 21 Value propositions for beach and dune nourishments**

| Value propositions (Benefits of ESS) | Description |
|---|---|
| Biodiversity | Preservation of the bays (Alfacs and Fangar) in the spit by the removal (and use) of accreted sediment. Further, the functioning of the barriers has an important role in the preservation of the ecosystems in the bays. For example, the Alfacs bay and the salt production zones are an important habitat for flamingos. Similarly, the bay hosts specific species of mussels (that have now gone extinct in other Mediterranean areas). There used to be a population of 100.000, but only around 10% remains. They live here because of the freshwater influence. |
| Biodiversity – Knowledge development | The (continued) monitoring and evaluation of interventions will add to the knowledge base concerning ecological restoration and management techniques. |
| Flood risk reduction – knowledge development | The beach nourishments, in particularly the construction of innovative dune structures experimental techniques and are subject to continuous monitoring, leading to the development and accumulation of new knowledge. As such the sites are subject to on site research and scientific investigation. |
| Erosion control | The design of the dune structures is meant to enhance sediment stabilisation (reduce erosion) and prevention of shoreline retreat. |
| Flood risk reduction | The Trabucador barrier has an important protective function, without it, La Rapita would be much more vulnerable to waves and the ecosystem in the bay behind the barrier would change. Further Marquesa beach and dunes (as well as the rest of the coastline) also have an important protective function for reducing flood risks for the hinterland. |
| Protection of cultural heritage and maintaining connectivity | The Trabucador Barrier is a 6km long sand barrier that also has the function of a road that connects the south industry to the rest of the land. Disruption/breaching of the Trabucador in the past led to disconnection for the salt producers, and for the people working in the natural park. For example, during storm Gloria the south spit was disconnected for 3 weeks. The road is only accessible for the workers of the industry and natural park and for the transportation of the corresponding goods. The barrier road used to be open to everyone (horse, bike, mobile homes, trucks, cars, etc) but that was a logistical chaos. During that time, it functioned with a toll system. Now it is closed for most users. |

| | |
|---|---|
| (Eco-) Tourism | The dunes, bays and beaches are important areas for active touristic activities such as kite-surfing, walking, and stand-up paddling, but also for the more passive “Sea, Sand, Sun” tourists. and passive |
| Carbon sequestration | In the Alfacs bay behind the barrier there is seagrass, which holds the potential for carbon sequestration. |

**Table 22 Value propositions for Sediment by-pass (pilot trial) The propositions in italic are those corresponding to effect expected when implementing this strategy on a more permanent scale, so beyond the effects that are expected from within the pilot trial itself.**

| Value propositions (Benefits of ESS) | Description |
|---|---|
| Knowledge development | The by-pass pilot trial will lead to development of knowledge regarding the technical feasibility and potential of the by-pass itself (the physical structure of the by-pass), and knowledge about the sediment loads in the water column and the transportation potential under different water levels (release strategies), including different zones in the Lower Ebro river (see also Figure 33 and Figure 34). These results can be used for the validation of existing models. As such, these results will lead to further insights into the feasibility of this strategy, and the conditions under which it can be more or less effective. |
| Reduction in Dam operation and maintenance costs / Dam lifecycle extension | Sedimentation is known to affect the safety of dams, can influence (reduce) energy production, and also influences storage and discharge capacity and flood attenuation capabilities. Further, sediment loads put pressure on dam gates and can potentially damage mechanical equipment. |
| Sediment supply for subsidence regulation and nutritional nourishment of rice-fields | There is a potential to reduce the costs associated to beach nourishments and the continuous relocation of sediment from the spits to the other zones along the coast, if sediments from upstream are transported by the river towards the delta and the river mouth. Depending on the transport capacity and amounts of sediment, deposition can also occur on the agricultural fields (in the past, farmers referred to “Liquid Gold” when sediment flushes occured) |
| Sediment supply for coastal erosion control | |

Market analysis (demand and supply) and legal requirements

We identify several important customer segments that are relevant for one or more of the three different strategies.

**Tourists, and the tourist sector** - Tourism has become increasingly important for the Ebro Delta’s economy and has increased substantially since the creation of the natural park in (1986). Visitor numbers are expected to grow in the years ahead. Tourism is seen as a big opportunity. The Delta is already hosting around half a million visitors yearly, especially during weekends and vacation periods. This tourism is linked to the natural and cultural values of the delta including the biodiversity, the landscape, the gastronomy, and the cultural traditions (Figure 31). Regarding the landscape, the delta has its own physiognomy (character and appearance) resulting from the totally flat terrain giving it a unique and spacious appearance, combined with the multiple and seasonal looks of the dominantly present rice paddies.

The Delta’s tourist related infrastructures are not in adequate state to facilitate this growing economic sector in a sustainable manner. As such, a Green Infrastructure Plan (GIP) is being developed. The GIP addresses the ecotourist use of the delta. It links the management and restoration with ecotourist activities. As such, it tries to further enhance restoration through enabling touristic activities/experiences in the restored sites. Further the plan addresses the lack of commuting infrastructures. Opportunities for an enhanced network of bike paths and walking tracks has been identified. The ambition, and expectation of the plan is that the number of people visiting the Delta can double, simultaneously recover more nature, whilst having less negative impact. The approach taken for the plan is to first co-develop it with stakeholders and partners, and only after that submit to relevant public administrations. The scope of the GIP only covers the “inland” delta zone, and not the coastal area as this falls under national jurisdiction. Further studies are conducted that look into the carrying capacity of the delta in terms of tourist numbers.

**Figure 31 Canoeing near Bombita (19-07-2023, photo credits: Heleen Vreugdenhil)**

**Figure 32 Selling locally produced organic rice at Riet Vell (photo credits: 19-07-2023, Heleen Vreugdenhil).**

**Farmers, the agricultural sector -** This stakeholder group is one of the groups that is heavily affected by the impacts of climate change and sea-level rise. Their existence and livelihoods are severely under threat. Specifically, subsidence control, security in freshwater supply, and protection against floods are important ecosystem service benefits for the farmers. If there is no new sediment supplied to the inland areas, then it will continue subsiding and finally leading to a situation in which rice production may not be possible anymore. This in turn would have negative consequences for biodiversity because the rice fields provide a unique habitat. Rice production in the Ebro accounts for 98% of the total Catalan production and as such, the third most important contributor within the European Union (Beukering et al., 2008). Production levels in the Delta have stabilized at around 6,000 Kg/Ha (Ibáñez, 2024). Although rice production is of economic importance, the productivity of the area is reasonably low due to the high natural salinity levels in the soils. However, on the other side, the productivity is relatively stable, resulting from the (until now) stable supply of freshwater.

Potential payments from farmers have not (yet) been investigated in the case study. In the past, before the construction of dams, farmers used to pay for receiving (nutrient rich) sediments. It was even referred to as “Liquid Gold” (Gorostiza et al., 2023). All farmers are aware of the value of sediment for improving the fertility of the soils. However, given the current agricultural practices with fertilizers and pesticides, receiving such sediment becomes obsolete. As such, tapping into payments / contributions from farmers is conditional on the ongoing agricultural practices as well as the attitudes of farmers concerning changing practices towards more ecological, sustainable, regenerative practices. Some entrepreneurs have already transitioned towards these different practices and are pioneers in bringing eco-friendly, ecological products to the consumer market (Figure 32) At this point there seems to be a low willingness amongst farmers to change practices. However, the changing demographics, specifically the young generation taking over businesses, has also been identified as an opportunity for the transition towards more sustainable farming practices.

Most of farmers in the irrigation communities do value sediment (especially given the ongoing subsidence) but it is not known if there is a willingness to pay for it. Further, it may be difficult to determine the effects of buying and applying such sediments on the production rates (output/yield) which is currently unknown. Further studies are ongoing to model the sediment transfer capacity in the irrigation systems – another boundary condition for being able to develop a supply and demand model of sediment for the farmers. This ongoing study is executed in collaboration with the irrigation communities.

**Fishing / aquaculture sector** - 9,000 tons of fish are caught in the delta each year, which is 15% of the total in Catalonia, making fishing another economic sector and form of livelihood. Almost 2000 people are employed in this sector (Barcelon Field Studies Centre, 2023). Aquaculture also occurs in the Ebro Delta, specifically the production of mussels and oysters in Fangar and Alfacs bays. Sustainable aquaculture is seen to be quite risky and there are still many technical questions. Further, there are significant challenges in the aquaculture domain related to rising temperature levels in the water of the bays. During the warmest periods the temperatures have been as high as 30 degrees. Further, the need for capacity, or in other words, entrepreneurs who are willing to step in to the aquacultural market, was identified as a limitation.

**Carbon credit market – regulated and voluntary**

In Spain, there are two carbon emission trading systems in place, namely the regulated (mandatory) carbon market and the voluntary carbon market, where the latter is of particular interest for NbS. The voluntary carbon market in Spain has existed for several decades, although in the recent years a more rapid growth has been perceived. From 2019 to 2021, credit issuance increased by 116% and demand by 130% (Santos, 2024). This has been explained by the ambitious emission reduction targets to be achieved by 2030 (Santos, 2024). On average the price for one ton of carbon equivalent ($tCO_2e$) is around 10 euros. However, the price greatly fluctuates, and has been seen anywhere between 1 euro per $tCO_2e$ up to 2000 euro per $tCO_2e$. Generally, the high(er) prices are seen within the context of biodiversity and restoration projects.

Catalonia was the first autonomous region in Spain in 2015 to encourage companies to report their emissions voluntarily (Santos, 2024). A voluntary agreement program for the reduction of greenhouse gas emissions was developed by the The Catalan Climate Change Office (OCCC). It is set up for those organizations that are looking to make a voluntary GHG reduction commitment, which in some cases implies these organisations go further than what is legally required from them. By setting up an agreement, signatory organizations commit to tracking their emissions and to establish reduction measures. Accordingly, these organisations report to the OCCC annually. Recently the Spanish energy company Iberdrola, which is involved in the energy operations upstream of the Ebro Delta, has committed entered into the domain of nature-based solutions and the carbon credit market through the launching of a new company, Carbon2Nature, which is focussed on nature-based solutions (Iberdrola, 2023).

### Value creation & delivery

Regarding the Lagoon and Wetland restorations, a range of different interventions are foreseen, following up on the restoration activities that have already occurred in the past. In the **Alfacada lagoon,** the main intervention still needed is the removal of 1,2 km of dike structure (Figure 31). Further emphasis in the Alfacada is placed on monitoring. As such the continued monitoring of the effects of restoration activities, developing procedures for ecological monitoring (of specific plants and animals) and experimental monitoring of the effects of increasing temperatures on the salt marshes and lagoon habitats. In the **Tancada lagoon**, no further interventions are currently planned. The continuation of monitoring the effects of restoration activities is planned. Interventions in the Bombita wetland area (Figure 34) are the cleaning or removal of existing canals, the removal of (parts of) internal and external dike structures, deepening the area (creating the lagoon), the removal of roads and (exotic) vegetation management.

The **beach nourishments and dune restorations** at Marquesa beach and Trabucador require additional nourishments (short and mid-term) and continuous monitoring efforts. The **sediment by-pass pilot** trial was planned to occur between 2022-2027. The pilot implements tests and monitors the process of sediment relocation from upstream of the dam to downstream in the Delta. In order for sediment to be transported by the river downstream into the delta plain, sufficient water flow is required. 100.000m$^3$ of sediment is expected to be transported.

**Figure 33 Removal of dike structure (1,2 km artificial dike) at Alfacada (Eurecat & UPC, 2023). This dike separates the lagoon from the sea. Removing this structure would lead to a restored connectivity allowing for the natural dynamics to return**

**Figure 34 Bombita reserve (Eurecat & UPC, 2023) part of the Canal Vell lagoon system, is a coastal area located on the north side of the river mouth. In the past the land was used for rice production, but the fields were abandoned and are now being re-naturalized.**

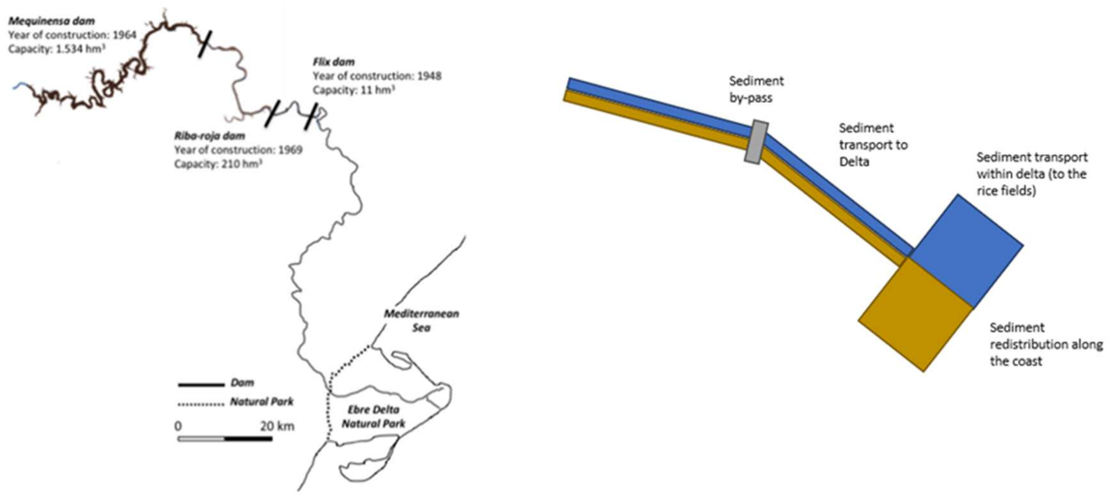



**Figure 35 Left: The lower Ebro River with the locations of major dams and the Ebro Delta (Natural Park) (Gorostiza et al., 2023); Right: Schematization showing the interconnectedness of water and sediment in the lower Ebro River system, including upstream of the dam, the dam, downstream of the dam, and Ebro Delta. Adapted from (Kruip, 2024).**

Implementation arrangements

Crucial in the implementation arrangements for all three NbS strategies (wetland, lagoon, and marsh restorations / Beach and dune nourishments and restoration / Sediment by-pass) is to develop an implementation arrangement in which continuous monitoring is embedded. As such, where the public authorities are primarily responsible (e.g. coastal protection) a procurement strategy with post-delivery activities (incl monitoring, reporting and maintenance) is recommended, as is the continuous collaboration (in parallel to the procurement) with scientific advisors. Similarly, for the sediment by-pass, a collaborative partnership consisting of responsible public authorities, scientific advisors and researchers, and the contracted engineering firm is recommended as well as close engagement with representatives from Endesa, Iberdrola, and the irrigation community. Contractor, Specific procurement contracts such as innovation partnerships could be an appropriate instrument. Regarding wetland and lagoon restorations the points of attention are also the continuation of monitoring, as well as the ongoing partnerships with the Ebro Natural Park and the public authorities responsible for the Marina and terrestrial protected areas, especially where the ownership is transferred once the initial restorations are complete. As such, the process of entering the carbon credit market should also be secured and coordinated through engagement with the future potential owners/managers of the areas restored.

Value capture

The sales of Carbon Credits and revenue generation from touristic activities (tourist fees) are identified and elaborated below under economic and financial projections.

Economic and financial projections

**Cost projections**

The sediment by-pass pilot trial is expected to cost € 4 million (for a five-year period between 2022-2027)

It was estimated that the costs for the construction of the dune systems have been around €15 – 20 per $m^3$. This includes strictly the dredging, transportation and construction activities. As such, up until now, the interventions at the Trabucador Barrier (where +/- 150.000 $m^3$ of sediment has been mobilized) have cost between € 2,25million – €3 million and at Marquesa beach (where +/- 33.000 $m^3$ of sediment has been mobilized) have cost between €0,49million - €0,66million)

**Currently, we have identified different potential sources of revenue**

**Sale of Carbon Credits from Wetlands:** 4830- 9660 € /y from Alfacada Tancada (350 ha), and Bombita 483-966 € /y (35 ha)

14 representative wetland sites in the Delta, have been studied to evaluate their carbon sequestration potential, including sites at Alfacada and Tancada (Fennessy et al., 2019). The result shows a high variability (32 to 435 g C m−1 yr−1) although those areas that are characterized by a hydrological connectivity have higher rates (averaging 376 ± 50 g C m−1 yr−1). We proceed with the average of 376 C m−1 yr−1. Alfacada and Tancada jointly cover a surface area of 350 ha which has been restored during the past years. Bombita wetland covers a total surface area of 416ha, of which 35ha are being restored. We use two different prices for the calculations, namely the average carbon credit price from the voluntary market (€10) and for comparison a higher-than-average price given the fact that these sites are ecological restoration sites (€20).

**Table 23 Preliminary calculations for revenue generation potential from sales of carbon credits for sequestration from restored wetland habitats**

| Voluntary market – Average price | Voluntary market - higher than average price |
|---|---|
| Price: €10 per $tCO_2e$ | Price: €20 per $tCO_2e$ |
| Sequestration rate : 1,37992 $tCO_2$ /ha /y | Sequestration rate: 1,37992 $tCO_2$ /ha /y |
| Restored Surface Area Alfacada & Tancada: 402 ha | Restored Surface Area Alfacada & Tancada: 402 ha |
| Restored Surface Area Bombita: 35ha | Restored Surface Area Bombita: 35ha |
| Yearly revenue generation | Yearly revenue generation: |
| Alfacada & Tancada: 4830 € /y | Alfacada & Tancada: 9.660 € /y |
| Bombita: 483 € /y | Bombita: 966 € /y |

| | |
|---|---|
| TOTAL: 6030 € /y | TOTAL: 12061 € /y |

**Sale of Carbon Credits from beach and dune restoration:** 1143 - 2286 € /y from Marquesa and Trabucador

Coastal dune systems also have the potential to store and sequester carbon where both the soil properties as well as available biomass (vegetation) plays a role in this process. At this point in time there is no data (measurements) available regarding these values in the coastal beach and dune systems in the Ebro Delta. Based on identified sequestration rates in studied dune systems in Italian cases (Bonito et al., 2017; Drius et al., 2016; Vecchio & et al., 2022). we calculate an initial projection of potential revenue generation from carbon sequestration at the Marquesa beach and the Trabucador barrier. We use the values for soil carbon storage, since these sites have very low biomass present (at this point). Again, we use two different prices for the calculations, namely the average carbon credit price form the voluntary market (€10) and for comparison a higher than average price given the fact that these sites are ecological restoration sites (€20).

**Table 24 reliminary calculations for revenue generation potential from sales of carbon credits for sequestration from restored beach and dune habitats**

| Voluntary market – Average price | Voluntary market - higher than average price |
|---|---|
| Price: €10 per $tCO_2e$ | Price: €20 per $tCO_2e$ |
| Sequestration: 1,2845 $tCO_2$ /ha /y | Sequestration: 1,2845 $tCO_2$ /ha /y |
| Surface Area Marquesa: 12ha | Surface Area Marquesa: 12ha |
| Trabucador: 77ha | Trabucador: 77ha |
| Yearly revenue generation | Yearly revenue generation: |
| Marquesa: 154 € /y | Marquesa: 308 € /y |
| Trabucador: 989 € /y | Trabucador: 1.978 € /y |
| TOTAL: 1143 € /y | TOTAL: 2286 € /y |

**Potential income from touristic activities**: €2.187.500 per year based on current prices of guided tours € 12 adults / €5,50 for children (weekly) average, and half of the million tourists make a visit of which again half are children and half are adults) (MónNatura Delta de l'Ebre, 2024). Currently, incomes generated only sufficiently cover the exploitation costs (including facilities and personnel)

**Public revenue generation through Tourist tax**: €2.250.000 per year

*Tourist taxes are being collected in Catalonia with differential rates (ranging from €3,00 for the more luxurious accommodations to €0,60 for the least luxurious accommodations). Taxes are charged for the first seven nights only to visitors aged 16 or more. Assuming an average rate (€1,80), 50% of the visitors being adults, and an average stay of 5 nights. These calculations exclude additional public revenues being generated by the 10% VAT charged. Currently, these taxes are not earmarked to flow back into the protection and restoration activities.*

**Sale of eco-labelled products**: amount unknown

Although the total amount is currently unknown eco-labelled products from the Ebro-Delta, are being sold. This includes the sales of organic agricultural products as well as the sales of certified salt. Currently these revenues are not earmarked to flow back into the protection and restoration activities discussed here, although partly dedicated to conservation activities directly related to the value chain of the products being sold.

**Table 25 Revenues generated that flow back into the projects**

| **Revenue source** | **Annual revenue potential** | **NPV of 5-year period (discounted at 10% for the private sector, and 3% social discount rate)** |
|---|---|---|
| Total carbon credit sales | €6.456 (at sales price of €20)<br>€12.911 (at sales price of €20) | €30.453 (at sales price of €20)<br>€60.906 (at sales price of €20)<br>(discounted at 3%) |
| *Tourist fees* | *€2.187.500* | *€9.121.580*<br>*(discounted at 10%)* |
| *Tourist taxes* | *€2.250.000* | *€10.613.471*<br>*(discounted at 3%)* |

#### Financial instruments

Carbon credits have been identified as a potential financial instrument. There is interest from stakeholders to deploy this instrument, however further monitoring data is being collected for verification and validation. Such evidence and monitoring are needed for the next step towards the carbon credit market. Interested parties to buy the credits are the (local) private sector who can buy voluntary carbon credits that can improve their corporate social responsibility (CSR). The European Union's Corporate Sustainability Reporting Directive (CSRD) can further stimulate this.

Further relevant instruments are eco-labels (although currently revenues are not earmarked to flow back into the projects), and ecotourism user fees (where the revenues generated can be used for the maintenance and research activities as well as for the further development of site specific recreational and educational infrastructure). Financial instruments, such as concessional loans, green bonds, or public loans, are currently not yet discussed. Up until now the investment sizes of the projects have not required upfront loans, rather resources within the (co-) funding arrangements can still be made available from within existing, or earmarked budgets.

#### Risk and contingency plan

The effectiveness of nature-based carbon credits is questioned due to credibility problems in voluntary carbon markets, resulting from past bad practices and significant media coverage. However, appropriate monitoring and following protocols as well as securing the appropriate agreements and guidance from the Catalan Climate Change Office should mitigate these reputational risks, if specific “safe” labels will be developed, these can increase trustworthiness amongst buyers.

The number of tourists that arrive in the Delta each year is increasing, which raises the question of how to manage and align the arrival of increasing numbers of tourists with preserving the values of the natural and traditional landscape. The Green Infrastructure Plan combined with further studies into the carrying of the delta in terms of tourist numbers should these risks, or at least provide further insight into the magnitude and potential other mitigative measures.

There is a lack of political support for the sediment by-pass. As such, this pilot trial has been put on hold (indefinitely). This occurred in spite of the available funding for the trial.

#### 7.3.5. Critical funding and financing challenges

Although not limited to the list below, the following challenges have been identified to play a key role in slowing down or preventing the further scaling-up of restoration activities.

A common vision amongst public (national, regional, and local) stakeholders particularly concerning the coastal defence strategy is lacking. On one side coastal protection efforts can focus on the expansion outwards (shifting the coastline outwards) through intensive nourishment strategies and as such incrementally increasing the width of the beaches (expensive). Alternatively, the coastline in its current situation can be maintained and coastal protection is accommodated inlands via wetlands, lagoons beaches and dunes. This second option which is cheaper than the first, counts on more resistance from local inhabitants in the region, since more land needs to be ‘sacrificed’ to create the natural buffer zone. Both options (although the first is more than the second) are conditional upon sufficient stock of sediment. Currently, limited sediment is available near the coast, driving up the costs for this first option.

In light of the available sediment budget, the second opposing view that has been identified regards the question of where to source the additional required sediment. On the one side, a lot of sediment is trapped upstream, which could be transported via a sediment by-pass through the Ebro towards the Delta. On the other side, the sourcing of additional sediment could be done further away from the coast.

Alternative (competing) pathways for the Ebro would include (for example) the development of golf courses, greenhouses, windmills, and solar panels. From a conservation perspective, these are not desirable, but they are serious competition for the restoration objectives. Especially since the revenue generation potential of such alternative land-uses is attractive for funders and financiers. To stay ahead of such developments a Green Infrastructure Plan has collaboratively been developed.

### 7.4. Extension 2: Financial scalability plan

#### 7.4.1. Upscaling dimensions

**“Saving the Delta” will require multiple interventions at different locations to be aligned and combined in order to tackle multiple societal objectives integrally and in a cost-effective manner.** This includes (but is not limited to) the following NbS

- Continued and increased wetland and lagoon restorations.
- Continued and increased beach nourishment and dune restorations.
- Tackling the future sediment availability gap, either through the sediment by-pass strategy or by tapping into another source for sediment supply.
- Continued and coordinated management of natural areas (terrestrial, marine, Natura 2000), and institutionalize the long-term responsibility for new and restored natural assets (to safeguard continuation of management, operation, maintenance, and monitoring).
- Equitable freshwater allocation and restored environmental flows.
- Riparian forest restoration.
- The further development and implementation of the Geen Infrastructure Plan in order to sustainably accommodate (eco)tourists.
- Transformation in the agricultural sector to sustainable practices, and expansion of sustainable aquaculture.

**A multi-sectoral, programmatic and adaptive approach is envisioned, based on a shared vision of the future of the Delta**. Given the physical, ecological and economic interconnectedness of the challenges in the Delta, a strong, and trustworthy institution is needed for this. At this point, there is no single institution or collaborative mechanism between institutions that has the (legal) responsibility or social license to coordinate this. A mechanism such as the CORE PLAT (RESTCOAST stakeholder engagement platform) is a starting point for such a collaboration and is seen to facilitate interaction between national level, regional level, and local level. Given the magnitude of the challenges, and the resources under pressure (space, water, food, money…) trade-offs will be unavoidable. For example, rice production is already seen to be competing with (eco-)tourism. There are about half a million visitors per year and tourism is seen as a huge opportunity. However, the arrival of more and more tourists and the corresponding infrastructure and space needed to accommodate for this growing sector may come at the expense of the traditional farming landscape. This exemplifies the need for a multi-sectoral approach to landscape and investment planning. This was put into words by one of the workshop participants "*Different stakeholders all have their own interests and only see part of the picture. This is also why some opportunities are not seen. We want to make the connection between the landscape and the economy, and hope to be able to take the stakeholders along in this bigger picture, or systemic view."*

**The cultural landscape is valued highly by the local community and also has its important ecological function. Such values tend to be overlooked in decision-making processes.** As expressed by another one of the participants in our workshop *"in the end it might be cheaper to relocate the people living in the area… but costs are not the only concern".* Social and cultural values are essential in decisions regarding the future of the Delta, and there needs to be a place for this. Valuing nature, or valuing the (non-market) benefits ESS comes with certain risks, especially if social and cultural values are not incorporated properly. Putting the environmental values and the social and cultural values in the decision making mix is also key for upscaling. There needs to be a place for this in decision-making, but typically cost-benefit analyses do not go this far.

**The need to create a platform, or a mechanism, in which funding contributions and revenue streams (inflows) for restoration projects (outflows) can be coordinated and managed at a larger scale**, was a final upscaling dimension that was pointed out. On the one side, funding from different sources is finding its way into the region. This is already in progress but the amounts and variation of funding are expected to increase in the future. For example, private sector regulations regarding the reporting of their operational activities (offering transparency regarding environmental, social, and governance impacts) is expected to drive up the funding streams towards NbS. Either for improved corporate reputation, for reducing operational risks or for offsetting negative impacts. Other examples of developments that are expected to drive up funding flows are the new EU restoration Law, improved networks with philanthropic and nature oriented organisations, and increased consumer awareness driving up the demand for eco-friendly products. On the other side, there are multiple projects, as listed in the beginning of the section, for which such funding and revenue streams can be put into use.

### 7.4.2. Upscaling barriers

Given the severe threats faced by the Ebro Delta, resulting mostly from (but not limited to) sea-level rise and coastal storms, all **stakeholders have reached consensus that action is needed. However, there is no consensus on what action** – in other words, how to address the challenges. There are two competing/ alternative views on the matter. The first is "expand coastline outwards" by increasing the width of the beaches. This strategy may be unrealistically expensive, and the necessary volumes of sand are most likely not available. The second view is to 'maintain' the existing coastline and to accommodate for buffering zones towards the inland. This alternative seems much more affordable but can count on severe resistance from inhabitants (who do not want to lose more land). Governmental authorities have opposing preferences, both in relation to the coastal zone as well as in relation to the proposed by-pass strategy upstream.

**Another important barrier is the public perception of the coastline**. Over time the shape of the Delta has continuously changed, it is a dynamic phenomenon. There was, and is, a continuous redistribution of sediment along the shore. The coastline in the Ebro Delta is one that is naturally dynamic with zones of erosion and zones of accretion. Given the rapid erosion rates and retreat of the shoreline, such dynamics that are no longer acceptable for the general public. In essence, the historic trends have led to a situation in which the general public desires to 'keep the shoreline fixed' and 'not move further back one meter". Flexibility towards a dynamic coastline is no longer present amongst the local stakeholders. Instead, preferences have transitioned towards the desire for a rigid, static, line, and as such a fixed shape of the coastline.

**Restoration activities are restricted by the availability of space and there are competing land-use alternatives.** Besides from the fact that the shoreline is retreating, the surface area of the Ebro Delta is highly utilized (mainly for agriculture, but also for urban and industrial areas and for (protected) natural parks). As such, there is no readily available space for interventions such as wetland and lagoon restorations. Competition for space is an existing challenge, which will remain persistent in the future. Conversion of land-use functions in inevitable. It was also pointed out that there are competing pathways for the Ebro, where nature restoration is one of these pathways. Others include the development of golf courses, transitioning towards greenhouses, and renewable energy production through windmills and solar panels. From a conservation perspective these are not desirable but are serious competition. Further, many of such competing land-uses typically have a more attractive financial profile since revenue generation is easier. If natural and social values are not taken into account, the opportunity costs for restoration will be too high and alternative pathways are likely to prevail over nature restoration.

### 7.4.1. Financial strategies for upscaling

Although not all barriers and complexities are "solved", financing upscaled restoration and coastal protection can include the following generic strategies.

- **Development of a shared multi-sectoral (long-term) vision for the Ebro Delta.** This should facilitate collaboration across sectors (public and private), across institutions (multi-level public sector collaboration) and across geographical, jurisdictional boundaries (coastal zone and river basin). Developing a shared vision seems to be an essential step to align the multiple objectives that all require resources (specifically space, money, and sediment), and to further the distribution of benefits and burdens. The current CORE-PLAT engagement mechanism serves as an initial step, yet should find continuation and expansion with more relevant stakeholders.
- **Monitor outcomes in order to tap into outcome-based payments.** Standardizing maintenance, monitoring and evaluation as an inherent and essential part of project implementation (rather than focus on initial restoration activities). Science-based monitoring holds the potential to unlock payment mechanisms for the delivery of services, rather than payments for project implementation. This seems applicable for several ecosystem services, where these are a few examples i) payments for the contribution for flood risk protection through the buffer zone and wave attenuation offered by wetlands and lagoons, ii) carbons sequestration and carbon storage in natural assets, and iii) changes in agricultural yields resulting from (future) nutritional sediment deposition
- **Strategic behaviour regarding land ownership.** Past wetland restoration projects have occurred primarily on lands that have become abandoned as result of unsustainable (economic) activity. For example, the yields on (agricultural) lands closest to the coastal zone, where the business is threatened with salt intrusion, and flooding events, are lower eventually leading to the decision to sell or abandon the land. Development of a wetland lagoon ecosystem in the coastal zone requires more land. The current law does not facilitate expropriation (and this may be undesirable as it leads to public resistance). As such, those lands (or businesses) that are close to their economic tipping

point should be bought opportunistically to create space for future restoration activities. An alternative strategy that is currently being shaped (or already implemented) is to offer private landowners a concession for business continuation the coming years, after which the property becomes public land.

- **Economies of scale through combining interventions.** Our analysis shows that cost reductions can be achieved through strategic sequencing or combining of projects, particularly in relation to sediment. For example, sediment that becomes available through the deepening of a lagoon or removing a dike structure can serve as a source (although not sufficient) for beach nourishments.
- **Public co-funding for public goods and private co-funding for common pool resources, club goods, and private goods.** Many of the eco-system services that are delivered by NbS are public goods. However, there are multiple public good benefits delivered, and as such multiple public funders should be able to contribute through co-funding structures to NbS projects that serve multiple objectives. In some cases, this may require adjustments of the public expense justification processes. Furthermore, for those goods that do not have public good characteristics, capture payments as much as possible through direct payments for ecosystem services or indirectly through for example, emission taxes, tourist taxes, payment for permits, or betterment levies.
- **Landscape scale value capture for eco-tourism.** Several of the past NbS projects contribute to enhancing the tourism potential of the delta. However, there is no direct link between the restoration of a specific site and the number of extra visitors that come, resulting from it. How many extra visitors will come for the beach? How many extra visitors will spend time canoeing on the lagoon? How many visitors are attracted to the gastronomy? In other words, the incremental value of NbS for eco-tourism is hard to define. A regional approach, in the form of tourist taxes from which at least a part flows back to NbS projects is recommended.
- **Funds for transaction costs.** In the current situation, tapping into private sources of funding leads to an increase in transaction costs, to such an extent that is disproportionate to the extra revenues it could deliver. A Catalan Climate Fund has now been developed. From this fund further research into the sequestration potential of the natural assets in the delta is being paid. This research is essential for unlocking the potential revenue generation from the carbon credit market but goes beyond the (financial) carrying capacity of individual restoration projects. This Catalan Climate Fund is ‘fed’ with public revenues from levied car emission taxes.

# Chapter 8. The Eems-Dollard Pilot

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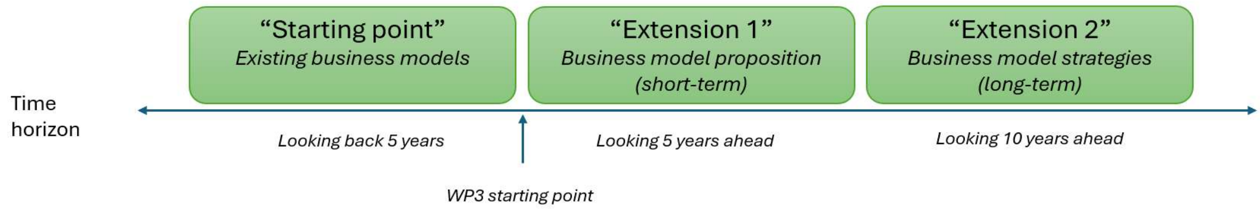
**Readers guide**




**9.1 Introduction**

- **This section provides a general introduction to the Eems-Dollard case**

**9.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - Eems-dollard Programmatic Approach
  - Overview of (pilot) projects within the Program and zooming in on three specific NbS, namely i) Raising agricultural lands ii) Dubble Dike with multifunctional intertidal zone and iii) Clayripening

**9.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Portfolio project named "De Groei Delta" (The Growing Delta) which includes the combinid implementation of three measures namely namely i) Raising agricultural lands ii) Clayripening and iii) establishing a natural zone
  - *The planning horizon of this portfolio project is 10 years, and as such overlaps with extension 2*

**9.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Integrated Coastal Zone Management

## 8.1. Introduction to the pilot

The Ems-Dollard estuary, with its sandflats, mudflats and salt marshes, lies where the Ems River meets the Wadden Sea and spans across the Dutch and German border (Figure 36). The Wadden Sea is one of the largest unbroken intertidal ecosystems in the world. The Ems River, with a total length of around 360 km, has its source in the southern Teutoburg Forest (North Rhine-Westphalia) and runs further through Lower Saxony before it discharges into the Dollard Bay (average of 80 $m^3/s$). From there, it continues as a tidal river towards the city of Delfzijl. Large areas seaward of the dikes are designated as Natura 2000 sites, in both the Netherlands and Germany.

The current shape of the estuary has been heavily influenced by anthropogenic activities. For one, large areas of land have been reclaimed from the sea during the past century. Saltmarshes were ringed with dikes, and peatlands were drained for agricultural use, leading to the current polder landscape. Very few natural transition zones and corresponding habitats remain, which are typical in estuarine ecosystems. These transition zones normally function as a natural place for fine sediments to settle. Further, the estuarine waterways are used for navigation and as such shipping channels have broadened and deepened over time. The rapid incoming tide from the North Sea brings along large volumes of sediment, which are not transported back in the same quantities as the outgoing tides. The combination of the lack of transition zones, strong incoming tides, and continuous dredging and depositing activities lead to high turbidity levels in the Ems-Dollard estuary. This excessive turbidity has consequences on the ecosystem and its biodiversity.


**Figure** 36 **Map of the Eems-Dollard and locations where a range of different (pilot) projects have been implemented (Programma Eems Dollard 2050, 2021)**

The region is also challenged by subsidence (resulting mostly from peat oxidation and gas extraction) leading to the area being vulnerable to sea level rise and in need of coastal flood risk protection. Sea level rise will threaten the survival of coastal wetlands, and there are still knowledge gaps regarding the effects of sea level rise on mudflats, sandflats and marshes in the estuary. On another note, public authorities in the Netherlands are concerned about the attractiveness of this area, or what they refer to as "liveability". The attractiveness of the area has decreased over the past years, especially since the more frequent occurrences of earthquakes and subsidence. Both nature and economic activity (jobs) play an important role in improving the liveability. The polders adjacent to the estuary are said to be productive lands and are of economic importance. Industry (chemical) and maritime transport are other important pillars of the regional economy.

## 8.2. Starting point: Current Business Model

Several restoration activities have occurred in the past or are occurring in the present. The activities, either pilot, research, or implementation projects fall under the umbrella of the Eems-Dollard 2050 program. The **Eems-Dollard 2050 program** (ED2050) started in 2016. In this program, national and regional stakeholders collaborate to achieve ecological improvement in the Eems-Dollard estuary. The initiation of the program was rooted in four motivations namely:

- Ecological restoration and protection of the ecosystem as the scarcity and value of this type of ecosystem (open estuaries) is increasingly recognized.
- Ecological restoration or ecological improvements are conditional for further economic activities and expansion in the area.
- The European environmental directives and Natura 2000 regulations require action to be taken.
- Several interventions can be implemented cost-effectively by combining different measures. For example, resources or materials that become available in one project can be used in another.

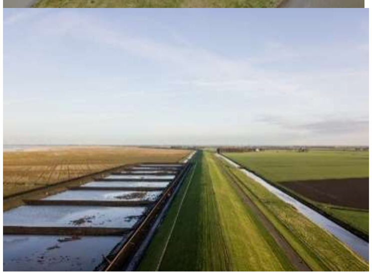
The ED2050 program is set up as adaptive and makes use of phased implementation towards a desired, or targeted, ecological situation in 2050 (Programma Eems Dollard 2050, 2016). The first phase of the program was in the period 2016 – 2020. The second and current phase is 2021- 2025. The results of each phase form the basis for the consecutive phase.

### 8.2.1. Interventions / restoration activities

Table 26 provides an overview of several of the (pilot) projects that have been carried out. The interventions contribute to the goals in several ways. For example, mud capture or sedimentation in projects like Marconi or Breebaart, is aimed to reduce turbidity levels of the Eems-Dollard, increase valuable natural areas and contribute to innovation in dike reinforcement projects by using clay to strengthen dikes.

**Table 26 Overview of different (pilot) implementation projects that have been carried out within the Eems-Dollard 20250 Program**

| Name | Description | **Visual** (ED2050, 2024) |
|---|---|---|
| Breeding Island Eemshaven | Construction of breeding island with material that became available from dredging activities |  |

| | | |
|---|---|---|
| Double Dike | Construction of second inland dike, behind the primary coastal dike. This creates a multifunctional (land-use: nature and aquaculture) zone in between the two dikes where a culvert is placed in the outer dike to allow for tidal influences and sediment deposition. |  |
| Rich Dike | Construction of tidal pools along the dike where water remains during low tides and the construction of a vertical “forest” of poles with ropes functioning as specific habitat for fish, mussels and grasses. |  |
| Marconi outside the dike | Construction of salt marsh landscape outside the dike, including a pioneer marsh, a higher marsh, and a breeding island. Was part of larger part of a larger levee reinforcement project. |  |
| Re-development of small polder | Construction of breeding and foraging islands, fish-friendly culvert, expansion of beach and swimming area and construction of playing zone |  |
| Re-development of polder Breebaart | Dredging of 70.000m$^3$ sediment that had settled here since 2001, was transported to the clay ripening. Further, activities include the placement of a new gully for trapping sediment, broadening a gully for predator management, replacement of materials on the bird island, enabling fish migration and tidal dynamics |  |
| Broad green dike pilot | Dike reinforcement using locally sourced sediments (a stretch of 750 meters). Using local clay leads to a different design, which is broader and less steep. Includes testing of clay characteristics in lab and test facilities, and tests on the pilot dike. |  |

| | | |
|---|---|---|
| Mudflat sediment for agricultural land improvement | Explore efficient ways to ‘harvest’, transport and apply sediment, investigate productivity gains in agricultural yields, explore legal frameworks and explore market readiness and feasibility. |  |
| Raising agricultural lands pilot | Explore and study techniques for the extraction of sediment from the water column, treat (salinity) and ripen, and apply on agricultural land. Monitor developments and responses on land (e.g. oxidation). Knowledge exchange on techniques and applications with Germany. |  |
| Mussel banks | Set out degradable nets and seed mussels to develop mussel banks, monitor the developments. |  |
| Reef blocks | Using the sediment from the estuary as raw material to build reef blocks, place these and monitor the developments. |  |
| Building blocks | Using the sediment from the estuary as raw material to create Lego-like building blocks. |  |
| Clay ripening pilot | Study and develop techniques to create clay from sediment from the estuary in an efficient way. |  |

### 8.2.2. ESS and Economic good typology

Although all individual pilot and implementation projects have their own unique (combinations of) ESS foregone and gained as a result of the interventions and changing land-use functions, Figure 37 summarizes on an aggregate level the primary ESS targeted and delivered by the different projects, and the type of economic good they constitute.

| | **Rivalry in consumption**<br>High | <br>Low |
|---|---|---|
| **Excludability** High | Private<br>*(1) Sediment*<br>*(2) Aquacultural products* | Club<br>(6) Intellectual interactions |
| **Excludability** Low | *(1) Sediment*<br>CPR | (3) Carbon sequestration<br>(4) Flood protection<br>(5) Subsidence control<br>(7) Eco-tourism<br>(8) Water quality improvements<br>Public (9) New habitats |

Descriptions

*(1) Sediment is extracted and used as the raw material for other purposes such as bricks, reef blocks and clay. In the case of sediment coming form dredging activities, it can be seen as a private good, when it is extracted form intertidal zones it can be considered a public good.*

*(2) Part of the intertidal zone behind the levee in the hinterland is designated for aquaculture, specifically the experimentation with salt resilient crops, fish, shrimps and seaweed.*

*(3) Carbon is captured in seaweed, emission reduction should be realized by using locally sourced materials for dike reinforcements, and carbon sequestration occurs in several natural areas.*

*(4) Several dike reinforcement projects are embedded in the program as well as intertidal zones in the hinterland.*

*(5) Subsidence control in those areas where natural siltation is facilitated, or where land is being raised artificially using sediments from the system*

*(6) Scientific research/knowledge development on techniques and monitoring of ecological impacts*

*(7) Bicycle networks have been established along the coast where several of the (pilot) projects have been implemented as well as historical harbours.*

*(8) Reducing turbidity levels in the water column, improving the base of the food chain.*

*(9) Creation of new habitats leading to biodiversity improvements*

**Figure 37 Changes in ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification**

#### 8.2.3. Funding: granting

Program-level funding, which is needed to cover the management and coordination of the program, is provided through co-funding arrangements (Table 27, Table 28). During the first phase (2016-2020) this was grant-based co-funding whilst during the following phase (2021-2026) the co-funding arrangement was established through in-kind personnel contributions from the principal parties. The intention is to tap into project-level funding opportunities, EU funding, and specific national climate adaptation funds to cover further program-level costs.

**Table 27 Overview of the division of funding to cover program level costs for the Eems-Dollard 2050 program for the period 2016 – 2020 (Programma Eems Dollard 2050, 2016)**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| Ministry of Infrastructure and Water | €200.000 | Program management | National | Co-funding, grant |
| Province of Groningen | €200.000 | Program management | Regional | Co-funding, grant |

**Table 28 Overview of the division of funding to cover program level costs for the Eems-Dollard 2050 program for the period 2021 – 2026 (Programma Eems Dollard 2050, 2016)**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| Ministry of Infrastructure and Water | - | Program management | National | Co-funding, in-kind |
| Ministry of Agriculture, Nature and Food Quality | - | Program management | National | Co-funding, in-kind |
| Department of Waterways and Public Works | - | Program management | Regional | Co-funding, in-kind |
| Province of Groningen | - | Program management | Regional | Co-funding, in-kind |

From the full list of (pilot) projects previously presented in Figure 26 we further analyse the funding arrangements for three specific projects. These are the projects *Raising agricultural lands*, *Double dike with multifunctional intertidal zone,* and *Clay ripening.* Each project is funded separately, based on the specific project objectives and stakeholder interests. For example, projects that include a dike reinforcement component typically involve funding from the regional waterboards and the National High Water Protection Program. Projects that include the usage of the dredged materials from the ports include funding contributions from the port authorities.

**Table 29 Overview of the division of funding for project 'Raising agricultural lands' (Programma Eems Dollard 2050, 2016; Programma naar een Rijke Waddenzee, 2018)**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| Waterboard Hunze en Aa's | €800.000 (jointly) | Implementation | Regional Waterboard | Co-funding, grant-based |
| Groningen Seaports | | Implementation | Port Authority Deflzijl&Eemshaven | Co-funding, grant-based |

| | | | | |
|---|---|---|---|---|
| Province of Groningen | | Implementation | Regional | Co-funding, grant-based |
| Department of Waterways and Public Works | | Implementation | Regional | Co-funding, grant-based |
| Waddenfonds | €800.000 | Implementation | Regional Investment fund | Co-funding, grant-based |

**Table 30 Overview of the division of funding for the project "Double dike with multifunctional intertidal zone" (Programma Eems Dollard 2050, 2016)**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| High Water Protection Program | €9.000.000 | Implementation | National | Co-funding, grant-based |
| Ministry of Economic Affairs | €200.000 | Implementation | National | Co-funding, grant-based |
| Province of Groningen | €3.600.000 | Implementation | Regional | Co-funding, grant-based |
| Waddenfonds | €3.400.000 | Implementation | Regional Investment fund | Co-funding, grant-based |
| LIFE Nature | €1.000.000 | Implementation | Supranational; | Co-funding, grant-based |

**Table 31 Overview of the division of funding for the project "Clay ripening" (Programma Eems Dollard 2050, 2016)**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| High Water Protection Program | €1.000.000 | Implementation | National; Earmarked for Flood protection | Co-funding, grant-based |
| Ministry of Infrastructure and Wate | €600.000 | Implementation | National | Co-funding, grant-based |
| Ministry of Economic Affairs | €1.000.000 | Implementation | National | Co-funding, grant-based |
| Waddenfonds | €4.500.000 | Implementation | Regional Investment fund | Co-funding, grant-based |
| Ecoshape | €500.000 | Implementation | Private; Foundation (network of organisations) | Co-funding, grant-based |
| Province of Groningen | €500.000 | Implementation | Regional | Co-funding, grant-based |

#### 8.2.4. Funding: value capture

Based on the analysis of ESS delivered we find different value-capture mechanisms that could be exploited in the future (Table 32).

**Table 32 (Future) potential funding contributions through value capture**

| Category | Funding type | Actor |
|---|---|---|
| Reduction in operational costs | Reducing costs for disposing of dredged materials. Partial remittance of revenue generation can be redirected to NbS. | Port Authorities |
| Recreation and tourism | Restoration can improve the attractiveness of the area. As the role of natural assets in the region increases, collected tourist taxes could be redirected towards NbS. | Municipalities |
| Increase/ continuation of agricultural yields | Much of the agricultural land is vulnerable to high (ground)water levels and salinization. Measures are meant to contribute to securing (and potentially improving) future agricultural production. Partial remittance of revenue generation can be redirected to NbS. | Agricultural sector, financial institutions ((land) asset owners) |
| Product sales (food) | Sales of local products such as fish, shrimp, and seagrass. Partial remittance of revenue generation can be redirected to NbS. | Local entrepreneurs and businesses |
| Product sales (materials) | Products produced from the sediment can be sold. So far, opportunities for the creation of bricks, reef blocks and clay have been explored. Revenue generation can serve as a cost recovery for the extraction and processing costs. Or Partial remittance of revenue generation can be redirected to NbS. | Local entrepreneurs and businesses, publicly procured engineering firms |
| Carbon Sequestration | Newly created habitats can deliver on the service of carbon sequestration. Further, several pilots contribute to the prevention of peat oxidation resulting in avoided emissions. Through the sales of carbon credits such values could be captured. | Private companies or individuals |

#### 8.2.5. Finance

Financial instruments, such as concessional loans, green bonds, or public loans, were not required for specific projects or the program as a whole. The money within the (co-) funding arrangements was made available from within existing, or earmarked budgets. Further, these resources were made available at the start of the projects, which implied that there was no financing gap which needed to be bridged by financing instruments (loans).

#### 8.2.6. Procurement / implementation arrangements

Many of the pilots and implementation projects are implemented based on collaboration agreements, or partnerships, between the multiple stakeholders involved. In some cases (such as the construction of Bird Island) or for specific activities (such as the construction of the secondary inland dike in the double dike project) an engineering firm is contracted through procurement, in accordance with public procurement law. Further, several projects involve Ecoshape, which is a network organisation that encompasses a consortium of over 15 parties including engineering consultants, knowledge institutes, contractors and NGOs (EcoShape, 2024).

### 8.2.7. Critical funding and financing challenges

Although not limited to the list below, the following challenges have been identified to play a key role in slowing down or preventing the further scaling-up of restoration activities.

Funding commitments from stakeholders remain short-term oriented, whilst the larger scale implementation of different projects requires a longer-term perspective on funding commitments.

Funding contributions are required to cover a particular transaction cost, namely the costs of program management. Ideally, these costs can be covered form funding contributions from individual projects, but this remains a challenge.

Much of the land on which restoration activities could occur in the future is private property. This leads to i) publicly initiated activities becoming more costly when land has to be purchased first ii) support from local stakeholders conditions the implementation opportunities, and iii) sites could be chosen that are not ecologically optimal, but where there is an opportunity based on available land and iv) the opportunity costs are high (for example, in case high value and high yield agricultural land needs to be repurposed for nature restoration).

Responsibilities regarding ecological restoration and coastal protection are fragmented amongst different public stakeholders. This leads to difficulties in getting restoration plans approved and in obtaining the required funding. Further, it leads to a lack of a systematic approach, acknowledging the interlinkages between sectors.

Even within the program, there seems to be competition for funding amongst restoration projects. Projects that deal with the removal of pollution (for example, the “Griesberg” a 200.000 m$^3$ – 300.000m$^3$ polluted area, which is a legacy from past industrial activities (Rijkswaterstaat, 2015) are not prioritized over projects that seem economically more attractive (due to the revenue generation potential).

## 8.3. Extension 1: Business model proposition and Business plan

### 8.3.1. Executive summary

The ecology in the Ems-Dollard estuary suffers from high turbidity levels, which in turn limits the primary production - the base of the food chain. Simultaneously, the region is challenged with a substantial coastal protection task as well as the challenge of continuous subsidence of the polders. The objective of this project, which is actually a portfolio of 3 different interventions that are jointly implemented, is to extract 1 million tons of (dry) sediment from the estuary. This sediment is processed and transported to be applied to raise the low-lying agricultural land and to be used as clay for future dike reinforcement projects. Further, a natural, intertidal zone in the hinterland will be constructed, where sedimentation can occur naturally with the incoming and outgoing tides.

The implementation project called “De Groeidelta” is estimated to cost an amount of €300M(€30 million per year for 10 years). The expected outcome is the production of 2 million m$^3$ of clay to be used in the future reinforcement of the (15km) Dollard dike, approximately 300-400 ha of agricultural land being raised, and a natural zone of 300 ha. The proposed funding model for the project is based on public co-funding and revenue generation. Offtake guarantees for the delivery and purchase of clay for the dike reinforcement projects are being discussed, as well as a loan to bridge the time gap between the implementation of the project and the revenue generation from carbon credit sales. The project has been registered at The National Carbon Market Foundation.

<table>
<tr><td>Value proposition</td><td>Problems addressed:<br><br>Water quality (High turbidity levels in water column)<br>Subsidence and peat oxidation<br>Lack of perspective for agricultural sector</td><td colspan="2">Benefits produced<br><br><u>Environmental benefits</u>: improved ecological functioning through decreasing turbidity, increased area of natural habitat and consequent natural sedimentation process, carbon emission reduction and carbon sequestration<br><u>Economic benefits:</u> Increased agricultural yields, Increased land value, Reduced costs for dike reinforcement (local clay), future perspective for agricultural sector, reduced operational costs for dredging activities, sales of sediment related products, opportunities for bio-agriculture practices conversion<br><u>Social benefits:</u> Agricultural sector job security, liveability of the region, recreational opportunities<br><u>Cultural benefits:</u> protection of agricultural livelihoods</td></tr>
<tr><td rowspan="3">Value creation</td><td>Key partners<br><br>Province of Groningen, Groningen Seaports, (procured) Engineering companies, Waterboard, Farmers, Entrepreneurs, Local Municipalities, Department of Waterways and Public Works, Groninger Landschap</td><td colspan="2">Regulation and Governance<br><br>Three implementation arrangements are proposed for which a decision is still to be made, these are a separate public fund structure, a separate private fund structure, or a special purpose vehicle under the umbrella of the Eems-Dollard 2050 Program. A financial intermediary can further be subcontracted for streamlining all project cash in/out flows.</td></tr>
<tr><td>Key resources<br><br>Knowledge gathered during pilot testing, Land</td><td>Customer segments<br><br>Water board, Groningen Sea Ports, Companies in agri-food value chain, farmers</td><td>Stakeholders<br><br>Public (3 local, 2 regional, 5 national level), Private (Business collaboratives, financial Intermediary, foundations)</td></tr>
<tr><td>Key activities<br>i) Transport, processing, and applying dredged material on agricultural land,<br>ii) Transport and processing of dredged material to ripen into clay<br>ii) Creation of intertidal natural zone for sediment entrapment</td><td>Customer relations and channels<br>Garnering public support, and specific support/interest form property owners through site visits and demonstrations. Intensive engagement with property owners for logistical choices. Carbon credit certification process and market utilization.</td><td>Beneficiaries<br>Local community, visitors and tourists, scientific community</td></tr>
<tr><td>Value capture</td><td>Costs €300M (€30 million per year for 10 years)</td><td>Revenue streams<br>€14M (reduced dredging costs)<br>€2-4M (carbon credit sales) – Project is registered for the voluntary carbon market.<br>€58 - € 100M (reduced material cost for dike reinforcement)</td><td>Financing and funding<br>Public and private co-funding through grants and revenue generation<br>Grant commitment /reservation so far (€42M from 6 public institutions or earmarked funds); Grant commitments under negotiation (€63M)</td></tr>
<tr><td>Transversal categories</td><td colspan="2">Impact indicators<br>- Tons of sediment extracted from the estuary<br>- Turbidity level<br>- Surface area of land raised<br>- Tons of clay produced and sold<br>- Km of dike reinforced with local clay<br>- Surface area of natural sedimentation zone<br>- Emission reduction ($tCO_2$ /ha /y)</td><td>Risks<br>Low turbidity related ecological improvement, lack of land and commitment from farmers, Natura 2000 regulation prohibit (parts) of the interventions, soil and clay quality problems. Expense justification from public authorities</td></tr>
</table>

**Figure 38 Business Model Canvas for 'The Growing Delta', NbS in the Eems-Dollard Estuary**

### 8.3.2. Mission and objectives of the restoration initiator

The implementation project called "De Groeidelta" which translates into *"the Growing Delta"* is in essence a portfolio project, where three different interventions (referred to as pillars) are combined and jointly implemented. These three different interventions are i) the raising of agricultural land with sediments extracted from the estuarine system, ii) the clay ripening of sediment extracted from the estuarine system, and iii) the creation of a natural zone for sediment entrapment (Figure 39). (Parts of) these interventions have been piloted or implemented in the past, as part of the Eems-Dollard 2050 Program. Current planning anticipates an implementation duration of 10 years. The primary initiator is the Province of Groningen. The objective is to extract 1 million tons of (dry) sediment from the estuary.

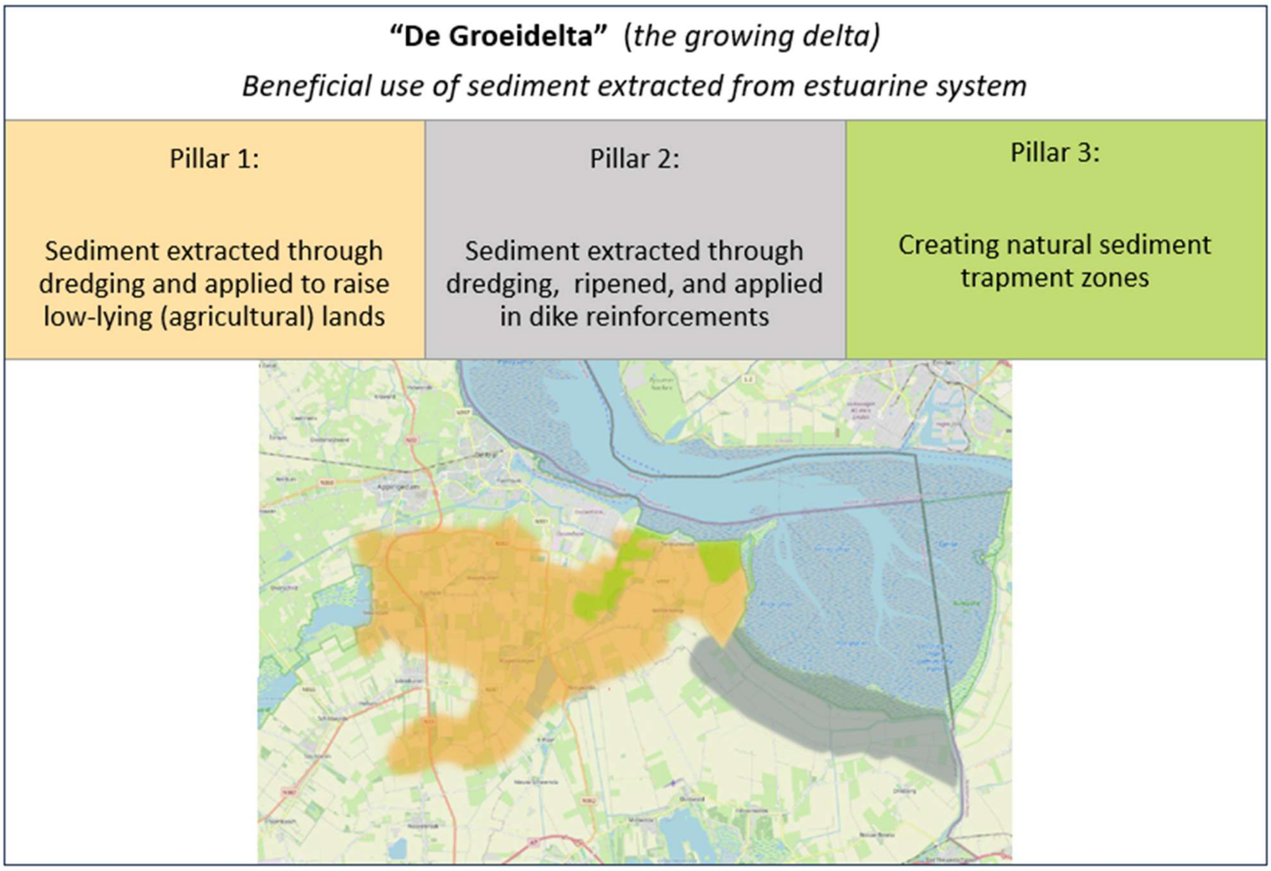



**Figure 39 Portfolio of interventions under the umbrella of "De Groeidelta" Orange: potential zone for application pillar 1, Grey: potential zone for application pillar 2 Green: zone for application pillar 3 (Working group Financing The Growing Delta, 2024)**

### 8.3.3. Stakeholder Overview

**Table 33 Overview of key stakeholders in the Eems Dollard**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| 1 | Province of Groningen | Regional government responsible for responsible for the implementation of higher-level government policy and (amongst others) regional spatial | Public | Regional Government |

| | | | | |
|---|---|---|---|---|
| | | planning (informing local spatial planning) and environmental policy | | |
| 2 | Municipalities of Eemsdelta, Het Hogeland en Oldambt | Local municipalities, are responsible for the implementation of higher-level government policy, administrative function with regards to social services for the population within their jurisdictional boundaries, responsible for local land use planning and granting of permits, concerned with liveability. | Public | Local Government |
| 3 | High Water Flood Protection Program<br>(Hoogwater-berschermingsprogramma) | Program in charge of national flood risk protection management programming and subsidizing, the alliance between the national government and regional waterboards | Public | National Government |
| 4 | Ministry of Infrastructure and Water | National-level government is responsible for improving quality of life (liveability), access and mobility (through the management and implementation of a network of roads, railways, waterways and airways) water management to protect against flooding, and improved air and water quality | Public | National Government |
| 5 | Ministry of Economic Affairs | National-level government is responsible for the development and implementation of climate policies | Public | National Government |
| 6 | Ministry of Agriculture, Nature and Food Quality | National-level government is responsible for the management and protection of large watercourses and conservation areas and (sustainable) food security | Public | National Government |
| 7 | Rijkswaterstaat | Executive organization of the Ministry of Infrastructure and Water Management, manages, maintains and develops the main road network, the main waterway network and the main water system | Public | National and regional Government |
| 8 | Waterboard Hunze en Aa’s | Regional Waterboard is responsible for ensuring water quality and flood risk management | Public | Regional |

| | | | | |
|---|---|---|---|---|
| 9 | Ecoshape | Foundation - Network organisation for the uptake of building with nature in water-related social issues, with multiple private sector members | Private | (Inter) National |
| 9 | Groningen Seaports | Economic operator and authority of the port of Delfzijl and Eemshaven and the adjoining industrial sites | Private | Local |
| 10 | Farmers | Landowners and land managers in the areas of interest and adjacent regions are challenged by subsidence and salinization. | Private | Local |
| 11 | Wageningen Marine Research | Scientific research institute | Private | (Inter) National |
| 12 | Groninger Landschap | Not-for-profit environmental organisation committed to the protection of nature, landscape, and cultural values | Private | Regional |
| 13 | Netics B.V. | Engineering company operating in the field of sediment re-use | Private | (Inter) National |
| 14 | *The National Carbon Market Foundation (*Stichting Nationale Koolstofmarkt) | Supports the voluntary, national carbon market by assessing plans and issuing certificates for verified emissions reductions | Private | National |
| 15 | The National Green Funds (National Groenfonds) | Financial intermediary, financial service provider and investor in projects that improve the natural environment (impact investment) | Private | National |

#### 8.3.4. Business model proposition

##### Value proposition

The underlying narrative of this project is to create a "win - win- win" situation. Firstly, the project addresses environmental quality issues. By extracting sediments from or stabilizing sediments in the estuarine system the problematic turbidity levels are being addressed. Secondly, the sediments extracted from the system will be reused to address other societal challenges such as subsidence (using the processed sediment to raise (agricultural) lands – pillar 1), and the coastal flood protection tasks (using processed sediment as clay for dike reinforcement – pillar 2). Thirdly to further stimulate sediment deposition natural lee zones in intertidal areas are created (pillar 3) further providing biodiversity benefits and recreational opportunities. As such, the liveability of the area is expected to improve and the prospect of business continuation of the agricultural sector is expected to be enhanced.

A further delineation of benefits is provided in Table 34. The listed benefits are still subject to further evaluation. For example, it still unclear how much the turbidity levels will be reduced resulting from these interventions, and how large or small the sequential effect on the ecosystem functioning will be. An

Environmental Impact Assessment is yet to be conducted. The ordering of the values in the table does not have any relevance.

**Table 34 Benefits derived from "The Growing Delta"**

| Value propositions (Benefits of ESS) | Description | Expected to be provided in | | |
|---|---|---|---|---|
| | | Pillar 1 | Pillar 2 | Pillar 3 |
| Locally sourced building material | Use of sediment as building material for raising land and dike reinforcements | ✓ | ✓ | |
| Dredging cost reduction | Reducing costs for disposing of dredged materials extracted from waterways and ports | ✓ | ✓ | |
| Subsidence control | Securing 'business continuity' of the agricultural sector since much of the agricultural land is vulnerable to high (ground)water levels and salinization. Natural accretion of sediment in natural zones also reduces subsidence | ✓ | | ✓ |
| Food provisioning | Potential increase in fish population through water quality improvements and increase in (nursery) habitats in intertidal zones | ✓ | ✓ | ✓ |
| Carbon sequestration | Increase in natural habitats | | | ✓ |
| Emission reduction | Reducing peat oxidation and locally sourced material for infrastructure projects produce less transport emission. | ✓ | ✓ | |
| Reduction in turbidity levels | Sediment stabilization and trapment in natural zones and removing dredged sediment form the system | ✓ | ✓ | ✓ |
| Visual screening | Given the specific location where the natural zone is expected, it serves as a visual buffer zone, between residential area and industry | | | ✓ |
| Tourism and recreation | Improved attractiveness for recreational activities (such as bird watching and hiking). | | | ✓ |

Market analysis (demand and supply) and legal requirements

We identify several important customer (market) segments that are relevant for *the Growing Delta*. Current planning efforts and calculations are guided by the target of extracting 1 million tons of dry sediment from the system per year. This 'practical' target was set as being a "safe" amount to extract from the system. "Safe" in light of the expected sediment needed for the resilience of the estuarine system (including the Wadden Sea region) facing sea level rise, but also an amount that is expected to lead to improvement of turbidity levels in the middle region of the Eems-Dollard. Given this target, one of the challenges is to match the supply of and demand for sediment to be extracted from the system (Arcadis, 2022a, 2022b; Provincie Groningen, 2020a, 2020b, 2020c).

**Supply and Demand of dredged material**

We can distinguish between different compositions of sediments, or dredged materials that differ in terms of densities and moistness. Within this report we refer to the following three categories; i) Wet mud - *which is the composition that is normally extracted by dredgers,* ii) Dry material and iii) and (in-situ) dried mud.

Groningen Sea Ports extracts 3,2 mln. $m^3$ of wet mud on a yearly basis from the two harbours located in the region (Delfzijl: 1,4 mln. $m^3$ and Eemshaven 1,8 mln. $m^3$). This is done to secure the navigability of the waterways. Normally, this dredged material would be discharged within the estuarine system but instead 58% of this dredged material (1,85 mln. $m^3$ dredged matter, approximately equivalent to 1 million tons of dry sediment) will be used within the context of de GroeiDelta. The characteristics of the wet mud from Eemshaven are more suitable for application for pillar 1 and 2 (more sandy & cleaner), but transport distance is around 30 km longer.

40% of the dry material will be used for **Pillar 1.** It has been estimated that this amount is sufficient to raise an area of 39 hectares with 0.8 meters in total.

Within the province of Groningen, public authorities are tasked with reinforcements of primary and secondary flood protection dikes, including dikes for both coastal and riverine flood protection. One of these dikes is the Dollard dike, for which an estimated total amount of 2 mil m3 of clay will be needed during a period of 8 years for the reinforcement of 15 km dike **(Pillar 2)**. By facilitating a process of clay ripening, the wet mud (dredge material) can be processed and made suitable for application on levies. Pilot projects have been conducted to test different processes.

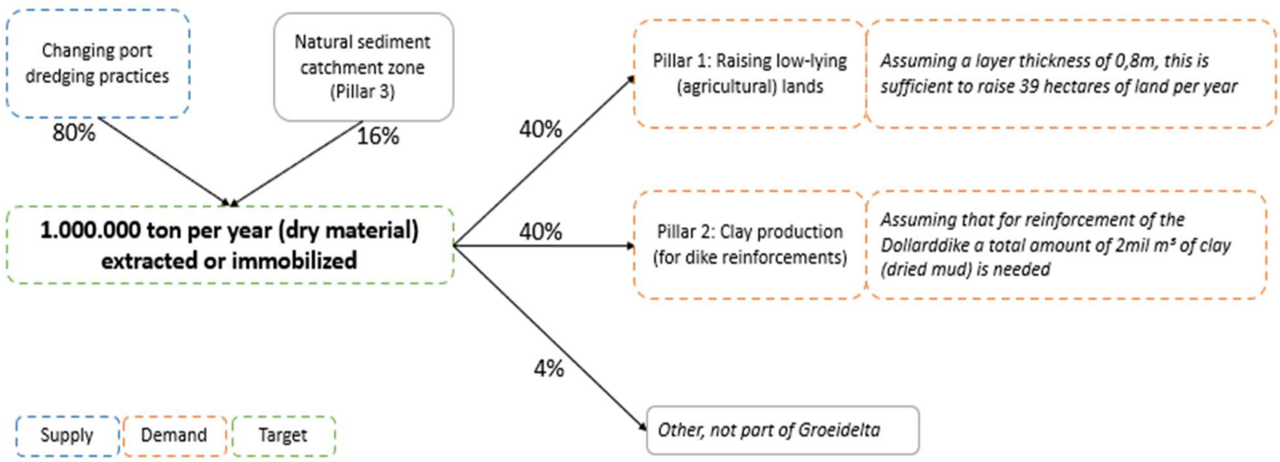



**Figure 40 Demand for dredged material within the pillars of de Groeidelta**

**Demand for Carbon Credits**

Initial interactions with stakeholders (business) that are part of the agricultural- food value chain have led to the identification of this group as a specific 'buyer' group for carbon credits. Carbon storage (or a reduction of carbon emissions from oxidation) and improvements of the agricultural – environmental production system are essential benefits for these stakeholders, who are also looking to reduce their environmental footprints. It is expected that business operating in this chain of processing and delivery of food products will be required to report and to reduce on their direct and indirect emissions.

The National Carbon Market Foundation, which was established in 2019, supports the voluntary, national carbon market by assessing plans and issuing certificates for verified emissions reductions. Emission reduction is determined independently by the foundation and one certificate is issued per tonne of CO2-eq. Based on interactions with representatives from the foundation emission reductions from the Growing Delta seem promising for exploitation through this voluntary market.

### Value creation & delivery

Table 35 summarizes the key activities required in each of the three pillars of the Growing Delta (Arcadis, 2022a, 2022b; Provincie Groningen, 2020a, 2020b, 2020c).

**Table 35 Overview of activities in pillar 1, 2 and 3 of the Growing Delta**

| | Pillar 1. Raising agricultural lands | Pillar 2. Clay ripening | Pillar 3. Natural catchment zone |
|---|---|---|---|
| Implementation Activities | - Dredging of wet mud<br>- Transport to washing location<br>- Washing of wet mud with fresh water* to reduce salinity levels (especially for wet mud from Eemshaven)<br>- From landing point the wet mud is transported to the destination through pressure pipes.<br>- approval of environmental quality<br>- construction of depots/storage (with quay to secure/hold wet mud) for further processing. Either directly on the land to be raised, or as intermediate step after which the dried mud will be transported to the land to be raised. | - Dredging of wet mud<br>- Transport to location closest to ripening depot<br>- Depositing wet mud through pressure pipes<br>- Drainage, or watering<br>- Sowing vegetation (potentially)<br>- Ploughing<br>-Harvesting and transportation | - Establishing culvert connection(s)<br>- Re-arranging natural zones for specific habitats and nesting grounds<br>-Deepening gullies for sediment to settle (and monitoring<br>- Passages for fish migration<br>- Constructing recreational infrastructure |
| Logistical and preparation activities | - Plot exchange / land re-parcelling operation<br>- Temporary exchange of lands<br>- Engagement with individual farmers | - Identification of suitable site for ripening depot | Coordinate with Groote polder project for potential efficiency gains |

*can only be executed from Nov – March.

**Implementation of Pillar 1**, the application of dredged material on land, is visualized in Figure 41 . Furthermore, raising the low-lying lands needs to happen per water level compartment. Once the land has been raised, the in situ water level needs to be adapted to avoid further peat oxidation whilst securing sufficient dehydration. As such, all the low-lying areas within the same water level compartment need to be raised. Often there are multiple stakeholders within one compartment, and, as such, different crops and agricultural techniques.

**Implementation of Pillar 2** entails the following activities; transporting and dredging the wet mud, establishing and arranging a depot for the ripening process with different compartments where the dredge material can be deposited through pressure pipes, ploughing with a crane or cultivator, applying drainage, potentially mixing with freshwater and sowing vegetation, harvesting the ripened clay, and transportation from the ripening depots to the location of application (Figure 42, Figure 43).

**Implementation of Pillar 3.** Historically the coastal zone is a dynamic area, with saltmarshes, peatlands, and other structures and estuarine habitats that are shaped and influenced by the tides and river flows. Much of this has been lost due to the construction of levees and land reclamation. The third pillar of the Groeidelta is concerned with establishing zones (on the landside of the dikes, in the polders) in which water and sediment can enter and sediments can settle in lee zones. The areas that are considered for this measure are amongst the lowest-lying and subsiding zones in between Delfzijl and Termunten. A total surface area of 300 hectares is targeted. To implement this, similar activities as were carried out in the project Polder Breebaart (see cross ref) are foreseen, namely, establishing culvert connection(s) through the dike that can be regulated, digging and re-arranging natural zones so that these are suitable for specific types of habitat and nesting grounds, deepening gullies for sediment settlement allowing for monitoring), creating passages for fish migration, and construction of infrastructure to enable recreational activities (such as bird watching and hiking). Efficiency gains may be established by connecting this third pillar of the Groeidelta to the project Groote Polder, which has similar ambitions/objectives. There are still choices to be made regarding the use of these newly established zones over their life cycles. These are a) serve the function of being permanent natural area, b) serve the function of a sediment bank - where sediment accretes and is harvested to be used for other purposes (such as raising agricultural lands) and c) temporary location for sediment accretion in preparation for industrial use (EcoShape, 2023; Provincie Groningen, 2020c).

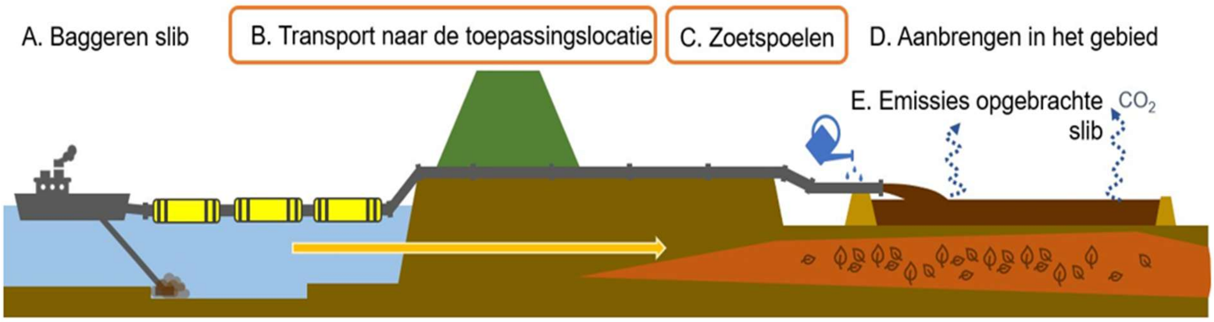



**Figure 41 Visualisation of the chain of activities required for the execution of pillar 1 (Arcadis, 2022a)**

**Figure 42 Aerial view of depot compartments during the pilot phase (ED2050, 2024)**

**Figure 43 Depositing wet mud through pressure pipes during the pilot phase (ED2050, 2024)**

Implementation arrangements

Implementation of pillar 1 of the Groeidelta requires intensive interaction with local stakeholders/ individual farmers and perhaps also the relocation of canals and roads potentially through a plot exchange / land re-parcelling operation. Such an operation has the potential to lead to more efficient implementation of pillar 1, whilst also having the potential to be beneficial for the farmers. Based on historical events, this is a process with which farmers are deeply, and culturally familiar, it is an instrument with a legal basis and institutions, and public authorities are also familiar with it. Raising the lands will occupy a time period of around 6 years (2 for application, and 4 for drying and processing), during which the land cannot be used for agricultural activities. Two options are discussed to bridge this: a) financial compensation for revenues lost, and b) supply of alternative suitable plot of land for business continuation. For a water level compartment of about 450 hectares, 300 hectares is needed for business continuation, where the quality and distance from own property also plays a role. Farmers have indicated a maximum distance of 20km from their current location is acceptable.

The operational scale of implementing *The Growing Delta,* with its three pillars requires significant capacity and organizational power. Further, public and private co-funding and revenue generation needs to be streamlined, payments need to be made (for example, payments for loss of land), stakeholder engagement continues to be key, and knowledge and implementation capacity will be procured. There are multiple options through which the governance structure and legal status of The Growing Delta can be organized. Particularly two novel options have been identified, which are still in need for further exploration.

- **A Private Fund structure,** in the form of a foundation (not for profit) with a societal objective. The project would be relatively more distant from the political arena and as such less vulnerable to politicking. However, public interests need to be guarded since the funding model is based mostly on public funding. This structure offers some flexibility with regard to capturing revenue streams that otherwise may remain uncaptured (public authorities typically can not be paid)

- **A Public Fund structure,** with which public parties are more familiar, since there are several examples in the area, such as The WaddenFonds. Co-funding stakeholders may have relatively more trust in such a structure. However, given the proximity to the political arena, the implementing organization will be more 'burdened' with the corresponding (bureaucratic) management activities and the decision-making time may lead to significant implementation (time) risks.

Continuation of project implementation under the Eems-Dollard 2050 Program is also one of the options. However our project partners signal that the scope of *The Growing Delta* (both in terms of time, as well as its objectives) is no longer aligned with Eems-Dollard 2050 Program. Further, regardless of the chosen governance structure, **a financial intermediary,** such as National Groenfonds, can be contracted to take over part of the financial management of the project.

#### Value capture

The following value capture mechanisms are foreseen:

- Partial/Full remittance from avoided dredging costs (Payment from the Port Authority)
- Sales of Carbon Credit for the avoided emission from peat oxidation
- Sales of clay supply for future dike reinforcement project / reduced material cost for dike reinforcement

#### Economic and financial projections

**Cost projections** for *The Growing Delta* are given below.

- Pillar 1: €100M (€10 million per year for 10 years), *for 0.8m elevation for 30 - 43ha per year*
- Pillar 2: €100M(€10 million per year for 10 years), *for clay for 15 km of dike*
- Pillar 3: €100M (€10 million per year for 10 years), *for 300 ha of natural zone*
- **Total Costs: €300M (€30 million per year for 10 years)**

These cost estimates remain uncertain. These are currently based on the experiences from past pilot projects, consultations with (engineering) experts, and estimated to be a reasonable ask from a 'political perspective'. Further, the equal distribution between the pillars also remains an estimate. Although further detailed cost calculations are deemed necessary, specifically regarding the exploration of the effect of different techniques and spatial/logistical choices on implementation costs, as well as the relative cost contributions of the different pillars, this amount is assumed to be the amount for which funding needs to be secured.

Different potential **sources for revenue generation and value capture** have been identified.

- **Reducing costs for disposing of dredged materials extracted from waterways and ports.** For both pillar 1, and pillar 2, dredged material is provided by Groninger seaport, and the associated operational cost reduction has led to a funding commitment of **€14M** (€700.000 per pillar per year). This is remittance of avoided costs.

- **Sales of Carbon credits.** For Pillar 1 an initial estimated amount of **€2-4M** is expected to be generated through the sales of Carbon Credits. Initial calculations are based on an estimated 35.000 $tCO_2e$ resulting from avoided peat oxidation and a price of € 80 per ton. These estimates are still highly uncertain.

- **Reduced costs for future dike reinforcements by using locally sourced and produced clay.** Based on a comparison of costs and benefits for different alternative designs for dike reinforcements, an cost reduction between 5% and 25% is expected from using locally sourced and produced clay as a building material. As such, a funding contribution of **€58M – 10M,** based on avoided costs is anticipated to come from the High Water Flood Protection Program, which is in charge of national flood risk protection management programming and subsidizing, in collaboration with the Waterboard Hunze and Aa's who are the responsible implementing organisation.

Other sources for revenue generation that have been explored but are **not (yet) 'capturable'**

- **Farmers (property owners) contributions / Payment for business continuity and value of land.** These stakeholders enjoy the benefits of project implementation directly, as they are currently being affected by subsidence and water nuisance/ inundations and have a lack of business perspective if the current trends continue. It is expected that if no action is taken agricultural productivity will reach its limits between 5 – 10 years. Initial estimates indicate that an increase in yield of around 5 – 10% on an annual basis can be expected, yet this is still highly uncertain. Further, an initial exploration also points towards a relatively small profit margin (varying per case, depending on crops, subsidies, and farm sizes). As such, potential contributions from farmers would lie in the range of **€100- 150** per ha per year. Further, raising agricultural lands would also lead to an expected increase in property value. Based on an assumed value of €80.000 per ha and an increase in value of 10%, the property value would increase by **€8.000**. This is however a paper value and does not lead directly to a cash flow. Further, this amount is relatively small compared to the cost per hectare (>€300.000 per hectare) of realization. Besides, although this stakeholder group enjoys the benefits of the project, they also endure nuisance (land is not usable for a prolonged period) and risks related to the project such as the duration and quality of the end products. As such, at this point, this value capture option is 'parked' for the time being. However, the use of an instrument such as the **betterment levy** may be further explored if the decision is made that it is desirable to capture this value, and as such partially contribute to cost recovery.
- **Sales of Carbon credits from Pillar 3 (natural zone)**

  The intertidal zone of 300 ha is also expected to contribute to emission reduction, especially through carbon sequestration through biomass. However, there are presently no estimations regarding the carbon capture or storage potential of the new habitats.

Financial Instruments

Carbon credits have been identified as a potential instrument. To deploy this instrument further calculations, verification and validation is needed. The project has been registered at the National Carbon Market Foundation to avoid future problems of additionality. Within two years after registration further, more detailed calculations need to be conducted.

Financial instruments, such as concessional loans, green bonds, or public loans, are currently not yet discussed. Most of the funding will be made available at the start of the project. A loan to bridge the time lag between the implementation and the revenue generation from Carbon Credits has been discussed and contacts have been established with European Investment Bank to explore potential instruments to cover this. Further, the revenue generation from the use of clay in the future dike project is substantial and an intention agreement or purchase guarantee is also under negotiation to mitigate market risks for the project.

#### Risk and contingency plan

The effectiveness and reliability of nature-based carbon credits is questioned due to credibility problems in voluntary carbon markets, resulting from past bad practices and significant media coverage. However, appropriate monitoring and following protocols as well as securing the appropriate agreements and guidance from National Carbon Market Foundation should mitigate such risks. If specific "safe" labels will be developed, these can increase trustworthiness amongst buyers.

The targeted amount of 1 million ton of (dry) sediment to be extracted from the estuary is no guarantee for actual ecological improvement. Continuous monitoring is recommended, and the establishment of a partnership or collaboration to accumulate essential scientific ecological expertise.

The actual funding contribution through the sales of Carbon Credits could be lower than anticipated. Additional credits from the natural zone (which have currently not been considered yet) could provide a buffer. Alternatively, a funding gap could be overcome by reducing the targeted amount of sediment to be extracted (although this may lead to insufficient ecological results)

The project may still encounter implementation restrictions from Natura 2000 legislation. However, substantial efforts have already been dedicated to assessing the magnitude of this risk to ensure project design is aligned with legal requirements.

The sediment that is being supplied by the two ports may be polluted and as such influence the value and usability of the agricultural land and clay. Continuous monitoring and measuring should mitigate. Early warning can avoid using polluted materials and ensure proper treatment.

Not all farmers are on board yet. Efforts are dedicated to continuous communication and engagement. For example, in preparation, several farmers were invited to participate in a field trip to sites in Germany where agricultural lands had been raised in a similar manner.

It may be difficult for public authorities to justify part of their grant contributions, specifically for their contributions to Pillar 1 (raising the agricultural lands). €100M is a substantial investment, benefiting primarily a small selection of farmers/property owners directly. A possibility to mitigate this risk is to establish conditions upon the benefitting farmers to ensure their commitments towards sustainable and/or ecological agricultural practices in the future.

### 8.3.5. Critical funding and financing challenges

The implementation of *The Growing Delta* could be framed as a next exploratory phase in the process of upscaling. At this point, most technical questions concerning the proposed techniques have been answered. Yet, the project comes with substantial logistical operational challenges, as such, the coming years will lead to the accumulation of knowledge and experience regarding implementation arrangements for larger scale interventions.

A further challenge is that at this point, the responsibility for providing "subsidence protection" or mitigating the negative consequences form subsidence has not been institutionalized.

## 8.4. Extension 2: Financial scalability plan

### 8.4.1 Upscaling dimensions

Different dimensions of upscaling are identified in the Eems-Dollard case study namely;

- Although the current project portfolio of the "Growing Delta" already spans an expected implementation period of 10 years and a surface area of approximately 45 hectares (total of three pillars) the intention is that this process continues over a larger area and longer time frame. As such, the ambition is that all the low(est) lying areas are raised to make them less vulnerable to flooding events from high groundwater levels and heavy rainfall, and the influence of salinization of the agricultural soils.

- Many of the technical challenges and question regarding techniques and approaches have been answered, but several organisational and financial questions remain. As such, the implementation of the "Growing Delta" can be seen as a pilot phase not in relation to technical readiness, but in relation to gaining knowledge, experience and support with regards to the organisational components of managing, coordinating and financing such a large project with multiple interconnected activities, objectives and funding streams.

- The issue of turbidity in the water column is a systemic problem with several dimensions. For one, along the coastline (before sediments reach the estuary) there is a lack of habitats where sediments can naturally settle. This results in a much larger amount now being deposited in one of the only places along the coastline where the sediments can still enter into the estuary. Furthermore, within the estuary itself there are also very limited paces where the sediment can settle. Additional pressures come from dredging and navigational activities in the estuary and also upstream of the river Ems. As such, addressing the turbidity problems and the effect it has in the ecosystem functioning requires a systematic, larger scale and transboundary approach.

### 8.4.2 Upscaling barriers

A first challenge related to upscaling is the lack of clarity regarding the (institutional) responsibility concerning subsidence. The process of subsidence, resulting for a large part from land-use and water management choices, is a continuous and gradual process. However, the responsibility for subsidence and the potential negative consequences resulting from it (such as peat oxidation, salinization, infrastructure damages) has not been allocated and distributed. This also leads to the challenge of justifying public expenditures for raising agricultural land, which is public money spent on a few farmers.

Particularly (but not limited to) this area of the Netherlands requires increased attention to ensure the attractiveness and liveability of the area. The creation of job opportunities and supporting the agricultural sector are part of this objective. However, this does lead to a situation where public and private interest are sometimes hard to separate. The lines become blurred. This has implications for questions related who carries what costs. Economic principles such as *the polluter pays* or instruments such as emission quotas and regulations become harder to implement.

Related to the first point, the multiple objectives behind "the growing delta" go beyond the mandate and priorities of one single institution. As such, there is a need for new organisational structures that can accommodate for longer term projects and programs that cross-cut multiple institutional objectives.

Further, the development of an integral vision among the different stakeholders (including the transboundary ones) is seen as an essential and urgent step in the upscaling process. Currently, there are different visions, for example, there is an ecological vision that addressed the different environmental problems in the estuary and more recently one of the waterboards has developed a vision regarding coastal flood protection. However, an integral vision, that considers and addresses land-use, economic, and environmental trade-offs is yet to be developed.

#### 8.4.1 Financial strategies for upscaling

**Conditional funding support stimulating the transition of the agricultural sector.** One of the strategies that can help overcome the issue of justification of expenses for a small group of beneficiaries is for the public sector to make payments conditional upon the transition towards greener, more sustainable business operations. This would mean that the return on investment for society is enlarged. In particular once completed, the raising of agricultural land can serve as a “fresh start” when a new soil and nutrient structure and water balance has been established. This could be applicable for the agricultural sector as well as for the port authority and industries.

**Integrated management plan and shared vision, aligning multiple objectives and dealing with trade-offs.** The existing visions, ideas, and interests for the areas as well as the multiple economic, social and environmental objectives require alignment. The development of an integral vision among the different stakeholders (including the transboundary ones) is seen as an essential and urgent step in the upscaling process. Such a vision can be translated into a management plan, not just with regards to what needs to be done, but also through which government structures and institutions. The development of a long-term, multi-sectoral and transboundary vision is key.

**Monitor outcomes in order to tap in to outcome-based payments.** Standardizing maintenance, monitoring and evaluation as an inherent and essential part of project implementation (rather than focus on initial restoration activities). Science-based monitoring holds the potential to unlock payment mechanisms for the delivery of services, rather than payments for project implementation. This seems applicable for several ecosystem services, in particular for carbon sequestration and biodiversity improvements (which could be marketed through environmental credits) and for changes in agricultural yields resulting from changes in soil type and structure.

**Strategic behaviour regarding land ownership.** Very recently the Province of Groningen has purchased a plot of land that was for sale, which can now serve as an agricultural area to be used by farmers during the time that their own land cannot be productive (when sediments are being supplied to raise the land, the land sits idle). Further, land is needed to establish clay ripening areas and natural zones. As such, an opportunistic approach towards land purchasing seems relevant, in particular because expropriation is not always legally possible and undesirable. Those lands (or businesses) that are close to their economic tipping point should be bought opportunistically to create space for future restoration activities.

**Further adapt procurement selection criteria to stimulate infrastructure engineering firms to make use of locally sourced building materials.** This strategy can further reveal novel sediment application potential, increase existing market potential and stimulate operational transition towards including these materials in the supply and construction chains.

# Chapter 9. The Foros Bay Pilot

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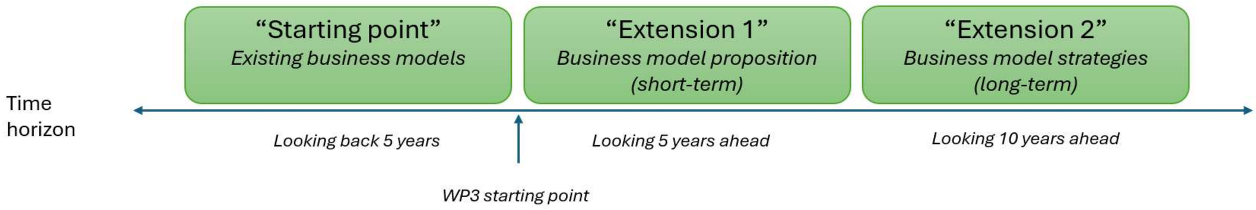
**Readers guide**




**10.1 Introduction**

- **This section provides a general introduction to the Foros Bay case**

**10.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
- 17 ha of (Active) Seagrass bed restoration.

**10.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
- Additional 10 ha of seagrass (*Stuckenia Pectinata* ) restoration within Foros bay

**10.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
- Upscaling is seen as essential to sustainably develop the Foros Bay area in the future, enabling also resilience to climate changes. Seagrass restoration is a part of potential NbS applied.

## 9.1. Introduction to the pilot

Foros Bay is a part of the Burgas Bay, the largest Bulgarian bay of the Black Sea. Both coastal and maritime activities in Foros Bay is in constant increase, such as tourism and urban development (Savov, 2007). This is partly because the Black Sea coast is one of the most attractive areas in Bulgaria and in the region for residents and tourists. The expanded tourism developments in the coastal zone of Bulgaria, has led to further intense urbanisation of cities, resorts and suburban areas. This rapid development is also seen in Burgas which is the fourth largest city in Bulgaria and strongly influencing Foros Bay (Stanchev et al., 2013). It is one of the most important ports at the Black Sea, leading centre of oil industry. The city is a centre of culture, science and art of national importance. See Figure 44 for a map illustrating the location of Foros Bay and Burgas Bay and the city of Burgas.

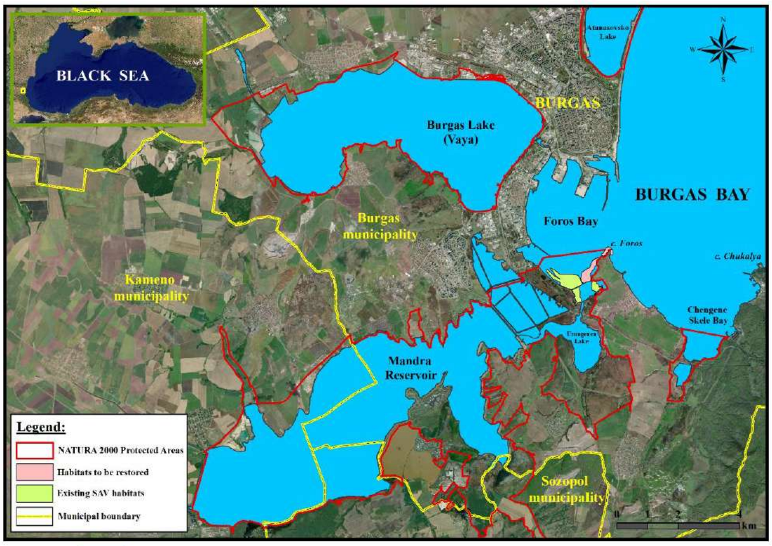



**Figure 44 Map of the Foros Bay system indicating the large drainage basin flowing into the Bay. Source: PPT from the Foros Bay pilot team.**

The intense development has also led to challenges such as pollution from industrial (e.g. oil industry) and domestic waste. In addition, climate change, coastal erosion, and cliff retreat are putting further serious stresses on the coast and its ecosystems. Another serious environmental issue in the Bay is pollution originating from the upstream catchments with intensive agriculture, especially in the 1980ies, that has resulted in increasingly eutrophic waters (see Figure 45).

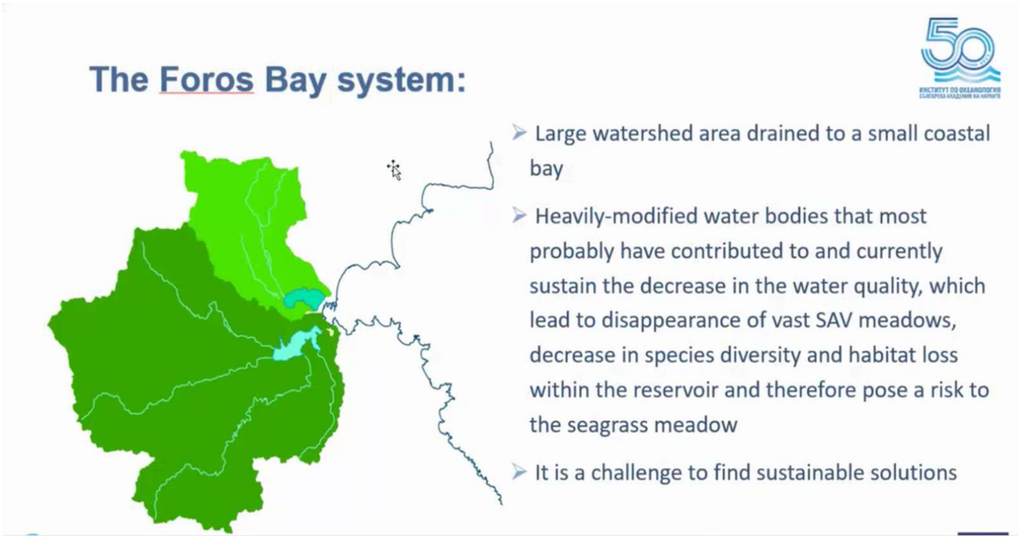



**Figure 45 Foros Bay, Burgas Lake and Burgas Bay. Source: Institute of Oceanology.**

In Foros Bay and surrounding Burgas region, there are many valuable and unique wetlands, lakes and coastal habitats. These are often protected by Natura 2000 designated as Ramsar sites, e.g. lakes of Atanasovsko, Burgas and Mandra. These lakes, together with the Pomorie Lake form the largest wetland along the coast with exceptional conservation value of international and national importance. (See Figure 46 for a map of the areas with natural values, and conservation status marked. See Figure 47Figure 46 for a more in zoomed map of the Foros Bay). They run into several smaller rivers with swampy river mouths. Seagrass covers about 58 ha of the Foros Bay. One of the reasons for high conservation value is the location in the natural migration route of birds along the Black Sea coast, Via Pontica, and provide space for birds wintering, breeding, resting and feeding. Some of these birds are endangered and very valuable for the biodiversity of Europe (Stancheva et al., 2017). For example, almost the whole European population of *Ciconia ciconia* pass through or spend nights within these regions. The same is valid for the representatives of *Pelecanus onocrotalus, Aquila pomarina* and *Falco vespertinus*. A site of great ornithological importance for the country is Srebarna reserve for its populations of *Pelecanus crispus*. World importance is Shabla and Durankulak Lakes, also located along the North Bulgarian Black Sea coast (Alexandrov et al., 2018).

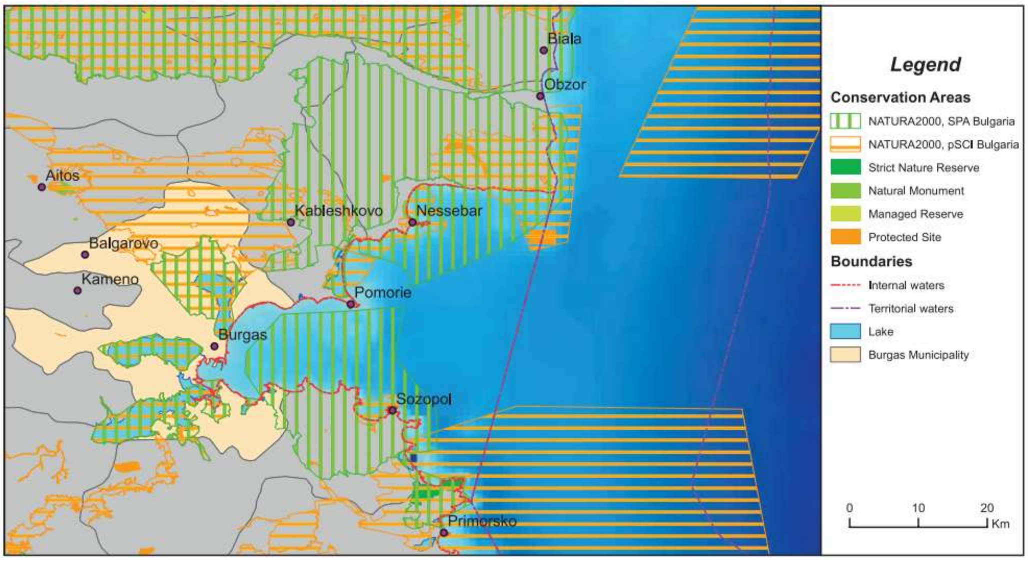



**Figure 46 Map of natural values in the Foros Bay and Burgas Bay and surrounding areas (Stancheva et al., 2017).**

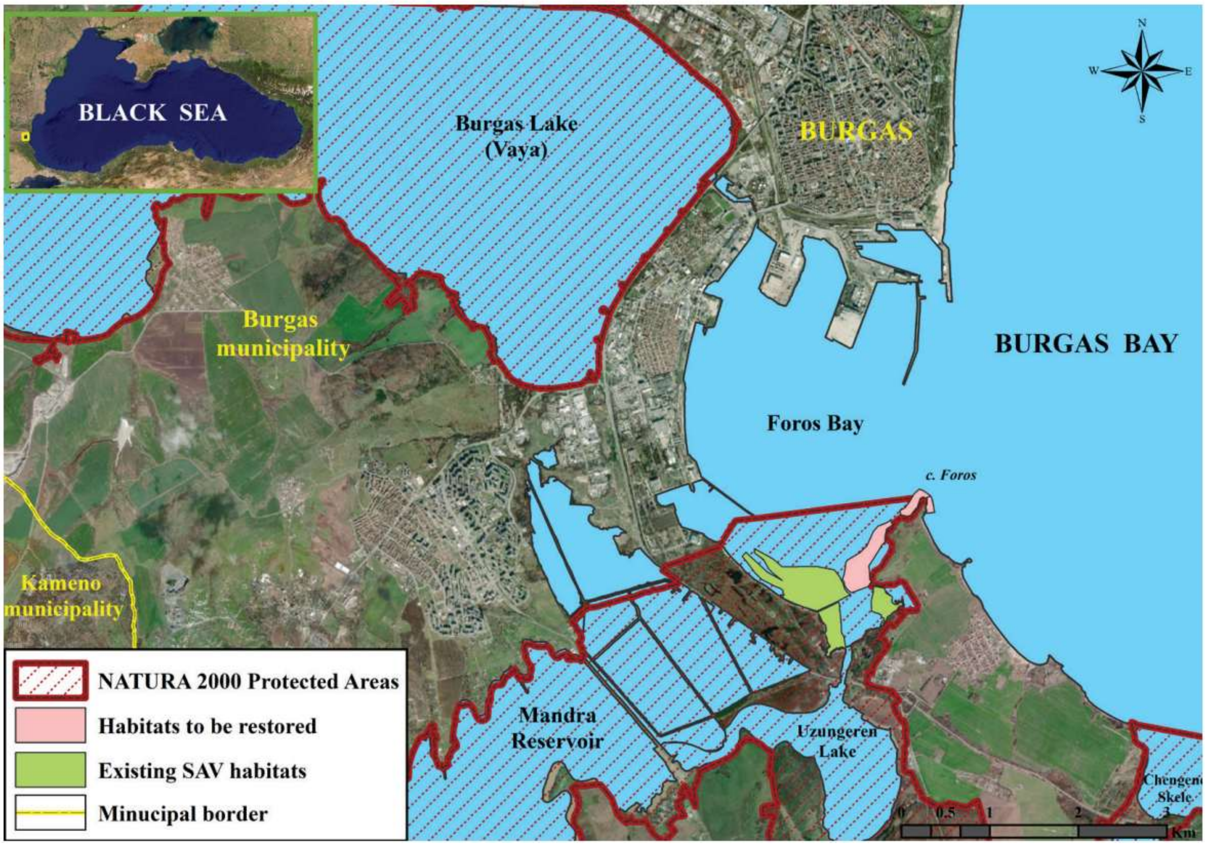



**Figure 47 A map of the Foros Bay indicating NATURA 2000 areas, and habitats to be restored. The area accommodates the habitat of submerged angiosperm plants (*Zostera spp., Stuckenia pectinata, Zannichellia palustris*). From the REST-COAST Foros Bay pilot fact sheet.**

As a result of increased economic activities over the recent years, leading to dramatic changes in the natural and cultural landscape, and consequently to irreversible destruction of many ecosystems, there has been a need to take urgent measures for recovery and future development of sensitive areas. Thus, valuable natural resources such as protected areas, wetlands, coastal lakes and marshes, beaches and dunes, forests and forest parks received the status of public property, thereby ensuring strict control of the state as an institution with respect to the management of those resources. For example, in 1991 the sand beaches were declared as state property (Stancheva et al., 2017).

Bulgaria is a relatively centralized country, with Bulgarian biodiversity protection and water management organized at two levels: national and regional/basin/local. The Ministry of Environment and Waters is the primary responsible institution, assisted by scientific advisory bodies known as the National Council for Biodiversity, Council of Scientists and National Water Council. Regional inspectorates of Environment and Waters and Black Sea Basin Directorate are basin-level and regional authorities.; the Ministry of Regional development and Public works, which is responsible for Marine Spatial Plan Development, and its local authorities – the District Governors. Local Municipalities are also involved in this process (Aljinovic, 2022).

Main climate-related challenges (Hodgson et al., 2010):

- Heavy rainstorms and rivers draining into low-lying coastal areas are the main factors affecting coastal flood risk.
- The Black Sea's coastal areas are expected to become increasingly vulnerable to the effects of erosion, partly due to climate change and sea-level rise, but largely due to the lack of effective coastal planning regulations.

- Fishing communities whose markets are based on just a few species are vulnerable to fluctuations in stocks, whether due to overfishing, climate change or other causes.
- At national level, institutional, political and financial constraints are among the main handicaps towards taking effective adaptation measures, and no national adaptation strategies have been adopted. However, projects to protect coastal areas from erosion are being undertaken in Bulgaria and Romania, although coastal strategies/legislation do not exist in either country.
- There is a significant lack of data regarding the costs and benefits of adaptation, and uncertainty surrounding future climate impacts.

Long-term sea level changes along the Bulgarian Black Sea coast have been traced for more than 100-year period. Based on the records of two marine stations, located in the towns of Varna and Burgas, a continuous sea level increase has been found, particularly over the last few decades. Natural and anthropogenic factors are pointed out as the main causes of accelerated sea-level rise. The natural factors contributing to sea level rise include changing river discharge into the Black Sea, rainfall-evaporation balance, water exchange through the straights linking the Black Sea to the Mediterranean (Dachev, 2000) and subsidence of the land. Anthropogenic factors affecting sea level changes are urbanization, dam and reservoir buildings, groundwater mining, deforestation, etc. See Figure 48for estimates of flood risk at 3 m SLR. Although such rates are not dramatic for the Bulgarian coast there would be a case of sudden sea level rise under extreme storm conditions (Palazov, 2010). Burgas Bay can experience extreme sea level changes, driven mainly by meteorological phenomena, such as seiches, which are typical for closed basins like the Black Sea, where water levels can vary from the mean between -112 cm and +250 cm. At the same time, Foros Bay is the most wave-sheltered area along the coast. See below for a map assessing the vulnerability of 3 m SLR (Stancheva et al., 2017).

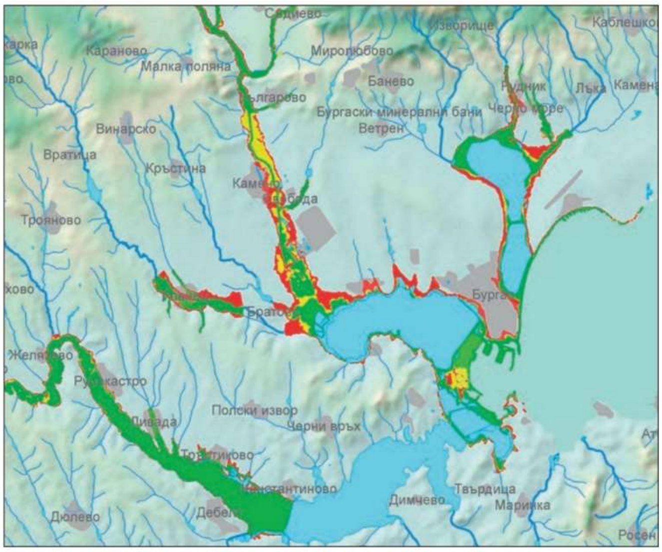



**Figure 48 Inundation in Foros and Burgas Bay for the scenario of 3 m sea level rise (Stancheva et al., 2017).**

### 9.2. Starting point: Current Business Model

This section describes the BM that is currently in place, covered by the funding of REST-COAST.

#### 9.2.1. <u>Coastal restoration activities</u>

- Part of the restoration activities in REST-COAST were aimed at **restoring the hydrological connectivity** between the Bay and the catchment area with adjacent lakes, which was hindered by sediment deposits and overgrown invasive vegetation. This included the preparation for procedure to change the Burgas detailed development plan in order to be able to perform a measure to reduce siltation of the canal connecting one of the lakes with the port area (in the inner most part of the Burgas Bay). Cost for this activity is unknown (but relatively small).

- **The restoration of up to 17 ha of seagrass populations**[1] (*Zostera nolti)* in the Foros Bay. The approach was to work through an assisted natural recolonization, planting in a first step an area of 300 $m^2$ of seagrass with donor seedlings from a Natura 2000 site, to create a basis for natural recolonization. Due to the fragile nature of the donor population, which cannot be disturbed too much, or overused as donor seedlings, the restoration could only proceed if it was experimental (smaller scale) and the restoration initiator is obliged to monitor the donor population's state a year after the intervention. In fact, the Ministry of Environment and Waters are more interested in the donor site than the restoration.
- The intervention also aims to gain experience and create restoration protocols on good practices to address risk factors and maintenance of the seagrass. The monitoring therefore investigates chances for success in the current conditions, (risk factors) which are beyond control, such as weather conditions, unauthorized physical disturbance. In addition, it will investigate the seagrass and its survival rate and maintenance in the current nutrient and contaminant loads.
- Other activities included modelling and assessment of selected ESS provided by seagrass. The modelling activities in other WPs used the supposed long term coverage of 17 ha as a reference.
- Measures were also planned to improve the conditions in the adjacent coastal wetlands (DT, 2022).
- The activities also will also include working with the help of **e-dna** to investigate how much biodiversity can improve, in terms of key species of fish, and identify the barriers for restoring seagrass, for example (lack of) light, other species, like algae.

- Interesting to note is perhaps that the pilot coordinator had also planned to implement a bird platform in combination of management of bulrush vegetation in Vaya lake. The rationale was that the excess of bulrush leads to hypoxia and also they prevent nesting. Birds feel nervous due to predators hiding in the bulrush. Both were planned in one procurement procedure but due to problems with technical specification we could not make it on time.

[1] The modelling activities in other WPs used the supposed long term coverage of 17 ha as a reference.

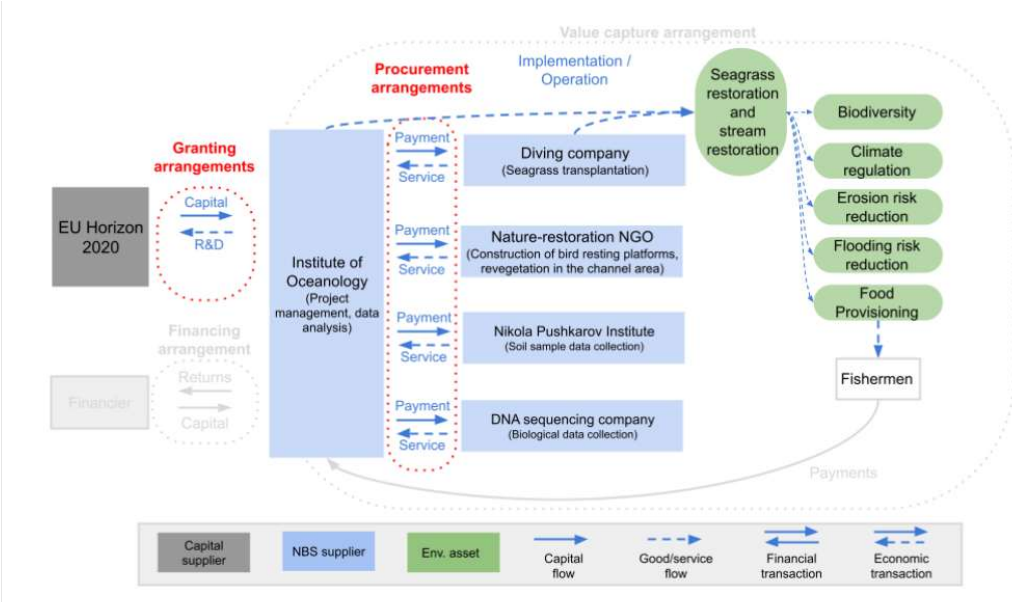



**Figure 49 Overview of the NbS Business Model in the Foros Bay Pilot. Opportunities for establishing future value capture and financing arrangements are shown in grey.**

The current business model is shown in the Figure 49. A granting arrangement from EU Horizon enabled the Institute of Oceanology to implement restoration of seagrass with the help of several subcontractors.

Initiator was the Institute of Oceanology, Bulgarian Academy of Sciences. In the Pilot, the Institute of Oceanology supervised and managed the project and evaluated restoration outcomes through the analysis of collected data.

The owner of coasts/beaches and coastal waters is the state, locally represented by the Regional Governor (also land owner) and is thus a key stakeholder.

### 9.2.2. ESS and economic good typology

The main ESS in the Foros Bay pilot include: the contribution of seagrasses to increase biodiversity, capture and retain carbon, and protect the coast from sea waves in current and future climate scenarios. The intervention was also projected to have a positive impact on local sediment dynamics and could ultimately result in decreasing rates of sediment deposits in the channel, thus saving costs for future dredging activities to the local government.

These services are classified as public and common goods. A full list of ESS of seagrass is listed in Table 36 below.

### 9.2.3. Funding: granting

Granting arrangements are covered by funding provided by the REST-COAST project.

**Table 36 Overview of division funding sources of seagrass restoration Foros Bay**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| European Union (Horizon 2020) | €125 000 | Restoration activities, monitoring | Supranational | Co-funding, grant |

| | | | | |
|---|---|---|---|---|
| | na | Restoration activities, monitoring | Public, Research Institute | Co-funding, grant |

The grant received from the REST-COAST is €125.000 for hands-on restoration. There was no co-financing. They did not make any adjustments due to inflation.

They have used up about half of the grant €65.000 only for procurement of divers and some additional costs for monitoring and consumables. The personnel cost related to planning etc. is not included.

The cost of restoration is relatively low, but it was partly because it was experimental. The problem is that the area is protected under Natura 2000 and the donor population (seagrass) could not be disturbed too much.

#### 9.2.4. Funding: value capture

No arrangements for value capture were made (Favero et al. 2022).

#### 9.2.5. Finance

No financing arrangements were made (Favero et al. 2022).

#### 9.2.6. Procurement arrangements

A diving company, hired through public procurement was VORTEXES LTD[2], NGO and different institutions were involved in the procurement arrangements (see Figure 49). The diving company was engaged in the dry season in June - August to implement the restoration. The procurement arrangements were through segmented public procurement. The collection of chemical and biological data from collected samples were procured by contracting specialised research institutes, while the analysis and interpretation of these was done by the Institute of Oceanography.

#### 9.2.7. Critical funding and financing challenges

- To restore the full 17ha is financially not feasible with the project grant because diving services are expensive. The restoration cannot be done without divers as there is no intertidal zone.
- Problems of public procurement for the seagrass restoration and a bird platform: Initially, the pilot coordinator had planned a platform for birds, but due to problems with the public procurement they gave up. The problem was that there was no previous model available for this procedure (they found only one more on the internet) and the responsible for the procurement was not happy with the technical description and they also ran out of time. The initiator also had quite the same problem with the seagrass, but they followed through with it.
- Insufficient project size: Limits financing and procurement but is not a barrier for grants. The small scale of the project limits investment size and the involvement of larger investors (EIB, 2023; Favero & Hinkel, 2023a).
- Jointness: The multifunctionality of NbS imply interdependent and inseparable transactions that affects multiple stakeholders in different ways (Favero & Hinkel, 2023b).
- Institutional challenges: The lack of decentralization (devolution) and unclear roles and responsibilities (Favero & Hinkel, 2023b).

[2] https://www.vortexes-ltd.com/en/

## 9.3. Extension 1: Business model proposition and Business plan

Additional restoration that requires new funding and therefore new business models and business plans.

The funding model is assumed to be the same, but not all details are worked out with the relevant partners.

### 9.3.1. Executive Summary

This section defines the plan of the Institute of Oceanology, Bulgarian Academy of Sciences for *extending* NbS restoration in the pilot area and *extending* NbS restoration objectives ("extension 1").

The objective is the continued restoration supporting already restored seagrass with additional 10 ha with the submerged aquatic seagrass *Stuckenia Pectinata* in the inner Foros Bay. This species is different than the one at the starting point and is more tolerant to disturbances.

Limitations of the approach could be the sediment supply for the creation of an artificial shallow area of clean sand as a substrate suitable for vegetation recolonization. Therefore, the recolonisation potentially needs to be supported by grey infrastructure (geotubes[3] to stabilize the substrate – see Figure 50). The need for additional support is determined by the area restored.

[3] Geotubes are a high tensile strength woven polypropylene geotextile designed to receive and retain pumped material, with the water content allowed to escape through fine pores until the required density of contained material is achieved. Geotubes are commonly used for dewatering in the paper, agriculture and wastewater industries. However, geotubes can also be used to retain dredged material (DM) to form structures, both onshore and offshore. Geotube technology is mainly used in coastal structures for flood and water control by raising dykes, but they are also used to prevent beach erosion, and for shore protection and environmental applications (Sheehan & Harrington, 2012).

<table>
<tr>
<td>Value proposition</td>
<td>Problems addressed<br><br>Bad water quality, turbidity and support the overall biodiversity, sustainability and resilience of the Foros Bay with restoration of the seagrass Stuckenia Pectinata</td>
<td colspan="2">Benefits produced<br><br>-Environmental benefits – reducing turbidity and protecting already restored areas – carbon sequestration, (biodiversity).<br>-Economic benefits – food provisioning, wave mitigation, erosion providing cost savings for dredging, infrastructure damage and port operation.<br>-Social benefits – eco-tourism, recreation, education and research<br>-Cultural benefits – water quality improving clarity (good for diving, tourism, boating, swimming) attractive living environment for town of Burgas</td>
</tr>
<tr>
<td rowspan="3">Value creation</td>
<td>Key partners<br><br>Institute of Oceanology, Bulgarian Academy of Sciences</td>
<td colspan="2">Regulation and Governance<br><br>Natura 2000 and Ramsar sites. EU + Two levels of governance: national and local. Lack of devolution.</td>
</tr>
<tr>
<td>Key resources<br><br>Scientific and technical expertise</td>
<td>Customer segments<br><br>-Eco-tourists (birdwatchers, recreational fishing, etc.)<br>-Entrepreneurs contributing to restoration activities<br>Port authorities</td>
<td>Stakeholders<br><br>Initiator was the Institute of Oceanology, Bulgarian Academy of Sciences. The owner of coasts/beaches and coastal waters is the state, locally represented by the Regional Governor (also landowner) and is thus a key stakeholder. Ministry of Environment and Waters</td>
</tr>
<tr>
<td>Key activities<br><br>Restoration of seagrass in 10 ha</td>
<td>Customer relations and channels<br><br>Scientific papers and conferences</td>
<td>Beneficiaries<br><br>-Tourists and visitors<br>Eco tour operators<br>-Owners / managers of real estate by the beach/coast<br>- Port and transport companies<br>Fisheries and aquaculture<br>-Citizens and local communities</td>
</tr>
<tr>
<td>Value capture</td>
<td>Costs<br><br>€200.000-300.000</td>
<td>Revenue streams<br><br>Eco-tourism<br>Carbon credits (not developed yet)<br>Cost reduction (PES schemes) for erosion and dredging, sediment capture, infra and port operation damage</td>
<td>Financing and funding<br><br>Taxation, Public grants, PES mechanisms</td>
</tr>
<tr>
<td>Transversal categories</td>
<td colspan="2">Impact indicators<br><br>Improvements of ESS<br>Indices of increased biodiversity<br>Impact on human (increased knowledge) and produced capital (revenues from eco-tourism, education)</td>
<td>Risks<br><br>Coastal development<br>Delays due to high transaction costs<br>Lack of funding available</td>
</tr>
</table>

**Figure 50 Business Model Canvas for NbS in Foros Bay**

**Figure 51 Geotubes. Is a textile material that can be used to cover areas to reduce or capture sediments.**

### 9.3.2. Mission and Objectives of the restoration initiator

**The Mission** is to continue to address issues of bad water quality, turbidity and support the overall biodiversity, sustainability and resilience of the Foros Bay with restoration of the seagrass *Stuckenia Pectinata*. This contributes to support a broader mission and a range of ESS, associated with seagrass, such as fisheries, and tourism.

**The Objectives**: To restore an area of 10 ha (a little less than the starting phase of 17 ha) applying submerged aquatic vegetation *Stuckenia Pectinata* (commonly called sago pondweed or fennel pondweed, and sometimes called ribbon weed) in the inner Foros Bay.

The restoration is envisioned to lead to improvement of water quality and to increase the chance of survival of the already restored *Zostera* (from the REST-COAST project starting point). Ideally, this restoration should be done following on the current restoration activities.

For physical boundaries of the restoration: see Figure 52. The physical boundaries of the Extension 1 are the inner Foros Bay (See 51 and area marked as D). The temporal boundaries are not specified.

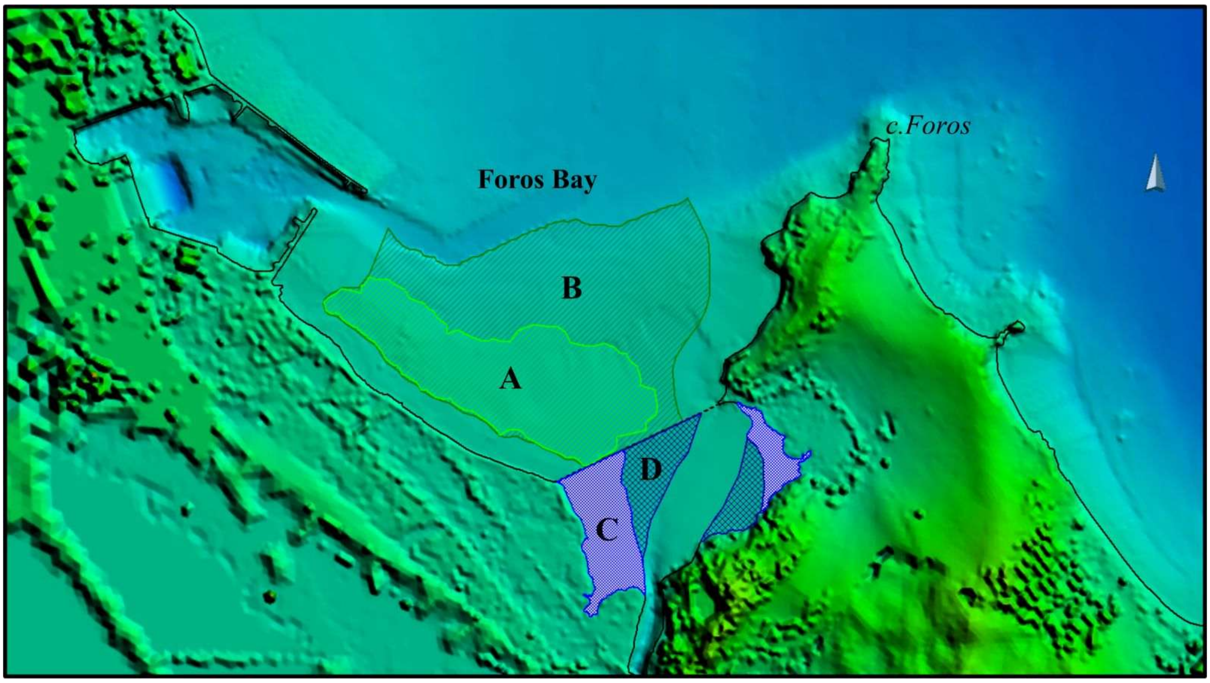



**Figure 52 Map illustrating the scheme of existing and planned to be restored vegetation (A – Existing Zostera N, B – Maximum limits for recolonization of Zostera N. according to light conditions, C – Existing *Stuckenia P.*, D – planned to be restored *Stuckenia P.*)**

### 9.3.3. Stakeholder overview

The Table 37 provides an overview of the stakeholders potentially engaged and relevant for restoration in the pilot ("extension 1"). Roles defined in Favero et al. 2022. For key stakeholders see the BMC at the beginning of this subchapter.

**Table 37 Overview of key stakeholders in Foros Bay**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| 1 | UNESCO Intergovernmental Oceanographic Commission (IOC) | Bulgaria is member | Public | Supra national |
| 2 | European Commission | EU's politically independent executive arm, drawing up proposals for European legislation, and implements the decisions of the European Parliament and the Council of the EU. i.e. makes sure EU laws are properly applied and manages EU spending programmes. | Public | Supra-national |
| 3 | The Ministry of Environment and Waters | The Ministry is the primary responsible institution for the governance of nature protection and management. | Public | National Government |
| 4 | Executive Environmental Agency | Management of nature protection and monitoring (laboratory analysis) of nature at a national level and at a regional level. | Public | National Government |

| | | | | |
|---|---|---|---|---|
| 5 | The Ministry of Food and Agriculture | Involved in the biodiversity protection process. | Public | National Government |
| 6 | Executive Agency of Fishing and Aquaculture | Involved in fisheries and management of fish stocks. | Public | National Government |
| 7 | Department “Fishing and control” Burgas | Body that control and monitor fishing vessels in Burgas under the Ministry of Agriculture. | Public | Regional |
| 8 | Department “Fishing Vessel Monitoring Center” Varna | Body that control and carry out vessel monitoring in Varna under the Ministry of Agriculture. | Public | Regional |
| 9 | The Ministry of Regional development and Public works | Responsible for Marine Spatial Plan Development, and its local authorities – the District Governors. | Public | National Government |
| 10 | Regional inspectorates of Environment and Waters in Burgas | Basin-level and regional authorities involved in the biodiversity protection process. | Public | Regional |
| 11 | Black Sea Basin Directorate | Black Sea Basin Directorate is a governmental body under the supervision of the Bulgarian Ministry of Environment and Waters, to carry out integrated water management through planning, collecting and providing information and control of the water resources as state property. | Public | Basin |
| 12 | The Institute of Oceanology | Carries out research in e.g. marine physics, chemistry, geology and archaeology, biology and ecology, coastal dynamics and ocean technologies. It carries out monitoring and gives expert advice. IO represents BAS as a co-ordinator of all studies related with the Black Sea and World Ocean by the National Oceanographic Commission (NOC) linked to (UNESCO). | Public | National |
| 13 | Bulgarian Academy of Science (BAS) | The Academy performs scientific work and assists and gives scientific advice to the government. | Public | National |
| 14 | National Council of Biodiversity | Assists and gives scientific advice to the government. | Public | National |
| 15 | Council of Waters | Assists and gives scientific advice to the government. | Public | National |
| 16 | Council of Scientists to the Minister | Advisory body to the Minister of Environment and Waters. | Public | National |

| | | | | |
|---|---|---|---|---|
| 17 | The Black Sea Coastal Association | Provides coordination and professional expertise on different aspects of marine industry and coastal zone development. Could support knowledge transfer within Europe (e.g. has already occurred with the Netherlands) | Public | National |
| 18 | The District Governor of Burgas District | Maintenance of river and canal conductivity in territories outside the boundaries of the Municipalities; Burgas District might take the initiative to create a Natura 2000 Management Plan for the Natura 2000 zone and/or Species Action Plans. | Public | Regional |
| 19 | Municipality of Burgas | Local Municipalities are also involved in this process. All of these institutions are given the opportunity to prepare and submit Protected Species Action Plans and Protected Areas Plans to the Minister of Environment and Waters | Public | Local government/ municipalities |
| 20 | Municipality of Pomorie on the north, municipalities Kameno and Sredets on the west and municipality of Sozopol in the south | Surrounding municipalities to the municipality of Burgas that collaborate on joint interest relevant for eco-tourism and environmental goals. | Public | Local government/ municipalities |
| 21 | Via Pontica Foundation | NGO established to protect the Bulgarian nature. Main stakeholder and facilitates the communication of the other stakeholders in Foros Bay restoration site (REST-COAST starting point). | Public | NGO |
| 22 | Various NGOs | Supports with implementation and monitoring of restoration. | Public | (Inter)regional |
| 23 | Huesker | A private company that can provide geotubes and installation that they already provide along the coast of Bulgaria | Private | Company, international |
| 24 | Burgas Lake Vaya–96 Ltd sand quarry | The waste waters after precipitation in two units of sedimentation equipment are discharged into the Vaya Lake; | Private | Local |
| 25 | Building materials company | Company with purification facility tailing dam waste waters after treatment plant are discharged into the Mandra Lake; | Private | Local |
| 26 | Real estate developers | Several real estate developers and architects are active in Foros Bay and involved in the rapid development of the coast and benefiting from good environmental conditions. | Private | Local |

| | | | | |
|---|---|---|---|---|
| 27 | Port authorities | Operators and managers provide port services (anchoring, mooring, loading and unloading activities, accepting and recycling of wastes, etc.) that may have a negative impact on the port and adjacent areas; | Public | Regional |
| 28 | Burgas shipyard | Carries out ship repair and metal scrap management. | Private | International |
| 29 | Center of underwater Archaeology | They do underwater archaeological studies in the Bulgarian Black Sea. They have research interests in the area of Foros Bay. | Public | National/regional |
| 30 | Lukoil Neftochim | Oil refinery in the vicinity of Foros Bay and Mandra lake. | Private | Regional |
| 31 | Individual landowners/ food producers | Farmers, beekeepers, aquaculture | Private | Local |
| 32 | Local businesses | Businesses, restaurants, accommodation, hunting activities, manufacturing, particularly those depending on ESS and in support of the local environment. | Private | Local |
| 33 | Tourism | Tourists, and smaller businesses, such as eco-tour guides, scuba diving centres, campsites owners, and bird watching tourism. Airport and airlines. Passenger companies (boat). Marinas and boat companies. | Private | Local-International |
| 33 | Local communities | Local communities (fishermen, residents, boating community). | Private | Local |

**Roles:**

**Initiators of the action:** The Institute of Oceanology, Via Pontica Foundation, Huesker. Others to be defined.

**Beneficiaries includes:** Local communities (fishermen, small-scale tourism, bird watching tourism), Local authorities, NGOs, businesses in particular those acting in support to NbS.

Funder/Grantor includes: Ministry of Environment and Waters and relevant supporting project funds

**Other actors involved:** The scientists are frequently networking with several actors in the governance system at national, regional and local level, including the National Council for Biodiversity, Council of Scientists, and other relevant departments of the University and National Water Council and the local municipality.

#### 9.3.4. Business model proposition

This section is an overview of all the BM in terms of value proposition, creation, delivery and capture identified for upscaling restoration ("extension 1").

##### Value proposition

Several values are expected/assumed from the restoration of seagrass *Stuckenia Pectinata*. The main services for the value proposition (mainly for seagrasses in general) are listed in the Table 38 below.

**Table 38 Value propositions for seagrass restoration, references in (Mtwana Nordlund et al., 2016) if not otherwise stated.**

| Value proposition (benefits of ESS) | Description |
|---|---|
| Biodiversity and (fish) beneficial habitat (e.g. for birds, invertebrates, nursery for fish and seagrass) | *Stuckenia Pectinata* is relatively tolerant to environmental disturbed conditions (such as turbidity) and planting it in the more turbid areas will provide shelter and lead to an increased chance for survival of *Zostera Noltii* already being restored within the REST-COAST project (the two restoration fields are adjacent to one another, see Figure 52). In addition, restoration of larger area of seagrass is assumed to result in higher biodiversity. |
| Food provisioning & raw materials | Healthy seagrass meadows promote diverse marine life, which can be economically valuable for fisheries. This biodiversity can enhance local fisheries and increase yields for commercial fishers. Seagrass can also serve as food for humans and animals. Furthermore, seagrass can provide compost fertilizer, materials for pharmaceuticals and other raw material. Seagrasses provide genetic resources. |
| Water quality | By trapping sediments, seagrasses improve water clarity, which benefits local tourism and recreational activities. Clear waters enhance the experience for divers and snorkelers, potentially increasing economic activity in these sectors. |
| Sediment control | Seagrasses stabilize sediments (E. B. Barbier et al., 2011), which is established from monitoring in the REST-COAST project. See below Figure 53 and Figure 54. Sediment control is a key ESS and affects several different ESS, including biodiversity, erosion control, carbon sequestration and water quality (E. B. Barbier et al., 2011). Sediment control could also demonstrate decreasing rates of sediment deposits in the channel, thus saving costs for future dredging activities to the local government. Measures will also need to be taken to improve the conditions in the adjacent coastal wetlands. |
| Erosion control | Seagrasses stabilize sediments, and can even elevate surfaces (underwater), which reduces coastal erosion, and can save costs related to property damage, loss of land, and infrastructure maintenance (E. B. Barbier et al., 2011; Potouroglou et al., 2017). Scientific studies in REST-COAST suggest that the introduction of seagrass meadows in Germany locally can reduce both current velocities and significant wave heights in the order of up to 30% in deeper areas and above 90% in shallow areas (Jacob et al., 2023). Studies in REST-COAST in Foros Bay suggest that vegetated and restored areas provide a significant reduction of erosion and sediment capture. See below Figure 53 and Figure 54. |
| Eco-tourism, recreation | The restored areas are natural assets for eco-touristic, educational and cultural activities. For example, activities at the local nature at Ecopark Vaya on Lake Bourgas (Lake Vaya) offers birdwatching, fishing, honey tasting, and boating. |
| Carbon sequestration | Sediment capture contributes to carbon storage in seagrass meadows, which has implications for climate change mitigation. This is often valued in terms of carbon credits. |
| Education & research, biodiversity and ecosystem knowledge | Seagrass can provide a source of information (e.g. navigation; water quality indicator; biological sentinels). For example, the restoration activities in REST-COAST include working with the help of e-dna to see how much biodiversity |

| | |
|---|---|
| | can improve, in terms of key species of fish, and identify the barriers for restoring seagrass, for example (lack of) light, other species, like algae. The (continued) monitoring and evaluation of interventions will add to the knowledge base concerning ecological restoration and management techniques. |
| Cultural values | Seagrass can provide "Bequest value" (satisfaction of preserving seagrass) Cultural artefacts and Spiritual & religious value. Burgas is considered to be the most romantic town in Bulgaria for its small streets in the centre, for the old houses and the Sea Garden. The location close to a beautiful environment is connected to the cultural values. |

**Sediment control – results of REST-COAST research**

As mentioned in the Table 38 above, an important value that was quantified in the REST-COAST project was sediment control. The Figure 53 below presents the estimates of erosion volume and area reduction due to presence of seagrass (or no seagrass) under different climates (SLR 4.5 and SLR 8.5) and extreme events return periods (20, 50 and 100 yrs). The results clearly show that there is much less erosion with restored seagrass vegetation, especially in terms of eroded area (second set of figures).

VEGETATION = Zostera Noltii     PRESENT VEGETATION = A     RESTORED VEGETATION = B

ERODED VOLUME [QUB.M]

| | | | VEGETATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NO VEGETATION | | | PRESENT VEGETATION | | | RESTORED VEGETATION | | |
| | | RETURN PERIOD | 20 | 50 | 100 | 20 | 50 | 100 | 20 | 50 | 100 |
| CLIMATE CONDITIONS | PRESENT CLIMATE | | 2092,4 | 3098,2 | 3582,8 | 366,0 | 570,3 | 629,4 | 337,2 | 549,5 | 589,3 |
| | SLR4.5 | Horizon 2070 | 2465,7 | 3489,3 | 5282,1 | 566,9 | 572,0 | 735,7 | 540,3 | 544,7 | 693,9 |
| | | Horizon 2100 | 3957,3 | 5047,8 | 6049,2 | 919,5 | 2261,5 | 2718,6 | 814,8 | 2214,2 | 2668,0 |
| | SLR8.5 | Horizon 2070 | 2633,5 | 3523,8 | 5613,2 | 581,2 | 689,4 | 760,4 | 537,1 | 659,8 | 707,5 |
| | | Horizon 2100 | 3991,4 | 5179,6 | 6016,7 | 2411,8 | 2443,8 | 2637,8 | 2229,6 | 2522,0 | 2696,6 |

ERODED AREA [SQ.M]

| | | | VEGETATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NO VEGETATION | | | PRESENT VEGETATION | | | RESTORED VEGETATION | | |
| | | RETURN PERIOD | 20 | 50 | 100 | 20 | 50 | 100 | 20 | 50 | 100 |
| CLIMATE CONDITIONS | PRESENT CLIMATE | | 0,3088 | 0,3381 | 0,3992 | 0,0417 | 0,1656 | 0,2400 | 0,0143 | 0,0187 | 0,0263 |
| | SLR4.5 | Horizon 2070 | 0,1607 | 0,3120 | 0,3939 | 0,0395 | 0,1437 | 0,2201 | 0,0187 | 0,0149 | 0,0263 |
| | | Horizon 2100 | 0,1611 | 0,3311 | 0,3902 | 0,0440 | 0,1465 | 0,2185 | 0,0266 | 0,0290 | 0,0408 |
| | SLR8.5 | Horizon 2070 | 0,1557 | 0,3089 | 0,3951 | 0,0397 | 0,1425 | 0,2158 | 0,0196 | 0,0153 | 0,0263 |
| | | Horizon 2100 | 0,1802 | 0,3290 | 0,3936 | 0,0521 | 0,1360 | 0,1992 | 0,0375 | 0,0324 | 0,0395 |

**Figure 53 Estimates of erosion volume and area reduction due to presence of seagrass under different climates. Source: Foros Bay pilot coordinator/researcher Nikolay Valchev.**

The Figure 54 below illustrates the data from the Figure 53 above that restored vegetation (right) has significantly less erosion area (in sq km) than no vegetation (left) and present vegetation.

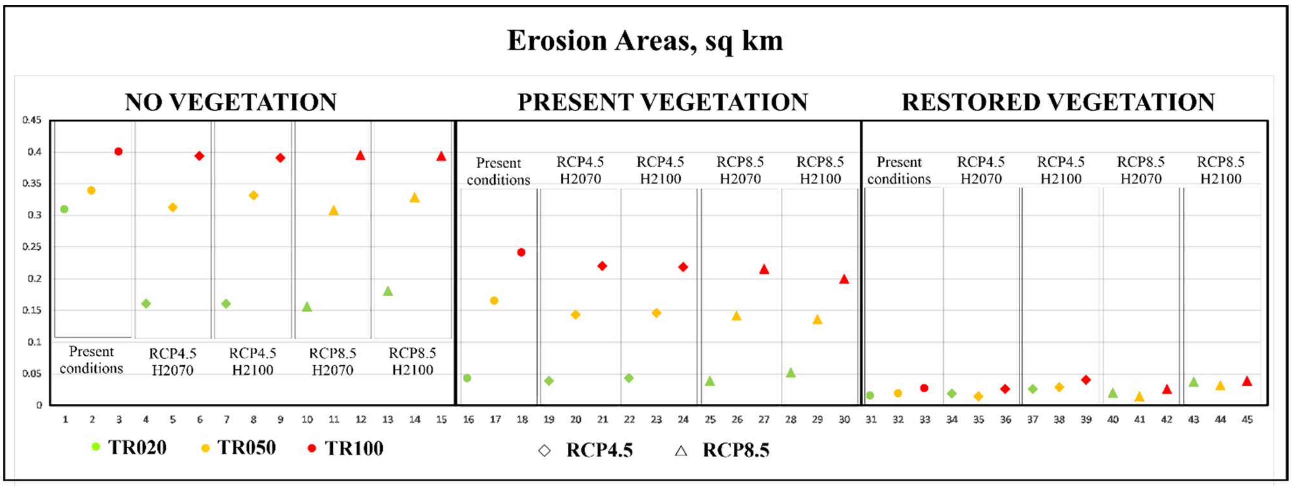



**Figure 54 Estimates of erosion volume/area reduction due to presence of seagrass under different climate projections (RCP4.5, and 8.5 for Horizon (year) 2070 and 2100). To the left is illustrated erosion with no vegetation, with present vegetation (missile) and restored vegetation (right graph). Source: Foros Bay coordinator Nikolay Valchev.**

**Estimation of monetary values of seagrass**

Seagrass ecosystems are one of the highest-valued ecosystems on earth (R. de Groot et al., 2012). To assess the monetary value of seagrass in Foros Bay a literature review was carried out.

Three different approaches could be taken to evaluate the value:

The *first* included using sediment stabilisation as a proxy which is an established method (Vassallo et al., 2013). However, further studies would be needed to evaluate the specific local value and impact of the sediment stabilisation on other ESS, such as wave impact, and biodiversity.

The *second* involves a range approximation value made based on several different assessments. Below is a table with the identified values, including estimates of values encompassing: all ESS of seagrass, coastal ESS, coastal protection/erosion, and food production (fisheries) to estimates of values of carbon sequestration. Values vary from (€160.457) and a higher estimate €424.860 – for 10 ha/yr. This is a rough estimation as the data relies on studies om different environmental and climate conditions. The economic value of seagrass ESS can vary significantly based on the specific region, the condition of the habitat, and the types of services being evaluated. In addition, seagrasses generally do not provide equal levels of ESS (Mtwana Nordlund et al., 2016).

**Table 39 Overview of generic seagrass-related ESS and their corresponding monetary values, and value of 10 ha (extension 1). The original value was adjusted for equivalent purchase power for the value in 2024 which was also x10 for 10ha seagrass which is the scope for extension 1.**

| **Ecosystem service** | **Value (original value)** | **Reference** (in (Mtwana Nordlund et al., 2016)**) | **2014 value of 10 ha in extension 1** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| All ESS of Seagrass | The monetary value of seagrass meadows has been estimated at up to $19,000 (€12.925) per hectare per year, (2008) thus being one of the highest valued ecosystems on earth. | (Björk et al., 2008) | ca €180.500 for 10 ha.[4] *) |
| Coastal ESS | Between €18.317 – €29.444 ha/yr (2007). | (R. de Groot et al., 2012) | €264.300-€424.860 – for 10 ha/yr*) |
| Vegetated coastal habitats in Australia | Approximately €13.337 ha−1 y−1 (2020). | (Jänes et al., 2020) | 160.457 for 10 ha/yr - *) |

*) Equivalent purchasing power in 2024.

**) All references are found in Mtwana Nordlund et al. 2016. The original references were included here to indicate the year the assessment was made, for a more precise calculation of the relative purchasing power.

The *third* involves assessing the different ESS provided determined by the sum of multiple valuation metrics (see Figure 55). This assumes that the total economic value of a seagrass ecosystem for a particular location should be the sum of the value of the goods and services provided by the seagrass beds a method proposed by scholars (e.g. (Dewsbury et al., 2016). No specific study was available for Foros Bay, so a literature review was made, assuming that collected values in all places are the same for seagrass. See Table 39. The different values for seagrass beds were identified and summarised. See Table 40 below. In addition, this is a rough estimation as the data relies on studies om different environmental and climate conditions. Also, seagrasses genera do not provide equal levels of ESS (Mtwana Nordlund et al., 2016). Some of this data was also generic for coastal ecosystems and not specific for seagrasses.

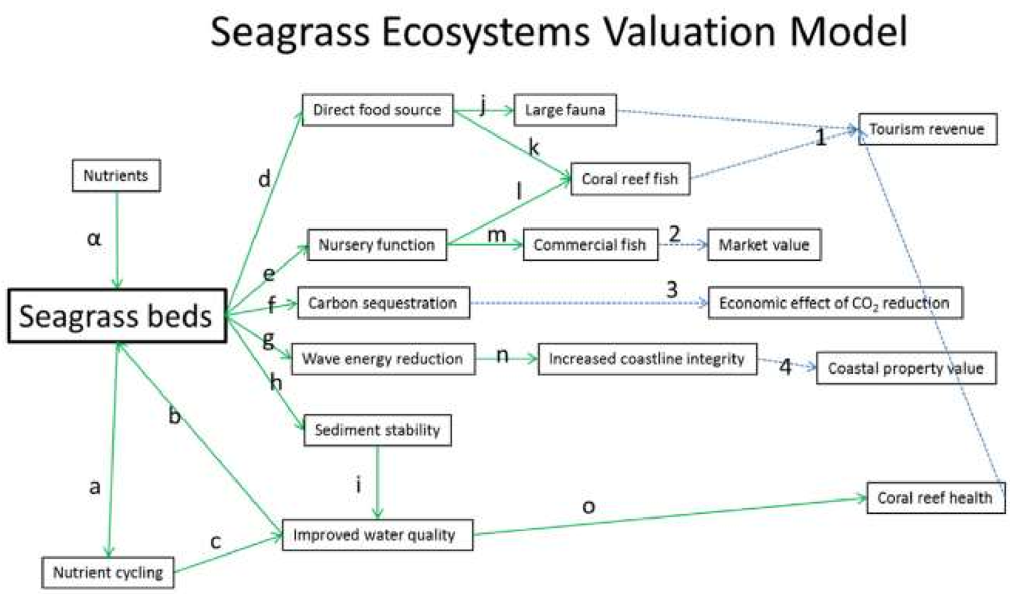



**Figure 55 Main ESS of Seagrass beds (Dewsbury et al. 2016)**

[4] Equivalent purchasing power in 2024. This was done using CPI inflation calculator: https://www.in2013dollars.com/europe/inflation/2008?amount=12000

**Table 40** Overview of *specific* seagrass-related ESS and their corresponding monetary values, and value of 10 ha (extension 1). The original value was adjusted for equivalent purchase power for the value in 2024 which was also x10 for 10 ha seagrass which is the scope for extension 1.

| Ecosystem service | Value (original value) | Reference (**) | 2014 value of 10 ha in extension 1 |
|---|---|---|---|
| Food production services (single cohorts of 12 commercial fish species) for coastal ecosystems | Range between 2396 int$ /ha/yr (€2.200)- €16.615 and up to €31.102 per ha (Sub-tidal habitat) (2022). The lifetime economic value for high and low natural mortality scenarios. (Whole lagoon ecosystem in Portugal). | (R. de Groot et al., 2012; Erzini et al., 2022) | €178,00 - €333.000 for 10 ha *) |
| Southern Australia the value of seagrass nurseries | €19.840 per ha/yr. | (Blandon & Zu Ermgassen, 2014) | €253.600 for 10 ha/yr *) – not included to avoid double counting |
| Nutrient Filtration and Water Quality Improvement (seagrass) | Range from $1.000 to $18.000 per hectare per year. (€910-€16.425) | Chat GPT | €12.000-214.000 for 10 ha/yr *) |
| Regulating services including climate regulation (coastal) | 479 int$ /ha/yr (€440) | (R. de Groot et al., 2012) | €5.700 for 10 ha/yr *) |
| Sediment control (seagrass) | Can range between approximately $1.000 to $10.000 per hectare per year. (€910-9100) | Chat GPT | Not included to avoid double counting |
| Coastal protection services of seagrass | 25,368 int$ /ha/yr - $30.000 / ha /yr in areas prone to erosion and storm damage. Seagrass beds reduce waves' energy by 40%. (€23.150-27.375) | (Antón et al., 2011; E. B. Barbier et al., 2011; R. de Groot et al., 2012) | Up to €400.000 for 10 ha/yr *) |
| Carbon sequestration of seagrass | Approximately $1,900 (ca €1.700) per hectare per year in some regions. | (Champenois & Borges, 2012; Fourqurean et al., 2012) | €22.100 for 10 ha for carbon sequestration service. *) |
| Tourism/recreation (coastal) | 256 int$ /ha/yr (€233) | (R. de Groot et al., 2012) | €3.000 for 10 ha/yr *) |
| Cultural values incl. Education and research (coastal) | 300 int$ /ha/yr (€273) | (R. de Groot et al., 2012) | €3.550 for 10 ha/yr *) |
| **SUM** | | | €624.000 for 10 ha/yr *) (using lower estimates) |

*) Equivalent purchasing power in 2024.

**) In Mtwana Nordlund et al. 2016

Results of the economic valuation of 10 ha of seagrass:

All ESS: Values varies from (€160.457) and a higher estimate €424.860 – for 10 ha/yr.

Adding up values: €624.000 for 10 ha / yr (using lower estimates).

Market analysis (demand and supply) and legal requirements

The main markets were identified and outlined. Table 41 summarises them.

**Table 41 The main markets identified.**

| Market | Contribution by seagrass |
|---|---|
| Fishing and aquaculture | Fishing stocks are depending on a healthy nursery which seagrass provides, and mollusks depend on good water quality, which seagrass contribute to. There is an increasing market or ecolabelling and certification (which can link fisheries to seagrass beds). |
| Tourism and recreation | Seagrass plays indirectly an important role in maintaining a good favourable environment for the tourism industry. |
| Attractive living conditions connected to cultural history | Seagrass provides the foundation for a healthy marine ecosystem, including a thriving avian fauna. |
| Real estate development | Seagrass realise the environments that real estate depends on in their marketing and business models. |
| Transport management/ port operations | The sediment capturing services of seagrass provide a value for the port (uninterrupted operations, less dredging needed) as well as the general environmental values for the passengers that come to visit the area and appreciating and using the ESS. |
| Beach management for tourism and real estate and private residents | The erosion problems in Foros Bay are known, and it would be relevant to specifically study the value of potential sediment controlling services of seagrass in the Bay. |
| Carbon sequestration | Not developed for Bulgaria, but according to the sediment research in REST-COAST, carbon capture can be assumed to be present. |
| Upstream agriculture | Payments for ESS for improving water quality / reducing pollutants in the water is a service provided by the seagrass. |

**Bulgaria - a marine and coastal economy**

The input of Bulgaria's maritime economy into the national economy is significant relative to EU standards. Several marine-based sectors, including coastal and maritime tourism, fishery and aquaculture, shipping, ports, ship building and repair, and oil and gas exploitation, generated roughly €995 million in gross value added (GVA) in 2018, which is roughly 2 percent of the national GVA of all economic sectors and accounts for 3.4 percent of all jobs, placing Bulgaria above European Union (EU) averages and above Italy and France. Coastal tourism alone generated 80 percent of all blue economy jobs and contributed 69 percent to the blue economy GVA in 2018. Other economic sectors include wellness and spa tourism, fisheries, aquaculture, and fish processing (The World Bank, 2020).

**Fishing and aquaculture**

There is a wide range of fishing species in Burgas study area. Some species are local stocks. In the last decade from the molluscs, an increasing commercial value has had the blue mussel (*Mytilus galloprovincialis*) along with the Rapa whelk (*Rapana venosa*). The catch of the Rapa whelk is done by diving in the summer. Looking to the future, aquaculture production is expected to increase, (by 60 % between 2016- 2023). Increasingly national legislation is becoming more targeted to control fishing supported by EU funding. For example, in 2013 the national legislation was amended to allow the beam trawling targeting Rapa whelk (EAFA, 2015). Since 2013 the beam trawling has been allowed in the established zones only. Sprat is one of the most important fish species being fished and consumed traditionally (Raykov et al., 2008). Many more valuable fish and aquaculture species are listed in Alexandrov et al 2018; and Stancheva et al 2017). In the black sea, fishing is predominantly small-scale coastal fishing (less than 12 m) (EAFA, 2021). In Bulgaria in 2012, there were 184 fishing enterprises: the majority (68 %) owned a single vessel, and 30 % owned between two and five fishing vessels. Total employment in 2012 was estimated at 5 638 jobs. In addition, data management is an area for attention and diversify economies in communities that depend on fisheries (EC, 2016). That together with environmental goals to improved surveillance and preservation of the good environmental status of the Black Sea is in line with seagrass as NbS. Fishing stocks are depending on a healthy nursery which seagrass provides (E. B. Barbier et al., 2011) and mollusks depend on good water quality, where seagrass contributes (Fernandes et al., 2009).

**Tourism and recreation**

Tourism in Bulgaria plays currently a key role, generating more than 10% of GDP, thus being a prominent sector boosting the local economy. The coastal proportion of this is evident. Ca 70% of overnight stays in the whole country in 2011 were from 14 coastal municipalities. The number of tourists in Burgas Municipality varies between 64,764 in 2003 and 105,895 in 2007. In 2011 the municipality accommodated several 91,281 tourists with 235,975 overnight stays. Therefore, the average tourist stay was 2.5 days. Main factors favouring the development of tourism in the Burgas Municipality are existence of large sand beaches; bioclimatic resources; cultural and historical heritage; protected Areas; forest resources; and good business development. For example, it is an attractive feature of the city of Burgas to enjoy the beach, (sun)bathing, and recreational fishing from the pier. See Figure 56.

**Figure 56 Fishing from the pier in Burgas. In the background people are enjoying the beach. Source: Youtube, Erik Clark's Travel Videos.**

Thus, seagrass plays indirectly an important role in maintaining a good favourable environment for the tourism industry (Stancheva et al., 2017). Species such as different species of dolphins also attract tourists.

Other attractions in the area include as salt production in Lake Atanasovsko, north of Burgas, which is also home to the largest colony of flamingos in Bulgaria, which are also attractive for tourists. Salt has been produced since 1906, with 40,000 tons of sea salt produced a year. Salt production is carried out even today in the traditional way. It was found that the production of salt is directly proportional to average winter numbers of waterfowl in the lake. Thus, it is a good example of a business that is not only environmentally friendly but even creates suitable conditions for the nesting of many birds (Stancheva et al., 2017).

Studies have shown that seagrass meadows and in general the productivity and biodiversity of marine ecosystems support Avifauna (birds) (Unsworth & Butterworth, 2021). Tourists are attracted by one of richest bird areas in Europe, with 274 species of birds on just one square kilometre. See Figure 57 and Figure 58. Also, the designation of Wetland of international importance (Ramsar), situated on the second most intensive migration flyway of birds in Europe - Via Pontica. Easy observation of rare and endangered bird species all year round. Dalmatian Pelican, White-tailed Sea Eagle, Pygmy Cormorant and other. Ramsar Convention Site, Natura 2000 site. Sites include Poda protected site, visits to the island Anastasia, and eco-tourism activities in the region. These activities complement the cultural attractiveness of the area, places for recreation and entertainment that complete the attractive appearance of Burgas.

**Figure 57 Wetland discovery tour offered at Ecopark Vaya with Foros Bay cruise.**

**Figure 58** Poda protected site (Foros Bay) offers birdwatching, (Dalmatian Pelican) and walking.

Smaller eco-tourism businesses exist in the area to provide services to tourists. For example, in Ecopark Vaya (western part of Burgas Lake) short cruises are offered for ca €70, 45 min including guide and lunch. See Figure 59. This experience meets the Global Sustainable Tourism Council criteria. Such labelling initiatives supports natural environments and promotes eco-tourism.

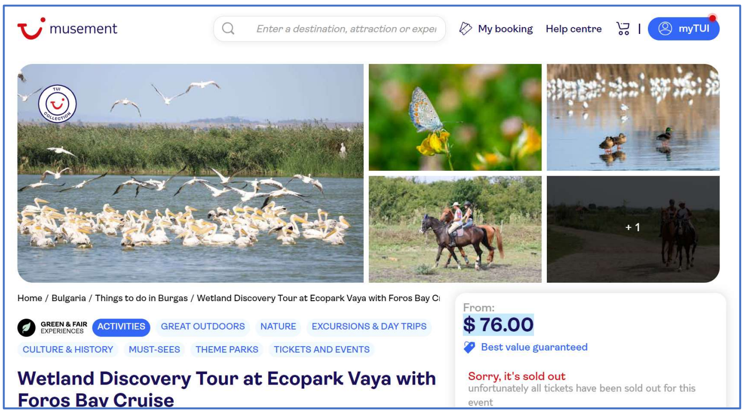



**Figure 59** Screenshot of a website advertising wetland discovery tours in the Ecopark Vaya (2024).

**Attractive living conditions connected to cultural history**

The location nearby and the favourable living conditions has always attracted people to the territories of contemporary Burgas as ever since ancient times. Evidence is presented in Archaeological and Historical Museum and the traditions and lifestyle of the local population- in the Ethnographical Museum. The natural resources of Burgas and the region are presented in the Natural History Museum. Such intrinsic values of a place are difficult to effectively value, but still proves some of the most powerful arguments for environmental protection, when people refer to sense of place and more emotional attachment. Seagrass provides the foundation for a healthy marine ecosystem, including a thriving avian fauna.

**Real estate development**

Bulgaria's partial integration into the Schengen area has fuelled interest in real estate in the country. Foreign and residential investors aspire to own Bulgarian properties, including elite apartments. In 2023, there was a significant increase in transactions in major resort cities, surpassing all previous records. Bulgaria's legislation doesn't hinder foreign investors from acquiring real estate. Bulgaria's planned entry into the eurozone in 1 Jan 2025 opens up for investing by foreign investors due to the option to buy residential property without the need for currency conversion.

There is an anticipated increase in demand for real estate in Bulgaria, which can provide a challenge for sustainable development, but also an opportunity if capitalised upon. For example, real estate developers in Foros Bay advertise for a development of an eco-village located in an attractive coastal area, with presumably good bathing waters and environmental areas beneficial for recreation (Arrogant Architects, 2024). The selling point is design of new and sustainable green residential areas with a marina located in the Foros Bay surrounded by habitats to be restored (see Figure 60 and Figure 61 with reference map of the location). Seagrass realise the environments that real estate relies on in their advertising and business models.

**Figure 60 Foros Sea Park Village (Arrogant Architects, 2024).**


**Figure 61 Planned location of the real estate development (left image) (Arrogant Architects, 2024). Part of the map presented above showing the seagrass restoration areas and protected area boundaries (right).**

**Transport management/ port operations**

Burgas is a logistic point of Pan-European Transport Corridor 8, which provides direct link between the Adriatic and the Black Sea coast. The Port operates 28 vessel's berths, having totally 4,800 ms of quays and realizes around 60% of the national sea import-export trade. It has huge storage facilities for accommodating different kinds of cargoes with a high level of security. The International passenger terminal has a capacity to 100 000 passengers yearly and hosts serve the biggest cruise liners of Royal Caribbean, Costa Cruises, Princess Cruises (ICT Cluster Burgas, 2024). The port is located in the vicinity of the seagrass beds see Figure 62. The sediment capturing services of seagrass thus is assumed to provide a value for the port, as well as the general environmental benefits for the passengers that come to visit the area (and its natural beauty).

In Cost-Benefit Analysis (CBA) for port related infrastructure design. It has for instance become apparent that the cost of constructing wave defences permitting uninterrupted cargo transfer up to 1-in-10 year storms far outweighs the cost of interruptions to port operations necessitated by structures scaled to give 10-in-1 year storm protection. This is especially relevant where the tidal range is increasing, and where the need for dredging becomes significant, both to keep channels free and to provide pockets of sufficient depth alongside quays. Dredging is expensive, as is the alternative of providing locked basins. The cost of providing and maintaining a deep dredged channel generally far outweighs the commercial benefits of uninterrupted operation in the short term. With suitable vessel traffic control and communications systems, ships can generally be scheduled to arrive and depart during the tidal window, without undue costs to owners. It would in this regard be useful to see whether seagrass can be integrated in such cost benefit calculations. The environmental assessment of dredging options will also require closer attention to weather and climate factors in the future. Reduction in sedimentation can significantly decrease maintenance dredging costs (Stoschek & Zimmermann, 2007).

The Foros Bay has 58 ha of sea grass, which should be able to contribute to a significant level of sediment control services relevant for the seaport and reducing the costs for dredging. Further investigations in the Bay could be needed. However, existing estimates of erosion could be extrapolated to provide an estimate for the whole of the Bay.

Dredging and dumping works are performed to keep the shipping navigation operational and safety navigation depth in the area of ports and canals. In the area of Burgas Bay there is only one dumping ground located at 20 nautical miles east from Burgas gas city between the lines separating vessel traffic. However, for the last five years there has not been dredging of the Burgas Port so it does not seem to be an urgent service (Stancheva et al., 2017).

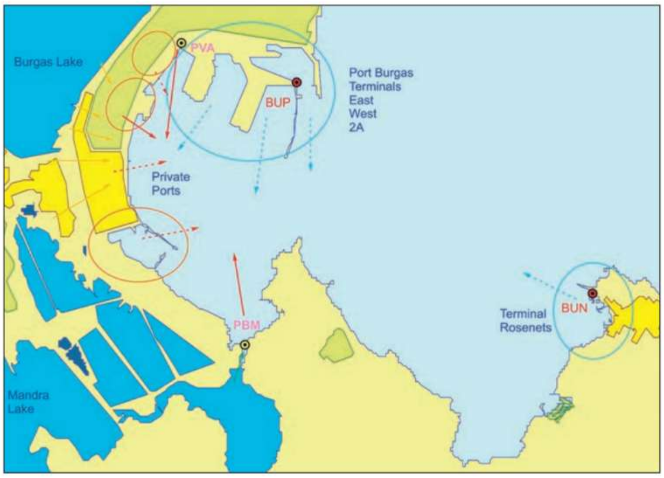



**Figure 62 Port activities and interactions with industrial activities in the Bay illustrating how they are very close to the seagrass habitats.**

**Beach management for tourism and real estate and private residents**

The coastline of Burgas Municipality has a length of 37.25 km. Sand beaches comprise circa 50% of the coastline having a total length of 17.2 km, whereas cliff sections have a length of 7.5 km. There is a large number of cross- and long-shore port and coastal defence structures along the coast of the study area with different purposes, including groins, dikes, rip-raps, seawalls, ports, port moles, spurs etc. and they account for a total length of 30 km (see Figure 63 for a coastline classification). Burgas Beach has the largest length, reaching 5.8 km and

stretching from the port mole of Burgas Port on the south and the coastal dike at Sarafovo on the north. Considerably smaller in width and length are beaches in the southern part of the bay formed between cliff sections at the existing capes stretching from the port mole of Burgas Port on the south and the coastal dike at Sarafovo on the north. Previous studies found that the coastline of Burgas Bay is one of the most heavily armoured along the Bulgarian coast (Stanchev et al., 2013; Stancheva, 2009). Such armouring is due to the construction of many port developments/infrastructure (one of the largest Bulgarian ports: Burgas, as well as Rosenets Oil Terminal. In 2015 the new fishing port of Sarafovo was launched (Stancheva et al., 2017).

The erosion problems in Foros Bay affecting the Bay are known. The highest average erosion rate of 1.05m/yr was measured along the coast at this section before coastal defence with the dike completed in 2003. Nowadays, due to the performed coast-protection activities the average rate of erosion ranges from 0.19 to 0.29 m /yr (Peychev & Stancheva, 2009). However, it is not known what the contribution of seagrass is in this regard. It would therefore be relevant to study the contribution of sediment controlling services of seagrass on erosion in Foros Bay. This in combination with increasing climate change with an increase in a number of highly intense storms, with consequences like the beach flood and the change of waves attack line.

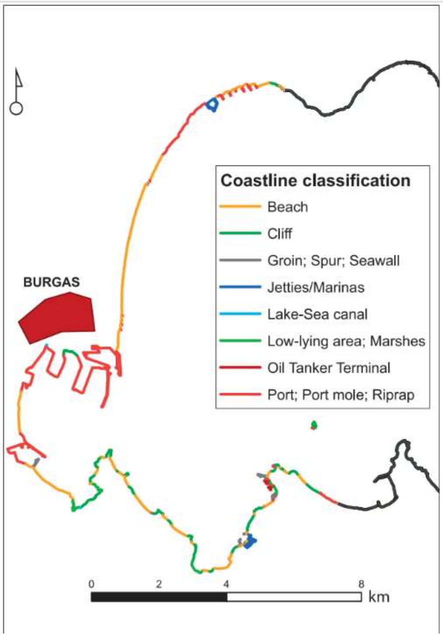



**Figure 63 Coastline classification around Burgas in Foros Bay (Stancheva et al 2017).**

Legal requirements related to the restoration activities: Permit for restoration is needed for reintroduction of local plant species.

**Carbon sequestration**

The carbon sequestration market for seagrass is not available in Bulgaria. The current Minister of Environment of Bulgaria has mentioned the role of terrestrial $CO_2$ capture and stresses that Bulgaria has a strong capacity and potential to participate in carbon credit schemes through forest management. [5]

**Upstream waste and nutrient from households, industry and agriculture impacting on coastal eutrophication**

The Burgas Bay's inner part is highly eutrophicated and has experienced extreme algal blooms and hypoxic events, especially in the 1980s. The main cause is intensive monoculture farming and pollution of soils and waters with pesticides. In 2009, inorganic Nitrogen was measured at 4.34 µg-A/L at Kraimorie, in Burgas Bay close to Foros Bay. High nutrient loads impact marine life including algae and seagrass health and cover and may consequently alter soil organic carbon (SOC) accumulation and preservation (Berov et al., 2012; Liu et al., 2022).

[5] Carbon Removal Policy in Bulgaria (carbongap.org)

### Value creation & delivery

The pilot coordinators expect that the action will increase the overall restoration effect, as the REST-COAST restoration actions will have synergy with the extension 1 actions.

The synergies are expected to be:

- Protection of the more sensitive Zostera planted by buffering more turbid waters, by reducing adjacent wave action, and contribute to increased sediment capture.
- Increased habitat area for the marine fauna, leading to potential to increased fish stock, and other marine food provision, eg molluscs.
- Increased ESS such as water quality improvement, which overall increases survival rates for other marine life including existing Zostera.

### Implementation arrangements

Being a small-scale project, integrated contract is the most probable provisioning /procurement arrangement, but this would be clearer when a dedicated call would be issued, or a specific arrangement possibility arises.

### Value capture

Identified grantors include Ministry of Environment and Waters (i.e. public funding) depending on if there is a dedicated call for nature restoration (through NbS related to ESS benefit).

None of the identified markets (Table 41) have a value capture mechanism in place to generate funding or financing for seagrass restoration.

Potential markets that could be possible to explore in the future:

- Fisheries/aquaculture: Value capture with certification schemes or eco-labelling. Customers' attention to sustainability labels in fishery and aquaculture products (FAPs) has been increasing in the last decades.
- Biodiversity – Payment for ESS (PES) cf similar project by WWF in the Danube in Bulgaria (Convention on Biological Diversity, 2014).

  Tourism and recreation: Increasing tourism in the area opens up responsible tourism and Payment for ESS (PES) for example to keep beaches intact and less eroded cf similar project by WWF in the Danube in Bulgaria supported by the GEF (WWF, 2012)
- Attractive living conditions connected to cultural history - Payment for ESS (PES) cf similar project by WWF in the Danube in Bulgaria (Convention on Biological Diversity, 2014).
- Real estate development - Payment for ESS (PES) for example to appreciate a natural beauty (which influences property prices).
- Transport management/ port operations - Payment for ESS (PES) reducing wave action and erosion and increase sediment capture. Building knowledge e.g. with private sector (dredging and port) with research and government on how to work out such arrangements.
- Carbon sequestration – needs to be developed for seagrass in Bulgaria.
- Upstream agriculture – PES schemes (Roberts et al., 2021).

#### Economic and financial projections

Costs for the restoration were assessed to about €200-300.000 depending on the technical solution (e.g. geotubes) to create an artificial shallow area /substrate.

From this about €40.000 is assumed to be costs for a diving company to carry out the replantation. This calculation is based on the costs for the starting point and adjusted for the smaller area (10 ha instead of 17).

Geotextile tubes vary in cost based on project size, system height, location, and other specific project site details. Geotextile tube sites cost in between \$1/ m$^2$, excluding installation. However, geotubes contribute to $CO_2$ emissions produced from the production of the materials and installation.

Other costs include time for the planning, administration, management, monitoring and research. This is yet to be defined.

There are no economic projections from any expected revenue stream for the extended restoration activities.

#### Financial instruments

No financial instruments are relevant at this point. However, several possibilities exist for the future, like municipal bonds and debt swaps.

#### Risk and contingency plan

Currently there is no risk and contingency plan that defines risks and mitigation strategies for achieving the NbS upscaling restoration objectives ("extension 1").

### 9.3.5. Critical funding and financing challenges

This section illustrates the financial challenges identified for the implementation of the proposed "extension 1" restoration and related business model proposition.

Low governmental and public awareness about the benefits of nature-based solutions and nature restoration in general.

The political and governmental context provides challenges for pushing through activities related to the restoration law and business model proposition dedicated or focused on green solutions / nature-based solutions.

So far, the project idea is on hold as the source of the financing is not clear. WP3 assessed there is a low level of capacity to approach funders. There is high capacity on the natural science side but not on fundraising/financing.

There is no dedicated program for restoration of seagrass, but restoration efforts focus more on the lake on the terrestrial part.

## 9.4. Extension 2: Financial scalability plan

### 9.4.1. Introduction: What does upscaling mean to the pilot

The involved actors are aware that activities listed above under the starting point and extension 1 (clearing out the channel and restoring 10 ha seagrass) only provide a temporary solution. Upscaling is seen as essential to sustainably develop the Foros Bay area in the future, enabling also resilience to climate changes.

A systems approach to upscaling is needed combining different measures in the river basin, where the major issue of eutrophication is perceived to be due to unsustainable agricultural practices. A starting point for upscaling is the Foros Bay landscape covering an area of ca 80 000 ha (a rough estimation done with google maps) including the seaside and terrestrial systems, and transitional waters[6] such as river mouths, lakes, wetlands between the inland and coastal waters. Different efforts are needed in addition to restoring seagrass that act in synergy to address eutrophication, pollution, turbidity, and other disturbance for example through installing artificial floating wetlands. All levels of the system should be addressed to get an overall higher benefit from the activities. These actions would provide synergy with the REST-COAST project and be based on past achievements, available best practices, and recommendations.

### 9.4.2. Overview of barriers preventing upscaling

Barriers are a combination of lack of devolution to the local level, unclear roles and responsibilities, lack of knowledge/awareness, and lack of finance:

**Lack of devolution**

There is a lack of decentralisation and thus not sufficient empowerment of the local authorities where much of the initiative power is located at national government level. The problem with this is that if there is a lack of will from the political level, there is no action. On the other hand, if the minister is open-minded and has a vision based on a good understanding of the problem, it will be initiated and implemented.

The distribution of funding is also centralised, and the allocation depends on which political party has the power, and with which region it is affiliated. Right now, the political party base is from Burgas, so the funding allocated to the Burgas municipality is quite large. However, the lack of power at the local level often means that local authorities lack financing. “In Bulgaria money is always the problem, there is not enough money for anything”.

**Lack of roles and responsibilities and heavy bureaucracy**

The way funding is being transferred to projects is also not very transparent and there are issues with the financial reporting of some projects. The local level can access funding via the regional governor and the municipality. However, there is often no clear division of responsibilities between them. In general, there are a lot of institutions, actors and stakeholders with overlapping mandates and different powers and intricate relations (municipality, regional governor that is appointed by the government, regional authority that is responsible for the protection of the environment). Also, different Directives (Marine spatial planning) are mandated to different Ministries with insufficient coordination. It is not very clear which authority is enforcing, and there is a lack of dialogue between the ministries, and between the local authorities. Much because of this situation, it is a heavy procedure to prepare a restoration program.

**Lack of understanding of the ecosystem-based approach**

In general, there is a poor understanding and recognition of the ecosystem-based approach by the authorities and by the population. For example, grey infrastructure is in principle preferred by local authorities, instead of a mix of grey – green or only green (NbS).

**Lack of value capture mechanisms**

From the previous section it is evident that seagrasses are of economic value to several markets, but there is no mechanism available to capture it. In general, the value of seagrasses as an ecosystem is often not considered in marine management decisions and rarely incorporated into NbS projects also outside Bulgaria (Lima et al., 2023). More promotion and evidence base are therefore needed at all levels (International, EU, National and local) to understand the important role seagrasses plays in the ecosystem and for society, e.g.

[6] Bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters, but which are substantially influenced by freshwater flows (EEA, 2024)

in making the area more attractive. This can for example be supported by more research and data availability of the services ecosystem provided and the relations with economic value creation.

**Lack of a vision guiding future action**

In general, at national level in Bulgaria there is lack of vision about what is important for local communities. This is perceived to be because the lack of broad involvement of local actors informing this vision. National plans and strategies are discussed at political level, and decisions are made with little time for discussion or involvement with the relevant actors. As such, it is not always evident that the proposed projects answer to the community needs. So, the main driver is perceived to be Europe, in terms of, prioritizing measures, and in terms of financing of certain actions. For example, prioritizing NbS also in national recovery and resilience planning.

**Lack of broader participation – connecting of NGOs/scientists with political decisions**

It is challenging for scientists active in restoration to engage and help drive change. The unclear roles and responsibilities and complex stakeholder landscape make it difficult for scientists to engage. Although scientists or consultants are involved in many developments, the broader consultation with the scientific community has not a given platform. Instead, the scientists need to be very active with a diversity of partners to potentially have input into key processes and be part of the decision-making system, and have access to projects and restoration ideas, but these kinds of projects are not always consulted.

The core plat of REST-COAST is a platform for broader participation, but it has experienced challenges for engaging the participation of the governmental actors, as many do not come to the meetings. The NGO sector is more open to this kind of discussion, but there are no representatives of the municipality, local authorities, governmental authorities, or ministries. On the other hand, the government may organize meetings, but it is only with the government present. Some work involves technical experts, but this work is more like consultancies, for example, environmental impact assessments. As such, the decision-making is perceived to be very political and less informed by scientific knowledge. See also (Andreeva et al., 2021) for more details on the governance-related barriers.

### 9.4.3. Financial strategies for upscaling

**A positive outlook**

Upscaling is surrounded by a positive outlook and energy forward. The municipal government of Burgas is interested in developing more long-term approaches. There is also a general positive feeling among actors as they see changes happening and plans on the horizon. There is a perception of an increase in the importance and the benefit from NbS with the national and local authorities. This is supported by a sentiment among actors that everything should be eco-friendly, for example real estate developments should be adapted as eco-facilities, and big resorts that is harming the environment should be avoided. It is even named a breakthrough of governance by the interviewees. In addition, there is new energy among actors through the adoption of the nature restoration law. Different actors are expressing interest in capitalizing on these developments, from the risk community and NGOs. This is because funding resources are strongly dependent on the progress of Nature Restoration Law and related strategies and frameworks/directives to be implemented by EU member states. The policy to restore 30% of habitats or important marine habitats is expected to play an important role in Foros Bay. The EU Missions on adaptation also provide many opportunities to address seagrass as part of coastal adaptation. In addition, new projects, for restoration of lakes have been initiated recently, contributes to the promising, positive outlook.

**Increasing tourism**

The tourism industry is expected to grow in the future in the Burgas Bay area, which increases the market values of ecosystems and the natural beauty that comes with a healthy environment. It is estimated that in 2030 the persons employed in the tourism sector will be around 20,000–22,000 (Master Plan of Burgas). This can mean an opportunity but also a challenge for marine life and seagrass restoration. One scenario is that socio-economic priorities dominate with increasing development on the coast and associated pollution and disturbance. Another scenario is that tourism is an opportunity to enhance ecosystem integrity and to make the linkages between the dependencies of a healthy environment for socio-economic development and especially tourism (Stancheva et al., 2017). For example, by applying eco-labels in the tourism industry and working with awareness and information.

**Sustainable fisheries**

Ecolabelling could also be a good option for the fisheries sector. In Favero & Hinkel (2023) this was already identified (relevant for fish provisioning ESS) which could be relevant for the smaller scale fishing fleet and the aim to protect the marine environment. Promoting eco-certified fisheries for aquaculture could potentially be well-appreciated by the local population and tourists, and for a European market.

**Addressing climate change and coastal risks**

With climate change, including e.g. sea level rise and increasing storms there will be need to address wave energy reduction, and erosion control in the maintenance of beaches, and coastal real estate. This includes also ensuring port activities are not interrupted, and mitigating erosion damage to port infrastructure, and reducing/avoiding dredging costs. Estimates of seagrass value for coastal protection are significant (see table 7-x) and need to be included in Cost Benefit analysis by coastal scientists, regional planning authorities, port authorities and enterprises. For the existing seagrass in Foros Bay, (58 ha) the value for erosion control could be as much as €2.320.000 per year. As such, this could be a base for exploring financing mechanisms based on cost avoidance –involving the port authorities or several of the companies depending on dredging. Financing seagrass restoration would as such reduce costs to dredging over time, as seagrass capture sediments and reduce damage to infrastructure after storms, knowing that seagrass reduce wave impacts. The European Union certainly will play an important role in driving these developments in making a connection between dredging (regulations) and payment for ESS.

Erosion issues are also relevant to the whole of the Black Sea area which calls for a regional approach (e.g. at least Bulgaria and Romania). The Bulgarian Black Sea coast has a length of 412 km, and 58% of it is exposed to coastal erosion and landslide processes (Peychev & Stancheva, 2009; Stancheva, 2009). For example, in Romania Constanta County is situated on the west shore of the Black Sea, with a shore of more than 100 km in length with intense erosion from the last 20 years, affecting 60% of the length, whereas in the most affected areas losing yearly approximately 5-6 meters of the beach (Secuiu & Costache, 2007). Addressing erosion at this scale with seagrass restoration and other NbS could tap into European Union structural funds related to the Green Deal or the marine /blue economy.

**Sustainable coastal developments**

Coastal developments could have detrimental impact on marine ecosystems. For example, the discharge of waste waters (both domestic and industrial) into the wetland lakes in the study area and cause significant pollution of the marine part. This originates from many industries, that would need to address wastewater treatment. Potentially, restoration of seagrass could support water quality improvement ESS, and potentially funds could be sought from the polluting industries in combination with improvements of treatment.

In addition, the oil industry poses serious threats if there is damage to the infrastructure and subsequent leakage to sensitive environments. It also deposits preliminarily treated wastewaters for oxidizing in decanters located in the Burgas and Mandra lakes vicinity. The decanters are a potential threat due to possible overflowing in case of floods, which are expected to increase in frequency and magnitude. In case of floods untreated waste waters could reach the Burgas Bay, area and contaminate the seawater. The oil company “Lukoil Neftohim” is considered to have developed its production site too extensively, and Burgas Lake has been effectively used as an open sewer. An arrangement to support environmental quality in the Foros and Burgas Bay area would therefore be in order.

To support sustainable coastal developments mechanisms *the Pollutors Pay Principle (PPP)* is relevant for the local authorities. It has been applied in the industrial sector, and can include taxes, fines and other measures, such as quotas for pollutant emissions and the Environmental Liability Directive. This could also therefore be applicable to industries and households upstream that discharge waste to the waters, as well as agricultural diffuse pollution. In similar cases around the world, NbS such as seagrass can be seen as a cost-effective method in addressing water pollution, instead of for example installing treatment plants (cf the case of Catskills Mountain in the USA).

There will be a continued strong pressure from coastal developments including real estate and marinas. One area is being planned in Foros Bay adjacent to the restoration areas for seagrass. This could also provide an opportunity for financing, as these developments depend on values found in a favourable and beautiful environment, for recreation, with e.g. bird life, and wide (non-eroded) and healthy beaches and bathing and boating waters, which seagrasses supports. For example, c*orporate social responsibility arrangements could* support to seagrass restoration and be relevant for the real estate developers and marinas built close to the seagrass restored areas, or from any of the port industries / companies. This would require arrangements to distribute the funding monitor on the developments and even educational activities which can be beneficial for the employees, customers or partners of the funding industries/companies.

**Inclusive participation**

A broader and transparent dialogue is needed to address an agenda for Foros Bay together with the local and the national level, to have a design phase that is sufficiently long to include all visions or opinions or ideas to come to be assessed for their effectiveness, and interest of the community. This would need to include public consultations in a facilitated dialogue, supported by science and identify research and data gaps that needs to be filled for the scientific community.

**Institutional arrangements**

A coordinating institution would be required, that could bring together different actors including government, scientists and NGOs, and respected equally by all parties. It would moderate the exchange of ideas and opinions to see what is doable and what is efficient to be done in what combination and make an action plan, with different actions and interventions, which can invite different actors. This can enable the implementation of the needed measures. Important characteristics of such a body would be non-bureaucratic, flexible, science-oriented structure. So far there is no such body or organization or coalition for coastal issues. But there is a coalition for the renewable energies, that can provide a role model and lessons learnt.

**Exchange with EU level**

Exchange at EU level is seen as an important future opportunity. Established practices in other European countries such as in the Netherlands could be providing important inspiration for Bulgarian coasts, including Forors Bay. The establishment of the Black Sea Coastal Association, acting as organization that efficiently could act as counterpart to facilitate knowledge transfer partnerships in coastal and port engineering and coastal zone management, could potentially be an actor to speed-up this process. This includes not only building expertise and knowledge, but moral support and encouragement. For example, a series of scientific conferences and seminars addressing payments for ESS as a topic, as well as on the training activities and the participation in European projects is emphasized also as a very important factor.

**The EU and associated strategies**

*"If Europe wants something, Bulgarian government will allocate funding for this kind of activities". (Interviewee from REST-COAST).*

The EU is and will remain an important driving force in defining many aspects of Bulgaria's national maritime economy policy development. In addition to the Water Framework Directive, Blue Growth, and Green Deal, The Black Sea Marine Strategy, which aims to support the EU *Marine Strategy Framework Directive (MSFD)* implementation, is very important. It requires Member States to achieve good environmental status (GES) for their marine waters. To that end, Member States must draw up marine strategies for their marine waters and cooperate with Member States sharing the same marine region or sub-region. These marine strategies comprise different steps to be developed and implemented over 6-year cycles. Seagrass restoration needs to be an important part of such strategy documents and as mentioned take a cross-border approach with Romania to address erosion and reaching good environmental status of Bulgarian part of the Black Sea (The World Bank, 2020).

To help the economy navigate through the "green" and "blue" transitions, Bulgaria can access additional EU-powered investments for specific areas, such as the EU BlueInvest platform22 and the future InvestEU program. The EU Recovery Fund, through a dedicated allocation for Bulgaria, will be instrumental in the short and medium term in scaling up investments in innovation in sustainable food and biomass offshore production and renewable energy in ways that preserve ecosystems. The World Bank, under its regional BBSEA program, is looking at avenues to support projects that address marine pollution and marine litter in the Black Sea countries (The World Bank, 2020).

Bulgaria is one of the main beneficiaries of EU funds (measured as a share of GDP) over the 2021 2027 financing period, including green goals. For example, the NRRP **Bulgaria National Recovery and Resilience Plan** provides opportunities, for reforms and investment. Bulgaria has a long history of hard coastal protection measures as coastal armouring structures can be found all along the coast. The development of a coastal protection strategy, relying on synergies between various nature-based solutions as building blocks could be considered as a sustainable alternative to hard infrastructure, where possible and effective (Kostovska, 2022).

Also, the Maritime Spatial Planning (MSP) could apply an ecosystem-based approach as referred to in Article 1(3) of the **Marine Strategy Framework Directive** (Directive 2008/56/ EC). However, human resources and information basis for MSP are still insufficient at municipality and national level. Lack of data is a current challenge for identifying land-sea interactions for Burgas study area, to inform marine spatial planning and strategy. For example, a detailed map of the bottom habitats, data on impacts of different activities on the land and marine environment, data on dredging and dumping, data on yachting and marine sports, data on military training activities, data on the direct impact of Lukoil Neftohim on the environment and wetlands, data about sediments specific substances content, data on oil spills and ship accidents and many other (Stancheva et al., 2017).

Several other important policy processes are relevant for the Foros Bay seagrass restoration and further upscaling:

- Habitats and Birds Directive
- Integrated Coastal Zone Management
- Marine Strategy Framework Directive

# Chapter 10. Nahal Dalia Pilot

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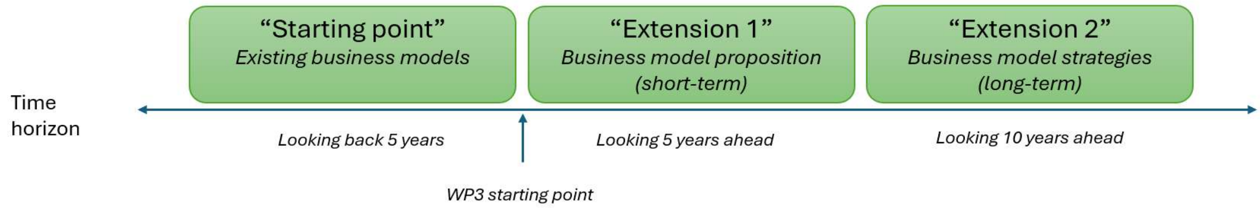
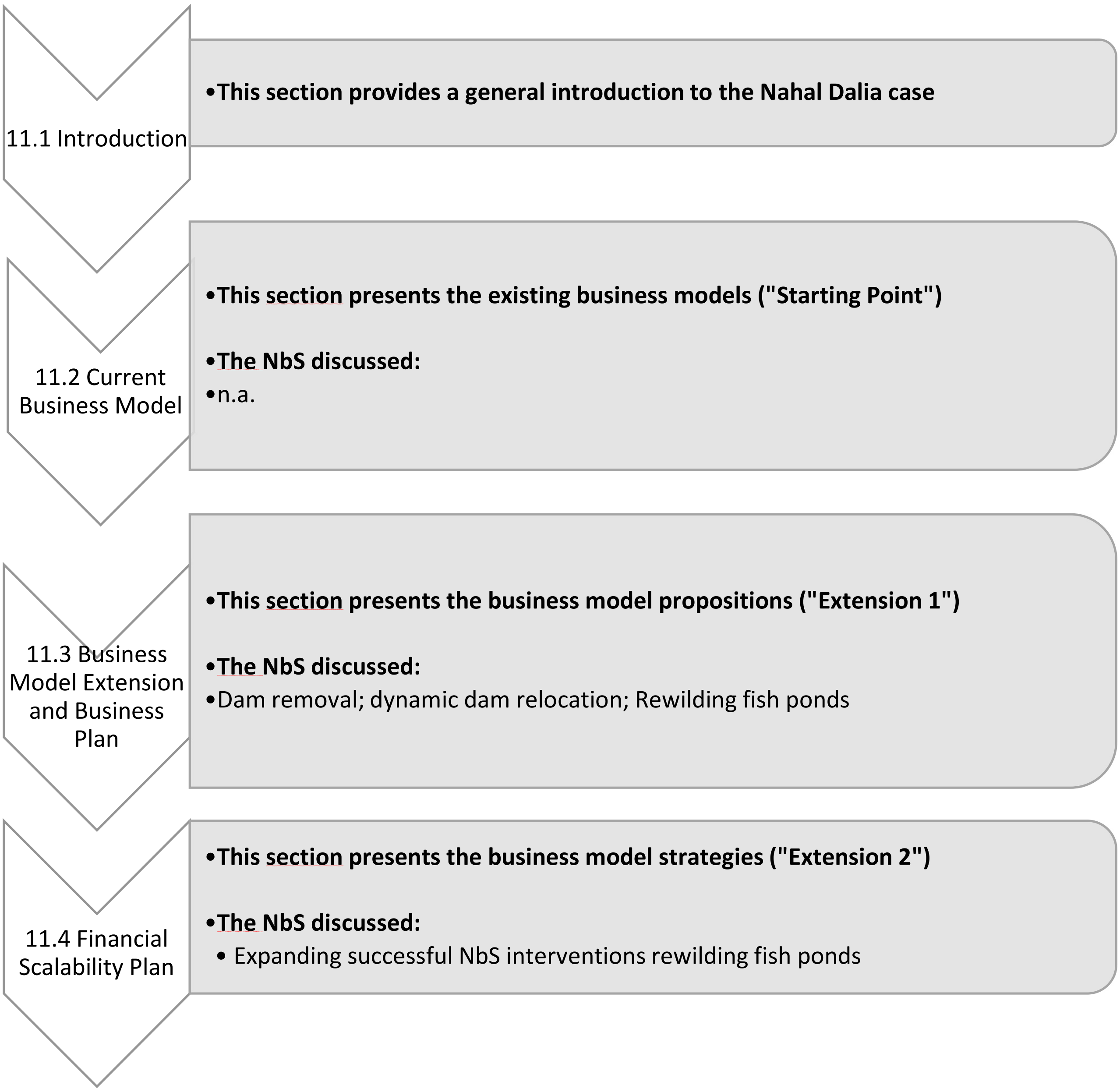
**Readers guide**



## 10.1. Introduction to the pilot

The Nahal Dalia pilot, considered for NbS coastal restoration interventions, is in the Hof HaCarmel region, in the Northern Coastal Plain of Israel. Restoration interventions in the pilot area are planned at two different spatial and temporal levels, as indicated in Table 42. It is worth noting that in the pilot of Nahal Dalia, there is currently no business model in place, there are no ongoing NbS restoration interventions at Nahal Dalia. Therefore D3.3 describes together current and extension #1 as the area planned for NbS restoration interventions.

**Table 42 NbS restoration upscaling levels targeted by REST-COAST tasks**

| Level of upscale/ Extension | Area of NbS restoration interventions | Status of restoration | Business model | Business Plan | Horizon (years) |
|---|---|---|---|---|---|
| Current and extension #1 | 55 ha (Difle) – impacted area Scratch and upscale coincide | Planned | Identified | Identified | 1-5 |
| Financial Scalability Plan Extension #2 | Similar ecologic units in N/S of 150 ha (within 200 ha) | Envisaged | Not available | Not available | 5-10 |

**Extension #1**, not yet executed, demonstrates current and upscale interventions that include rewilding of one fishpond, that will be used to circulate effluent water from the fish farms. The area impacted by the NbS restoration intervention is approximately 55 ha. The restoration needs to be planned in detail after choosing alternative interventions to be implemented, with the business model and plan to be identified and developed respectively. The temporal horizon of reference is 5 years. For this area, a business model proposition and business plan have been developed and described.

**Extension #2** targets similar ecological units of 150 ha and considers rewilding of additional fishponds. The restoration status is envisaged and examined theoretically. Additionally, the project seeks to address the national outline plan (TAMA 1) for flood mitigation and provide solutions for basin-wide runoff management (TAMA 1, Amendment 7). As part of the outline plan, protective mechanisms for the river system will be established, including statutory protection for areas (i.e., protected areas) important for runoff management. Within this framework, the Israel Nature and Parks Authority (INPA) aims to promote a statutory solution that includes the formal declaration of the estuary and the designation of the coastal lagoon as a nature reserve. Subsequently, it is proposed to create hydrological connectivity between the estuary and the coastal lagoons to enrich and protect these wetland habitats and expand the estuary's area. These proposals are currently in the preliminary stages of feasibility assessment for statutory regulation but have the potential to upscale the restoration areas as part of the pilot. The business model is yet to be identified, and the business plan is not applicable at the current phase. A Financial Scalability Plan is provided. The temporal horizon of reference is 10 years. Figure 64 illustrates the areas affected by extension #1 and # extension 2.

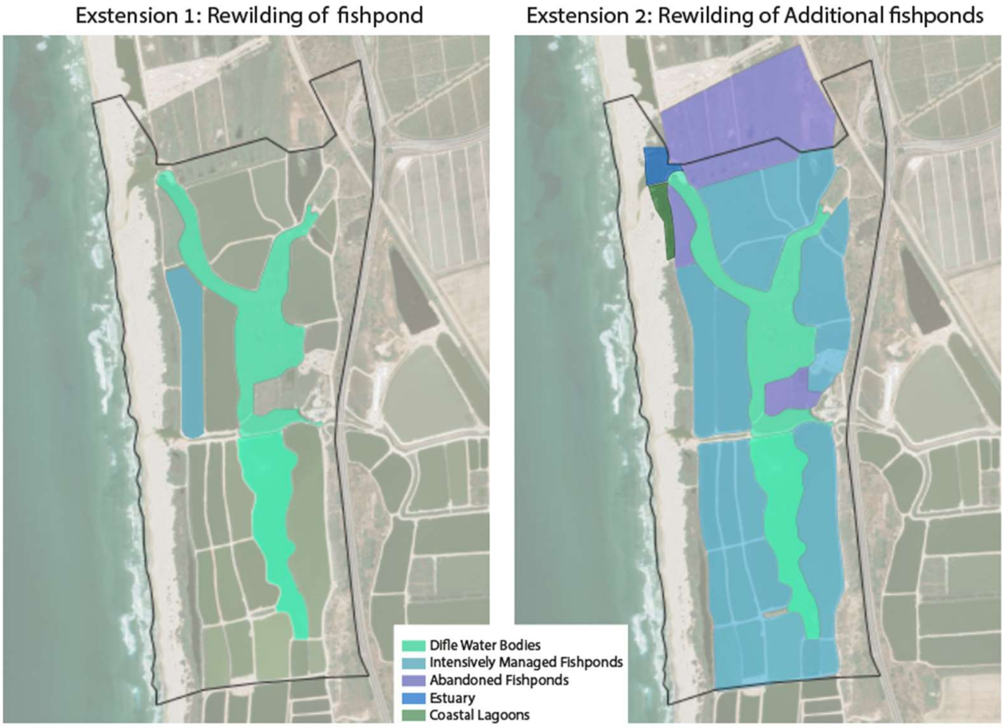



**Figure 64 Areas affected by extension #1 and extension #2.**

## 10.2. Starting point: Current Business Model

This section does not apply to Nahal Dalia since no current business model has yet to have any ongoing NbS restoration interventions in place for Nahal Dalia.

### 10.2.1. Funding: granting

No funding for restoration activities were made.

### 10.2.2. Funding: value capture

No funding for restoration activities through "value capture" were made.

### 10.2.3. Finance

No financing instruments for restoration activities at the starting point were made.

### 10.2.4. Procurement arrangements

No procurement arrangements at the starting point were made.

### 10.2.5. Critical funding and financing challenges

Irrelevant.

## 10.3. Extension 1: Business model proposition and Business plan

This section describes the business model developed through the business model canvas (Figure 66) and the business plan for NbS restoration interventions (extension #1), described in each subsection.

As mentioned in section 8.1, NbS restoration interventions have not yet been executed in Nahal Dalia. Therefore, there is no proper distinction between current restoration and extension #1 in the pilot.

### 10.3.1. Executive Summary

This business plan describes the management, business, and financial strategies for current and upscale interventions that include the rewilding of one fishpond, which will be used to circulate effluent water from the fish farms in an area impacted by the NbS restoration intervention of approximately 55 ha in Northern Difle, Nahal Dalia. The restoration needs to be planned in detail after choosing alternative interventions to be implemented. The business plan considers a temporal horizon of five years. The upscaled restoration plan will target different interconnected problems (i.e., water quality/scarcity, overexploitation of groundwater, upstream pumping of water for irrigation/aquaculture purposes, low fish and crop yield, damage from flooding, development pressure, loss of biodiversity, state ownership over property, etc.) allowing the improvement of five primary ESS and biodiversity that will produce a large variety of benefits of environmental, economic, social and cultural type to multiple stakeholders and beneficiaries. The Israel Natural Parks Authority (INPA), whose mandate is to preserve natural reserves in the country with a specific focus on wetlands, will manage a set of NbS restoration interventions (i.e. Dynamic Dam Relocation Upstream; Dams Removal & Replacement by Weir; Rewilding of Fishponds; Flood water Reservoir and Habitat Heterogeneity), supported, through procurement arrangements, by several implementing organizations of scientific and technical competence. The significant amount of estimated costs will necessitate the development of a financial strategy that goes beyond public funding (granting arrangements) by attracting private investments through innovative financing arrangements and value capture arrangements stimulated by economic activities in eco-tourism and education.

<table>
<tr><td>Value proposition</td><td>Problems addressed<br><br>-Over-exploitation of groundwater<br>-Upstream pumping of water (irrigation/aquaculture)<br>-Water quality<br>-Low fish and crop yield…<br>-Damage from flooding<br>-Loss of biodiversity<br>-Land abandonment<br>-Loss of economic development<br>-Development pressure<br>-State ownership over property</td><td colspan="2">Benefits produced<br><br>Environmental benefits: Allowing outlet for sediments and decrease in organic matter accumulation on the bed; Increase in BDV by improving connectivity between Nahal Dalia and the estuary; Increase in BDV by allowing seasonal characteristics such as winter floods, rain events, etc.; opportunity for adaptation of species; enable the return of pollution-sensitive species; wild fishponds will create a buffer between human activity and the reserve; improving the reserve's water quality; etc.<br>Economic benefits: Annual costs saved for infrastructure repair; Better fish quantity and quality for the market; Saves purification costs; Better water quality for agriculture; etc.<br>Social benefits: Educational opportunity to learn about species in the ecosystem; Opportunity for the professional community to learn about aquaculture -nature reserve dynamics.<br>Cultural benefits: Human-nature experience; Maintain cultural landmarks</td></tr>
<tr><td rowspan="3">Value creation</td><td>Key partners<br><br>-Drainage Authority + INPA for dam removal\relocation<br>-Maayan Zvi + INPA + SPNI for fishponds rewilding<br>-Maayan Zvi + INPA for flood Water Reservoir<br>-INPA for habitat heterogeneity</td><td colspan="2">Regulation and Governance<br><br>Multiple regulations are in place, impacting the governance of the NbS restoration interventions: Nature's rights for water; Nature Reserves and National Parks law; Nature reserve regulations; Land Authority regulations; Terrestrial fishery's reform; Fishpond effluent quality standards; Drainage and Flood Protection Law.<br>However, at proper governance structure has not yet been established.</td></tr>
<tr><td>Key resources<br><br>-Knowledge/Technical expertise (in-depth studies)<br>-Technical means<br>-Tools and restoration techniques<br>-Agreements to promote interventions from all stakeholders</td><td>Customer segments<br><br>-Visitors and Tourists<br>-Students</td><td>Stakeholders<br><br>15 stakeholders: 11 are governmental organizations, 1 NGO and 3 organizations from the private sector).</td></tr>
<tr><td>Key activities<br><br>-Dynamic Dam Relocation Upstream<br>-Dams Removal & Replacement by Weir<br>-Rewilding of Fishponds<br>-Flood water Reservoir<br>-Habitat Heterogeneity</td><td>Customer relations and channels<br><br>Website (social media)</td><td>Beneficiaries<br><br>-Kibbutz Maagan Michael-Dag'On<br>-Fishing Park<br>-Public community (citizens, tourists)</td></tr>
<tr><td>Value capture</td><td>Costs<br>-Pre-planning monitoring and ecological (518.700 €) + hydrological analysis (144.018 €)<br>-NbS intervention Planning-alternatives (1.069.239 €)<br>-Construction of NbS intervention (7.607.344 €)<br>-Monitoring (369.458 € / year)</td><td>Revenue streams<br>Ecotourism (€250.000)<br>Educational activities<br>Carbon credit (not estimated yet)</td><td>Financing and funding<br>Grants (INPA, Water authority), Open area conservation fund. Private investors.</td></tr>
<tr><td>Transversal categories</td><td colspan="2">Impact indicators<br>Improvements of ESS output/level (e.g. for Water Purification: Chlorophyll, Algae composition, NDSI Soil index, for Food provisioning: kg of fish production; for Climate Change Regulation: Carbon sequestration measurements; above-ground biomass, soil organic carbon)<br>Indices of increased BDV, e.g. Shannon-Weiner Index and Simpson's Diversity Index<br>Impact on human (increased knowledge) and produced capital (revenues from eco-tourism, fishing, GDP)</td><td>Risks<br>-Water availability<br>-Salinization; Not enough volume to treat fishponds affluents<br>-Water shortage<br>-Failure of vegetation restoration</td></tr>
</table>

**Figure 65 Business Model Canvas for NbS in Nahal Dalia**

### 10.3.2. Mission and Objectives of the restoration initiator

The mission of the Israel Nature and Parks Authority (INPA) is to conserve, preserve, and maintain Israel's natural landscapes, wildlife, and cultural heritage sites. INPA aims to ensure the sustainability of these resources for future generations while promoting public awareness, education, and enjoyment of nature. This includes managing nature reserves, national parks, heritage sites, and marine protected areas, as well as enforcing laws and regulations to conserve biodiversity and natural habitats. To advance its conservation goals, INPA also engages in scientific research, wildlife monitoring, ecological restoration, and international cooperation.

In line with the mission described above, INPA is committed to NbS restoration activities in the area by proposing the following restoration **objectives**:

1) Further improve water quality and increase biodiversity in the reserve
2) Disconnect the dependency between the fishery sector and the reserve's water bodies
3) Restore connectivity between Dalia stream and the sea
4) Reclamation to the public.

These objectives can be promoted on-site through the expansion of restoration activities carried out within the boundaries of the pilot site, and they will be used as a model for future initiatives.

### 10.3.3. Stakeholder overview

The pilot core team has identified 15 stakeholders mainly affected by NbS restoration in Nahal Dalia and 10 stakeholders within the CORE-PLAT with whom a dialogue was held. The list includes 12 stakeholders from the public sector and three from the private sector, grouped in the following **categories**:

**Public sector**

11 Governmental organizations

- Hof Hacarmel Regional Council – Local municipality
- Carmel Drainage and Streams authority - In charge of drainage and surface water management on a broader scope
- Hof Ha-Carmel Agricultural Water Association - Responsible for supplying water to the local authority and part of the steering committee.
- Israel Nature and Parks Authority - The government authority is responsible for nature reserves and national parks and is involved in restoration activities and land management.
- National Water Authority - Executed water policies and surface water / Groundwater abstraction quotas. Part of the steering committee.
- Ministry of Agriculture - Regulates fishery activities and thus greatly influences the area.
- Ministry of Environmental Protection - Engages in local planning processes, assists municipalities with their environmental responsibilities, and supervises them when formulating requirements for acquiring business licenses. It also Regulates fishery activities / Reforms.
- Ministry of Tourism – Responsible for tourism development.
- Israel Antiques Authority - Regulates excavation and conservation and promotes research.
- Israel's Land Authority - Israel Lands are nationally owned and can only be leased by the Land Authority. Thus, land buyers are granting lessee's rights formally, not complete ownership rights. The authority is the official landowner on the site and gives lessees to the kibbutz to use the land under conditions defined by law.
- Regional Planning Bureau - Plan and regulate land use and development according to national and regional planning policies.

**1 NGO:**

Society for the Protection of Nature in Israel - SPNI is an Israeli non-profit environmental organization working to preserve plants, animals, and natural environments. It represents BDV by protecting the lands and waters needed for survival.

**Private sector:**

- Kibbutz Ma'ayan Tzvi – Landowners (under long- term lease) and managers of the fishery.
- Kibbutz Maagan Michael - Rent and operate the fishponds of Maayan Zvi and, which are influential on the site.
- Kibbutz Dor - Influential neighbors with the potential for planning collaboration since some of its fishponds are in the pilot area.

**Table 43 Overview of key stakeholders in Nahal Dalia**

| ID | Name of the organization | Mandate, role and responsibilities | Legal nature | Category | Level |
|---|---|---|---|---|---|
| 1 | Kibbutz Ma'ayan Tzvi | Landowners (long- term lease) and managers | Private | Company | Local |
| 2 | Kibbutz Maagan Michael | Influential neighbors | Private | Company | Local |
| 3 | Kibbutz Dor | Influential neighbors. There's potential for planning collaboration | Private | Company | Local |
| 4 | Hof Hacarmel Regional Council | Local municipality | Public | Government | Local |
| 5 | Carmel Drainage and Streams authority | Government- In charge of drainage and surface water management on a broader scope | Public | Government | Regional |
| 6 | Hof Ha-Carmel Water Association | Dalia river Surface Water consumer. Part of the steering committee | Public | Government | Regional |
| 7 | Israel Nature and Parks authority | Governmental Authority in charge of nature reserves and national parks including where restoration is about to take place | Public | Government | National |
| 8 | National Water authority | Executer of water policies and surface water / Ground water abstraction quotas. Part of the steering committee | Public | Government | National |
| 9 | Ministry of Agriculture | Regulates fishery activities | Public | Government | National |
| 10 | Ministry of Environmental Protection | Regulates the influence of the environment on people. I.e,: air, noise and light pollution. the fishery, the water emission quota, and timing to the sea. Regulates fishery activities / Reform. | Public | Government | National |
| 11 | Ministry of Tourism | Interested in tourism development | Public | Government | National |
| 12 | Israel Antiques Authority | Promotion of work in the field requires Work High permits | Public | Government | National |
| 13 | Israel's Land Authority | Land owners-Israel Lands are nationally owned, and they can only | public | Government | National |

| | | | | | |
|---|---|---|---|---|---|
| | | be leased. Thus, land buyers are granting lessee's rights, formally not full ownership rights. | | | |
| 14 | Regional Planning bureau | Plan and regulate land use and development according to national and regional planning policies | public | Government | National |
| 15 | Society for the protection of nature in Israel (SPNI) | Israeli non-profit environmental organization working to preserve plants, animals, and natural environments. | public | NGO | National |

Concerning the alignment with the NbS paradigm (analysis made in synergy with the work executed in WP5), 5 stakeholders have a very-high alignment. 3 stakeholders are only partially aligned. The remaining 7 stakeholders are unconcerned with the NbS paradigm, although 4 are involved in the CORE PLAT.

Assessing the level of influence/interest of stakeholders, the map in Figure 66 shows the positioning of the stakeholder types that are involved in restoration upscaling in the Nahal Dalia pilot.

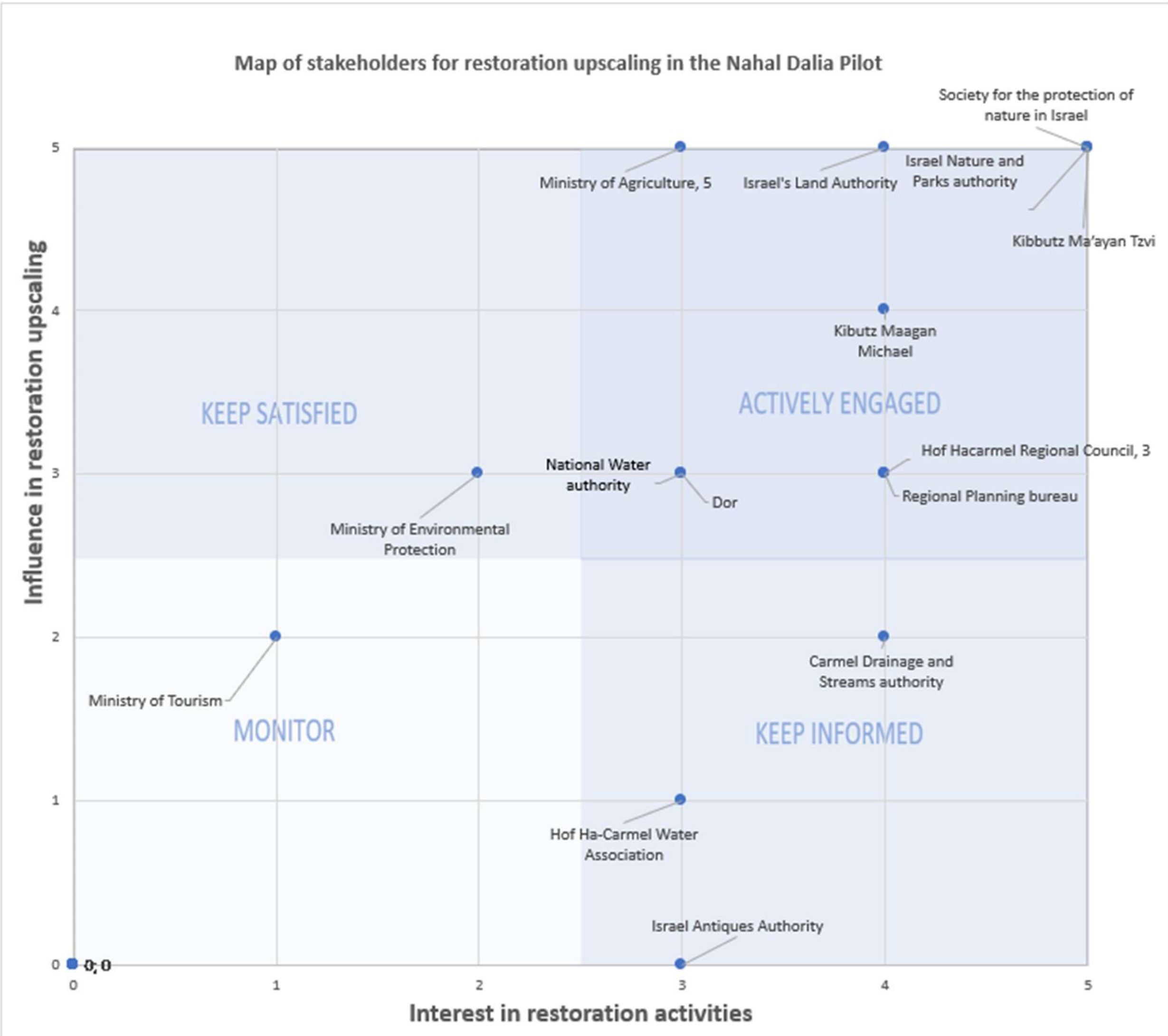



**Figure 66 Stakeholder map of Nahal Dalia NbS restoration plan**

The map provides valuable insight into the specific stakeholders that can play a key role in developing and implementing the business plan (upper right quadrant). At the top of the quadrant are positioned the following organizations: INPA that is the initiator of the NbS restoration activities; the kibbutz Ma'ayan Tvi that is the landowner of the area interested in restoration; and SPNI, the environmental NGOs engaged in preserving BDV in the area.

#### 10.3.4. Business model proposition

The business model proposition for the current and upscaling restoration ("extension 1") is described in its three main components, as follows: i) the value propositions derived by coastal restoration; ii) the activities and the organizations engaged in creating and delivering the value propositions; iii) the value capture mechanisms that will allow to generate revenues and get funding in order to sustain the restoration investments. The NbS business model (Figure 67) provides a concise overview of the business model proposition co-developed with stakeholders in Nahal Dalia.

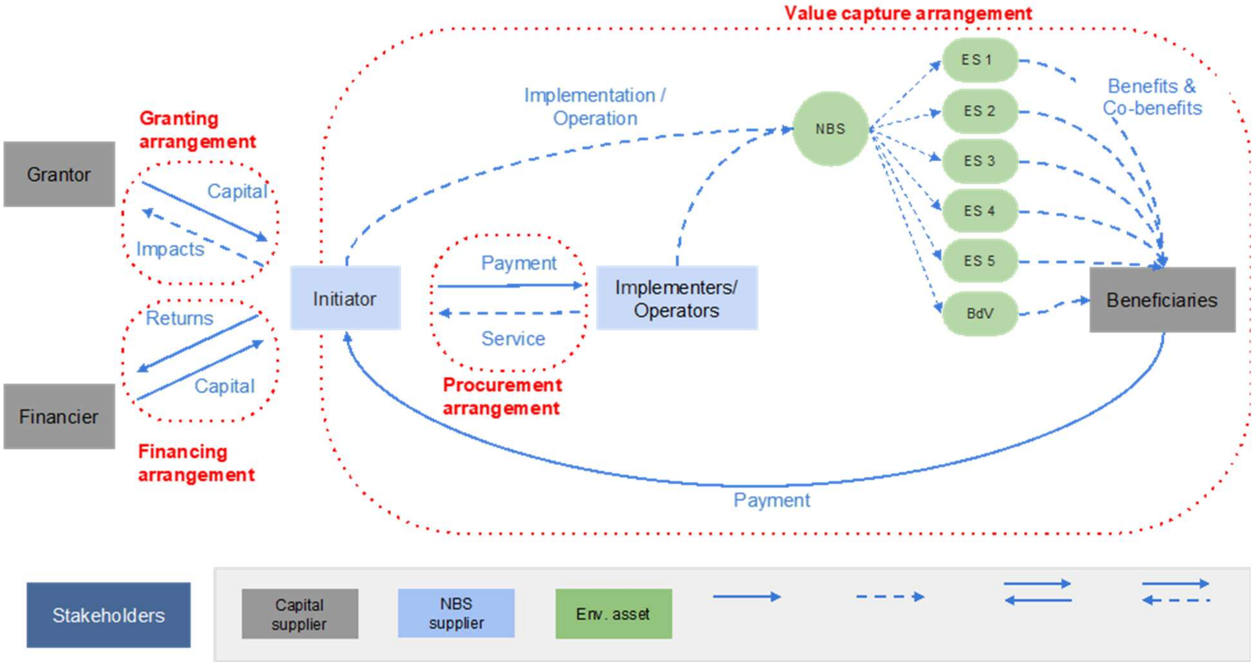



**Figure 67 The NbS business model, based on Favero et al. (2022)**

Value proposition

Several **problems** emerged from the assessment undertaken by the Nahal Dalia pilot team and the main stakeholders, including:

- Water scarcity affects the areas of activity of all the landowners.
    - Over-exploitation of groundwater – harming the ecosystem and the water regime in the reserve and desalinating the groundwater. The problem is relevant for INPA for the Water Association, which uses the pumped underground water for irrigation.
    - Upstream pumping of water for irrigation/aquaculture purposes can affect most of the stakeholders: the kibbutz, the Water Association for irrigation, the Drainage Authority for the hydrological functions, and the INPA because of the high impact of the pumping on the quality of the water and the amount of freshwater flowing into the reserve.
- The decrease in water quality is considered particularly relevant for the INPA due to the key role of water quality in the functioning of the reserve and ecosystems. It is also important to a certain extent

for the kibbutz and the Water Association that uses the water for irrigation. However, the Drainage Authority is independent of water quality for its operations.

- Low fish and crop yield are relevant mainly to the kibbutz that profits from the fishery and operates it and to the local population, which consumes local products.
- Damage from flooding – damage from flooding causes damage to agriculture, infrastructure, and pumping capacity relevant to the Kibbutz and the Water Association operations. Last winter, the western dam was breached twice, which is typical. Increasing flood frequencies due to climate change may affect the number of times the dam is breached. This is particularly relevant to the Drainage Authority, whose main function is dealing with the risk of floods. For INPA, the relevance is mainly reflected in the effect on the water regime, as flooding affects seasonal water level, water quantity, and quality and increases stream-estuary connectivity. At the same time, the Kibbutz's people are unaffected.
- Loss of biodiversity– This is relevant only to the INPA. Since 1980, Nahal Dalia's Biodiversity (BDV) has been increasingly degraded. Many species have been lost from this habitat, e.g,.: *Unio terminalis delicatus* and *Myriophyllum spicatum*. The main causes for BDV loss are the impact of water regime alterations and limited connectivity due to the stream dams, followed by water pollution caused by adjacent fishery effluents discharged into the nature reserve.
- Loss of economic development – The Kibbutz owns the land and is the main beneficiary of economic development. The Drainage Authority is also involved in economic development as it has the power to act for nature conservation, as defined in the Drainage Law. The authority can raise capital for economic development, such as roads and viewpoints.
- Development pressure – Future development plans in the area conflict with environmental and drainage considerations. Thus, it is only relevant to the INPA due to the potential damage it can cause to the ecosystem and the increased drainage requirements that will need to be handled by the Drainage Authority.
- State ownership over property - According to the regulations of the Israel Land Authority, for the kibbutz to be able to continue to own the land, it must continue to maintain agriculture. This problem is significant only for the kibbutz.

The pilot Core Team and their stakeholders were requested to assess the **relevance of the improved ESS and Biodiversity** for contributing to solve the above-listed problems. The following considerations have emerged, including the additional of other ESS contributions such as flood water for irrigation and tourism:

- Food provisioning (FP) - The kibbutz are the owners of the fishery; thus, FP is their concern.
- Climate Change Regulation (CCR) - In terms of carbon storage, the kibbutz is interested in the issue as a possibility for future income and INPA as an economic lever to limit fishery activity.
- Water Purification (WP) – Very relevant for INPA because better water quality in the reserve will improve the ecosystem function in several ways. It is also relevant for the kibbutz because they circulate the water from the fishponds in the reserve. Better WQ in the reserve means better water circulation for the fishponds.
- Reduction of flood risk (RFC) – When referring to this issue, we are relating to flooding risk upstream. This is relevant for INPA because this issue influences the water regime and finding solutions that fit stakeholders' needs, though there is no direct impact on INPA’s work. It is relevant to the kibbutz that sometimes deals with flood damage to the fishery’s infrastructure, and relevant to the Drainage Authority, which bears responsibility for flood damage by virtue of its role.
- Biodiversity (BDV) – This has large relevance to INPA, which promotes environmental values and nature conservation. Indirectly relevant to the kibbutz since BDV contributes to both tourism values and water quality in the fishery.

- Flood water for irrigation (FWA) - Very relevant to the kibbutz and water association that uses flood water for irrigation. It is also relevant for INPA to manage the reserve's water regime and improve its water quality.
- Eco-Tourism – This is very relevant for the INPA since involving the public and local tourism will contribute to sustaining the project over time. Relevant for the kibbutz that supports tourism as another income for the kibbutz. Eco-tourism will have to be customized to the peculiarity of the pilot area, assuming a low negative environmental impact for Nahal Dalia.

Following the description of the problems identified and the contribution that NbS restoration can provide to solve them by improving ESS and biodiversity, the following table summarises the four types of environmental, economic, social and cultural **benefits** provided by each type of NbS restoration intervention.

**Table 44 Types of environmental, economic, social, and cultural benefits provided by each type of NbS restoration interventions.**

| **ESS, BdV** | **ESS /BdV output level** | **Benefits** | | | |
|---|---|---|---|---|---|
| | | **Environmental** | **Economic** | **Social** | **Cultural** |
| NbS #1 - Dams Removal & Replacement by Weir | | | | | |
| RFR (Reduction of Flood Risk) | Decrease in probability of a flood occurring. | - | Annual costs saved for infrastructure repair. | - | - |
| WP (Water Purification) | Major Ions<br>Chlorophyll<br>Algae composition<br>NDSI Soil index. | Allowing outlet for sediments and decrease in organic matter accumulation on the bed. | Lower cost of fish effluent treatment. | - | - |
| FP (Food Provisioning) | kg of fish production (due to reduction of fish mortality). | | Better fish quantity and quality for the market. | - | Maintaining the local improved aquaculture heritage. |
| BDV | Indices of increased BDV, such as the Shannon-Weiner Index and Simpson's Diversity Index. | Increase in BDV by improving connectivity between river and estuary.<br>Increase in BDV. | - | Educational opportunity to learn about species in the ecosystem. | Human-nature experience. |
| NbS #2 - Dynamic Dam Relocation Upstream | | | | | |
| RFF (Reduction of Flood Risk) | The decrease in the probability of a flood. | - | Annual costs saved for infrastructure repair. | - | - |
| WP (Water Purification) | Major Ions<br>Chlorophyll<br>Algae composition | Allowing outlet for sediments. | Lower cost of fish effluent treatment. | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | NDSI index. | | | | |
| FP (Food Provisioning) | kg of fish catch (due to reduction of fish mortality). | Improvement in biodiversity. | Better fish quantity and quality for market<br>Wild Species | - | Maintaining the local improved aquaculture heritage. |
| BDV | Observation of species movement up and down the stream.<br>Increase in BDV (Shannon, ASPT) | Increase in BDV by improving connectivity between river and estuary.<br>Increase in BDV.<br>Opportunity for adaptation of species. | - | Educational opportunity to learn about species in the ecosystem. | Human-nature experience. |
| NbS #3 - Rewilding of Fishponds | | | | | |
| WP (Water Purification) | Major Ions<br>Chlorophyll<br>Algae composition<br>NDSI index. | Enable the return of pollution-sensitive species.<br>A new habitat - a thicket within the wetlands. | - | | Human-Nature experience. |
| CCR (Climate Change Regulations) | Carbon sequestration measurements<br>Above-ground biomass, Soil organic carbon (SOC). | Reduction of CO2 emission. | Carbon credit market. | Opportunity fo professionals to learn about aquaculture - nature reserve dynamics. | - |
| BDV | BDV indices | New habitats.<br>Wild fishponds will create a buffer between human activity and the reserve.<br>Return of species due to better water quality. | Additional maintenance costs | Educational opportunity | ALQ (aesthetic landscape quality) |
| NbS #4 - Flood water Reservoir (includes natural elements) | | | | | |
| WP (Water Purification) | Major Ions<br>Chlorophyll<br>Algae composition<br>NDSI index. | Instead of discharging fish effluents into the reserve, they can be discharged into the reservoir, improving the reserve's water quality. | Saves purification costs | - | Maintain heritage landscapes |

| | | | | | |
|---|---|---|---|---|---|
| FP (Food Provisioning) | Tons of crops per year. Reduces water pumping | Less pressure on the natural water regime. | Saves costs of flood water pumping. Better water quality for agriculture. | Safer and higher food quality. | |
| (Fresh) Water availability | Residual flow to the estuary. | Additional habitats for birds. | Maximizing flood water catchment. | Indirect benefits in food consumption. | - |
| NbS #5 - Habitat Heterogeneity | | | | | |
| WP (Water Purification) | Physio and chemical parameters. | Permanent flow to the estuary. | - | - | - |
| BDV | BDV indices. | Additional ecological niches. Variety of habitats. | Additional maintenance costs | - | Biocultural diversity |

The project deals with the tension between nature conservation values and the commercial and operational needs of the fishery. The NbS intervention, apart from their first goal of ecological restoration of the Nahal Dalia, also refer to this tension by providing solutions that will meet the needs of the fishery without harming its function, to harness the stakeholders to promote the restoration interventions. Therefore, ESS related to the interventions support each other to enable transformations mainly in the fields of economics (which refer to the operation of the fishery and maintenance of the interventions) and promoting biodiversity.

For example, NbS #4 Flood water reservoir (indicated in the table above), which will include natural elements (as mentioned in WP4/T4.2), supports ESS WP and freshwater availability, which have environmental and economic benefits.

The ESS also has secondary social and cultural benefits, which enrich the NbS intervention. Combining all NbS interventions will provide long-term benefits for the ecosystem, economic development, and society.

The most important, or primary value proposition of the NbS restoration intervention refers to biodiversity that is mainly driven by NbS #1 + NbS #2 + NbS #3 + NbS #5.

The secondary (co-benefits) value proposition of the NbS restoration interventions refers to water purification is driven by all NbS restoration interventions. WP has consequences for the ecosystem function and the functioning of the fishery.

The economic benefits associated with the five main ES and Biodiversity can be described in terms of economic goods and can be classified according to the feasibility of their exclusion and rivalry, as indicated in Table 43.

**Table 45 Overview of the ESS delivered (E- Excludable; R – Rival; NE – Non- Excludable; NR- Non-rival)**

| ESS/BdV | E- Excludable; R – Rival |
|---|---|
| Food Provisioning [FP] | E +R |
| Climate Change Regulation [CCR] | NE + NR |
| Water Quality Purification [WP] | NE + NR |
| Reduction of coastal erosion risk [RCE] | NE + NR |
| Reduction of coastal flooding risk [RFR] (upstream) | NE + NR |
| Biodiversity [BdV] | NE + NR |
| (Fresh) Water availability (FWA) | E +R |
| Eco-Tourism [TOU] | E + NR |

### Market analysis (demand and supply) and legal requirements

The main sectors of the market demand that will be relevant for generating potential revenues are represented by:

**Eco-tourism (including bird watching, cycling, and hiking)**. Based on similar wetlands like Agamon Ha'hula and Agamon Hefer, the potential number of visitors is 500,000 annually. However, due to the smaller capacity of the Difle Wetland, we have revised this potential to be 50,000 visitors per year.

**Educational activities on nature restoration**. A similar activity takes place in Ma'agan Michael's bird-watching park. The park offers study tours on aquaculture, primarily for elementary school pupils. Additionally, the park is exclusively open to photographers. The estimated annual number of visitors is 5,000, with an expected increase to 10,000. The demand for this activity is part of the demand for eco-tourism.

### Value creation & delivery

This section describes how INPA (the initiator) will engage other implementers, through which management strategy, procurement/contractual arrangements and business strategy in order to achieve the NbS restoration objectives and perform the restoration interventions proposed in the business plan.

The **initiator** of the restoration interventions is the Israel Natural Parks Authority (INPA), whose mandate is to preserve natural reserves in the country with a specific focus on wetlands. INPA is responsible for designing, planning, implementing and monitoring a set of five main restoration interventions, collaborating with several implementers, and in particular:

Drainage Authority + INPA for dam removal\relocation

Maayan Zvi + INPA + SPNI for fishponds rewilding

Maayan Zvi + INPA for flood Water Reservoir

INPA for habitat heterogeneity

The **main NbS interventions** are described below:

NbS #1. Dynamic Dam Relocation Upstream – There are two existing dams in the Northern Difle that hold the water levels in the reserve: the Eastern dam, and the Western dam. The dams are used to maintain a water level of 1.7m in the reserve, which is used as an operational reservoir for the fishery's activities (circulation of fishponds discharge and water pumping to fill the fishponds). The dams contribute to sediments accumulating in the reserve, lack of seasonal water level fluctuations, and separation between the Dalia stream and the estuary. This NbS intervention aims to replace the existing dams with dynamic dams and examines alternatives for the dams' locations. Relocating the dam upstream will reduce the water body area in the Difle Reserve, which serves as an operational reservoir for the fishpond. This action, combined with the construction of the dynamic dam, will allow the flow of fresh floodwaters into the reserve, thereby improving the existing water quality. It provides a solution that enables the continued operation of the fishpond, although it will not completely eliminate its dependency on the Difle Reserve. However, the introduction of fresh floodwaters into the reserve is ecologically vital for habitat restoration.

NbS #2. Dams Removal & Replacement by Weir: This action will facilitate the free passage of floodwaters through the Difle Reserve and all the way to the sea. By replacing the dams with weirs at a height that allows floodwaters to pass during winter water levels, it will enable the free flow of fresh water and the purification of the water in the Difle Reserve. This also provides a solution that enables the continued operation of the fishpond, while still allowing the conditions for habitat restoration and hydraulic connectivity.

NbS#3. Rewilding of Fishponds - This project will transform fishponds into high-functioning wetland habitats, reducing their impact on the reserve. These wetlands can sequester significant amounts of atmospheric carbon for decades, thanks to their vegetation and soil conditions that promote biomass growth and slow decomposition. The project aims to sequester about 11 tons of carbon annually, enhancing biodiversity and optimizing carbon sinks. Shallow wetlands with submerged and bank vegetation are essential for addressing the climate crisis, offering both ecological and scenic benefits. Additionally, these ponds will provide an alternative for recirculating discharge water from the fishponds outside the reserve.

NbS #4. Flood Water Reservoir: Establishing deep water bodies as a winter reservoir with a capacity of approximately 500,000 cubic meters to capture floodwaters before they are lost to the sea. This initiative will reduce the fishpond management's reliance on nature reserves. The percolation of fishpond waters into the sandy ground will stop, increasing the area of habitats returned to nature. It will also decrease the need for summer pumping of water from Nahal Dalia's nature reserves for fishpond operations, thereby enhancing the ecological function, resilience, and robustness of these aquatic systems. The reservoir will be designed to include aquatic habitats along its banks and water surface.

It is worth nothing that NbS interventions #2 and #3 propose an approach to the overall management of the water resource in the Nahal Dalia estuary area as part of the adaptation to climate change and improving the interface between the fishery and the reserve. The plan is promoted by the Nature and Parks Authority in cooperation with many other entities, including Ma'ayan Zvi and Ma'agan Michael, the Carmel Drainage and Streams Authority, the Society for the Protection of Nature in Israel, and the Hof HaCarmel Regional Council.

NbS #5. Habitat Heterogeneity- The reserve's banks, engineered as steep and uniform embankments of the fishponds, lack structural complexity and natural characteristics, offering little ecological value. Our goal is to establish a functioning ecosystem through this NbS intervention by creating stable, vegetated banks suited to the water regime and gradient, fostering ideal conditions for plant growth. We will provide diverse habitats, such as Softshell turtle nesting areas and organic-rich muddy banks for shorebirds, enhancing biodiversity. Additionally, we will address seasonal water level fluctuations and expand the protective buffer between the fishing ponds and the ecological core. Since the banks are within the reserve's water body, INPA can proceed with restoration efforts without needing agreements with other stakeholders or landowners.

The NbS restoration interventions will be implemented according to business and management strategies carefully designed to guarantee the achievement of the restoration objectives defined in the business plan.

The project’s management structure is based on the local “Coastal Restoration Platforms”, named CORE-PLAs, created with the aim of engaging stakeholders in the co-design of hands- on restoration actions based on a common vision. For each intervention, individual work meetings are conducted with the relevant members or stakeholders of the CORE-PLAT to achieve arrangements and agreements promoting the implementation of the restoration interventions.

The INPA team will make the information available to the public to increase awareness. Additionally, the team will plan to connect and collaborate with other planners in the region to exchange knowledge and ideas. If there is a chance to incorporate an adjacent area, such as Dor's abandoned fishponds, that is not currently part of the plan, the team will investigate and pursue it. The pilot team will be responsible for seeking capital and funds to implement the project.

The **business strategy** will have to consider the type of benefits produced to multiple stakeholders, the type of economic good (public, private, common, club) associated the improved ESS and the possibility of diversification of income sources.

Concerning **stakeholders** and **beneficiaries**, in addition to the categories of stakeholders previously described the main beneficiaries who will directly benefit from or are impacted from the ESS flows include:

1. Kibbutz Maagan Michael-Dag’On: Ma'agan Michael Kibbutz, which manages the fishpond, relies on the water from the Difle Nature Reserve to operate the fishery. The proposed actions to improve water quality directly impact the water regime in the fishpond. Better water quality for Ma'agan Michael could potentially increase the fishponds' yield, impacting FP.

2. The public - The public benefits from ESS (ESS) in restoring Nahal Dalia and the Difle Reserve through improved water quality, reduced flood risks, and enhanced biodiversity. These efforts lead to cleaner water for consumption and agriculture, mitigate flooding damage, and support diverse plant and animal life. Additionally, restoration projects provide recreational opportunities, boost local economies through eco-tourism and increased agricultural productivity, and offer cultural and educational value by preserving natural spaces for learning and enjoyment.

An overview of the main stakeholders, beneficiaries and customers is provided by Table 46.

**Table 46 Overview of stakeholders, beneficiaries and potential customers**

| Stakeholders/Beneficiaries | Potential Customers | Type of demand |
|---|---|---|
| INPA | Public<br>Maayan Zvi | Restore the nature reserve to the public.<br>Water quality improvement for fish farms |
| Land Authority | Public | Open area for recreation |
| Drainage Authority | Public<br>Maayan Zvi | Reducing the cost of flood damage |
| Water Association | Farmers | water availability |
| Kibbutz Maayan Zvi | Kibbutz | Increasing fish yield |
| Fishing Park | Public (citizens)<br>Visitors and Tourists | Buying fish<br>Ecotourism |

Moreover, the business strategy shall combine a coherent set of measures/interventions (NbS package) taking into consideration the adaptation plan (WP4/T4.3). The presented NbS packages that form the strategies\alternatives below are now developed as part of WP4 and require further processing. However, they form the basis for the development of the alternative future restoration strategies, below mentioned:

Strategy 1: Mitigation - 50% of investment for WP + 50% investment for BDV driven by NbS #2+ NbS #5.

Strategy 2: Diversification of income sources - 60% of investment for WP+BDV+RFR driven by NbS #2+#3+#4+#5 + 40% of investment in FP+CCR driven by NbS #2+#3+#4.

Strategy 3: Ecological Upgrade - 33% of investment in RFR+33% of investment in WP+33% of investment in BDV driven by NbS #1+#3+#5.

Each of the five above-mentioned NbS restoration interventions is described in terms of its **main activities**, impacted area size, total project duration, phase duration (planning, implementation, and monitoring), and associated costs.

The detailed costs for each action are based on estimates from the project team and the planning team of the expected costs. This estimate relies on cost analysis from similar projects, the funding received, and the anticipated funding for advancing the restoration activities, as well as the costs of restoration activities that have already been carried out.

For all NbS interventions specified activities, initial monitoring was conducted within the process of hydrological and ecological analysis. Further monitoring, after implementation, will be conducted yearly according to a monitoring plan that will be developed by experts, considering also the ecological needs in site.

Additionally, the detailed description of all predicted actions within the NbS intervention, are based on estimates from the project team and the planning team (except from detailed activities of phase A of Habitat Heterogeneity, that was already implemented.

Activities planned for each NbS Intervention:

1. Dams Removal\Relocation Upstream - Western Dam

Activities: Hydrological and ecological analysis, initial planning alternatives, relocation/removal of the Western dam, and various technical and NbS interventions such as deconstruction of the old dam, deepening the water body, installing water valves and drainage pipes, constructing a new dynamic dam, sediment removal, bank stabilization, and installation of fish passages.

Duration and Cost: The total project duration is 9 months, with 5 months for planning and 4 months for implementing. Monitoring is conducted yearly. The planning cost is €19.704, implementing costs are €246.305.

2. Dams Removal\Relocation Upstream - Eastern Dam

Activities: Similar to the Western dam intervention, involving hydrological and ecological analysis, planning alternatives, and the same set of technical and NbS interventions.

Duration and Cost: The project also spans 9 months, divided into 5 months for planning and 4 months for implementation, with yearly monitoring. Costs are €25.616 for planning, €320.197 for implementation.

3. Flood Water Reservoir

Activities: Hydrological and ecological analysis, planning alternatives, installing pipes and pumps, excavation of pond bottoms, sealing works, bank restoration, vegetative restoration, creating aquatic habitats, and installing floating islands.

Duration and Cost: The project lasts for 9 months, with planning taking 5 months and implementation 4 months, alongside yearly monitoring. The costs are €29.567 for planning, €363.451 for implementation.

4. Rewilding of Fishponds

Activities: Hydrological and ecological analysis, planning alternatives, excavation and sealing of pond bottoms, pipes installation, creating structural complexity in banks, vegetative restoration, and installing floating islands.

Duration and Cost: This 9-month project allocates 5 months for planning and 4 months for implementation, with yearly monitoring. The planning cost is €41.379, implementation is €275.862.

5. Habitat Heterogeneity

Activities: Hydrological and ecological analysis, planning alternatives, various technical and NbS interventions like bank stabilization, vegetative restoration, and habitat creation.

Duration and Cost: This extensive project spans 18 months in total, with 15 months for planning and 3 months for implementation, accompanied by yearly monitoring. The planning cost is €343.354 for phase A and €343.618 for phase B, implementation costs are €1.714.286 for phase A and €1.356.113 for phase B, with monitoring costs of €184.729.

### Implementation arrangements

This section briefly illustrates the various procurement arrangements through which the initiators will engage several implementers in the execution of the NbS interventions and the key resources needed.

Different procurement arrangements are expected to be issued by INPA, as illustrated in the following table:

**Table 47 Overview of who carries responsibility and the type of procurement arrangements envisioned per NbS restoration interventions**

| NbS | NbS restoration interventions | Responsibility | Procurement Arrangements |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Dynamic Dam Relocation Upstream | Drainage Authority | Acquisition Lease contracts and governmental funding |
| 2 | Dams Removal & Replacement by Weir | Drainage Authority | Governmental funding |
| 3 | Rewilding of Fishponds | INPA & Maayan Zvi Kibbutz | Land lease by SPNI |
| 4 | Flood water Reservoir | Drainage Authority | Acquisition contracts |
| 5 | Habitat Heterogeneity | INPA | Land lease |

The **management structure** (involving initiator and implementers) allowing the implementation and maintenance of the listed NbS restoration interventions is based on the CORE-PLAT. For each intervention, meetings are conducted with the relevant members or stakeholders of the CORE-PLAT to achieve arrangements and agreements promoting the implementation of the restoration interventions.

In particular, the pilot team of Nahal Dalia, including INPA, AGMA and RUNI, will play a key role in the implementation and maintenance of the restoration interventions. The team will make key information on restoration available to the public to increase awareness. Additionally, the team will plan to connect and collaborate with other planners in the region to exchange knowledge and ideas. If there is a chance to incorporate an adjacent area, such as Dor's abandoned fishponds, that is not currently part of the plan, we will investigate and pursue it. Moreover, the pilot team will be responsible for seeking capital and funds to implement the restoration interventions.

Key **resources** for planning, implementing and monitoring NbS interventions include knowledge and technical expertise, which are important for understanding and applying best practices in restoration. Additionally, the availability of technical means and tools is necessary to carry out the interventions effectively. Another component is securing agreements from all stakeholders to promote the interventions, as collaboration is essential for the success of the project (i.e., Ma'ayan Tzvi and INPA). Given the complexity of reaching these agreements and managing the various partnerships involved, effective management tools are vital to the implementation process. Moreover, there is a need for external consulting to fill knowledge gaps, particularly in assessing the economic benefits and costs of each proposed solution for the landowners. The main monetary and non-monetary resources required for the proposed NbS interventions are described below:

- Knowledge/Technical expertise- To implement the upscaling restoration, the project team’s knowledge needs to be enriched. There is a need for in-depth study on estuary restoration and understanding the conditions required for a thriving habitat in the Nahal Dalia estuary. This includes engaging with professionals and research organizations in Israel. Additionally, the team needs to delve into the management of the interface between the fisheries and wetland habitats, examining case studies from Israel and consulting with other experts to propose feasible solutions for the Difle Reserve using various tools, including regulatory ones. These topics were raised by the project team, and workshops will be planned. Moreover, an experiment on sediment reuse and an aquatic plant trial are planned. The findings from these experiments, along with sharing them with the professional community, will assist in advancing upscaled restoration activities. These experiments are being promoted by the project team and are in the resource mobilization stage.
- Technical means and Tools, such as the sediment treatment experiment and the aquatic plant trial will explore additional techniques that are not currently used in the project. These restoration techniques, along with the integration of additional technological measures, will help optimize targeted restoration activities and implement new methods in the demonstration project.

- Agreements to promote interventions by all stakeholders - Currently, restoration activities are sometimes delayed due to disagreements among stakeholders. To advance the project, a new strategy for dialogue with stakeholders and compensation, if necessary, must be found. Communication and fostering agreements with stakeholders is a sensitive issue, and solutions to reach agreements are under continuous discussion.

Since reaching agreements with the stakeholders and managing all the partnerships in the project are complex processes, management tools are particularly significant for the implementation of the actions, in addition to the need for external consulting to receive the knowledge missing regarding the examination of the economic benefits and costs of each proposed solution for the landowners.

From a **regulation and governance** perspective the regulation framework is quite broad, including Nature's rights for water; Nature Reserves and National Parks law; Nature reserve regulations; Land Authority regulations; Terrestrial fishery's reform; Fishpond effluent quality standards; Drainage and Flood Protection Law. However, it shall be noted that a proper governance structure has not yet been established.

There is a broad consensus regarding the opening of the reserve to the public at the end of the restoration, but it is not yet clear to what extent and under what terms. However, the primary mode of communication with consumers will be through the website and social media. A different communication mechanism will be implemented with beneficiaries who are landowners or stakeholders through the establishment of a long-term reserve administration that will be responsible for direct dialogue when needed.

#### Value capture

This section briefly describes the direct versus indirect value capture (funding), identifying the potential/targeted grantors.

The two main direct value capture streams identified and capable to generate revenues are

- Eco-tourism and educational activities: With a yearly visitor capacity of 50.000 and an anticipated willingness to pay of €5, the potential annual revenue can amount to €250.000.
- Revenue from carbon credit due to carbon sequestration by fishponds rewilding.

The main potential **investors or funders** of the NbS restoration intervention are INPA, water budgets from the National Water Authority and The Fund for the Preservation of Open Areas. All these funding sources are governmental grants at the national level, provided by governmental authorities:

- Israel's Nature and Parks Authority - INPA is the governmental body responsible under Israeli law for the preservation of the country's natural and heritage values. It operates under the Ministry of Environmental Protection and manages nature reserves and national parks in Israel, enforcing nature conservation laws in open spaces. The authority is divided into four districts: North, Central, South, and Eilat. Nahal Dalia is located within the North district. The environmental unit of the authority implements projects and work plans in open areas, funding nature conservation and habitat restoration activities.
- Water Authority - One of the Water Authority's goals are to conserve and restore the country's natural water resources as a strategic asset, and to regulate the water sector, supervising suppliers and consumers through economic and administrative tools. The Nahal Dalia pilot offers solutions for water regime management in the Difle Nature Reserve, improving water quality for agricultural use. These solutions align with the Water Authority's interests, which fund similar activities. Therefore, it is a potential funding source.
- Open Areas Conservation Fund - The Open Areas Conservation Fund operates under the Israel Land Authority, providing various funding routes, including climate-related funding. Public authorities can

apply annually for funding, provided they meet the fund's criteria. The Nature and Parks Authority has received funding from the Open Areas Fund in the climate route for establishing a floodwater reservoir as part of the Nahal Dalia restoration project. This year, INPA submitted several additional projects through the climate fund route to promote further activities in the project and is currently awaiting the fund's response.

Usually, the authorities provide partial funding and there is a need to find Matching funds - funds that are set to be paid in proportion to funds available from other sources. Thus, it is necessary to find additional investors with similar interests to fund some of the activities.

In Nahal Dalia pilot, the potential investors are from the private sector and consist of the stakeholders that benefit from the restoration- Kibbutz Maayan Zvi and Kibbutz Maagan Michael. Private entrepreneurs in the fields of tourism can also potentially invest in the development of the area.

### Economic and financial projections

The business plan's economics is projected over a 5-year period, considering costs, cost reduction, and revenues as well as economic valuation methods for non-market services:

- **Opportunity costs** are the benefits or value forgone by choosing one alternative over another (Haghpour et al., 2022).
- **Avoided costs** are the economic value of the ecosystem benefits by estimating the costs that would arise if this ecosystem were no longer available. This approach reflects the additional expenses society would incur without these natural services (Joint Research Centre: Institute for Environment and Sustainability et al., 2015).

The implementation phase includes costs directly generated from carrying out the interventions:

**Dam removal & replacement by a weir or dynamic dam relocation upstream**. The existing dam is breached once every three years, resulting in €37.500 in damages (Ginzburg, Per. Comm.). Therefore, these interventions are equivalent to an annual avoided cost of €15.080 at a 10% discount rate.

1. **Floodwater reservoir**. This reservoir, which includes natural elements, is planned to replace fishponds. The reservoir will cover an area of 20 hectares and have a capacity of 250.000 cubic meters (cm). The floodwater reservoir entails three cost components:

The floodwater will be utilized for irrigation and aquaculture using a pumping system, which results in increasing electricity costs by €0,165 per cm (Shaham, Per. Comm.). Therefore, the electricity cost is expected to increase by €40.625 annually.

This pumping system also entails additional maintenance costs that we are currently unable to estimate.

Opportunity cost: the reservoir is involved in the loss of fish production, which amounts to a net income of €1.592 per hectare (Ministry of Agriculture and Food Security, 2023) and a total of €31.833 for 20 hectares annually.

Cost reduction: Ma’ayan Tzvi currently uses freshwater and runoffs for irrigation, costing €0,325 and €0,2 per cm, respectively. In addition, Difle’s water used for aquaculture costs €0,125 per cm. Therefore, the average cost of cm is €0,22 (Shaham, Per. Comm.), resulting in an overall annual saving of €55.000.

2. **Habitat Heterogeneity and Rewilding of Fishponds**. These interventions are expected to attract visitors for recreational and ecotourism activities, such as bird watching, cycling, and hiking. However, accommodating visitors involves management and maintenance costs, which we currently cannot quantify, and the question of who will bear these costs.

Currently, we have identified two potential sources of revenue:

Eco-tourism and educational activities: With a yearly visitor capacity of 50.000 (Auzan, Per. Comm.) and an anticipated willingness to pay €5 (entrance fee of Agamon HaHula), the potential annual revenue can amount to €250.000.

Revenue from carbon credit due to carbon sequestration by fishponds rewilding.

Table 48 summarizes the potential cost and revenue annually and over a 5-year period (discounted at 10% for the private sector, and 3% as a social discount rate):

**Table 48 Potential cost and revenues annually and over a 5-year period (discounted at 10% for the private sector, and 3% as a social discount rate)**

| NbS Interventions | Annual | 5-year |
|---|---|---|
| Avoided damage due to dam removal or relocation | €15.080 | €57.167 |
| Floodwater reservoir - increased electricity cost | €40.625 | €154.000 |
| Floodwater reservoir – loss of fish production | €31.833 | €120.670 |
| Floodwater reservoir- water cost reduction | €55.000 | €208.490 |
| Revenue of eco-tourism and educational activities | €250.000 | €1.144.930 |

### Financial instruments

Concerning the role the potential investors/funders can have in Nahal Dalia, to maintain the restoration interventions and preserve nature over time, they can act as:

Buyers of ESS, i.e. organizations which want to purchase (or rely on/benefit from) ESS for corporate goals, cost, risk or regulatory duty. Kibbutz Maayan Zvi and Kibbutz Maagan Michael can act as buyers of ESS, generating transactional payments;

Investors of capital, i.e. institutions like banks and funds, high net worth individuals or businesses seeking a monetary return. Repayable debt or equity investments, including short-term loans. However, at the current stage of the project, there are no expected funding or investors from this category;

Donors of fund, i.e. grant funders, public bodies, or entities acting with philanthropic purpose. The potential funders in this category are INPA, the National Water Authority and The Fund for the Preservation of Open Areas. All these funding sources are governmental grants at the national level, aiming to promote different aspects of nature conservation and restoration.

### Risk and contingency plan

This section defines risks and mitigation strategies for achieving the NbS restoration objectives.

**Table 49 Overview or risks and mitigation solutions.**

| NbS | Type of risk | Likelihood | Impact | Mitigation solution |
|---|---|---|---|---|
| Dynamic Dam Relocation Upstream | Water availability: Not enough flood water to provide for the fishery's needs due to climate change. The need for water exceeds the existing water volumes available. | Low | Low | Try a different alternative for the dam's locations or reconstruct dams in previous locations. |
| Dams Removal & Replacement by Weir | Salinization due to extreme weather events | Low | Medium | build a reservoir to allow enough flood water to provide for the fishery's needs. |
| Rewilding of Fishponds | Not enough volume to treat fishponds affluents. | Medium | High | Combine technologies to |

| | | | | |
|---|---|---|---|---|
| | Alternative treatment of effluent water in ponds instead of in the reserve is not effective. | | | purify effluent water more Effectively. |
| Flood water Reservoir | Water shortage: The need for water exceeds the water volumes available from winter floods in the reservoir.<br>Excess of water: The reservoir might be too small in X years to deal with the amounts of water.<br>Low income: Changes in tariffs, no longer be convenient growing fish. | Low | Medium | Increase size of reservoir |
| Habitat Heterogeneity | Failure of vegetation restoration - mai invasive species.<br>Vegetation restoration will be examin in 5 years.<br>One of the reasons for potential failur is a lack of success in managing water levels - banks that are exposed too lat or too early, thus can't stabilize natura riparian vegetation. | Medium | Low | Switch to dam relocation or construction of dynamic dam to fix water levels.<br>Instead of natural establishment of species, selection of species for planting and close monitoring including treatment of unwanted species |

#### 10.3.5. Critical funding and financing challenges

Concerning financial challenges, Fausto & Hinkel (2023) have previously identified three main financial mechanisms to be considered, including

**Tourism user fees.** This is confirmed in the business plan developed for extension #1. The mechanisms should address the financial barrier of (Long) time lag for impact. For this, the transfer enablers are: Water quality and biodiversity ESS produced; Beneficiary identified; and Pre-existing hospitality facility. The transfer barrier is Social acceptance

**Carbon credits.** The Nahal Dalia Pilot is currently considering the possibility of generating and selling carbon credits through ecosystem restoration. With the removal of the dam and the re-establishment of hydrologic connectivity, the construction of an alternative, artificial water reservoir will be required to sustain the operations of the contiguous fishponds. In order to enhance carbon sequestration, the NbS initiator is considering the plantation of reeds within the planned artificial water reservoir. However, the ecological team at INPA has not progressed with carbon sequestration modelling or assessment so far in order to monetize this ES.

The mechanisms should address the financial barrier of Low excludability. For this, the transfer enablers are: Stated interest from key stakeholders and Planned activities to enhance ESS. The transfer barrier are: Climate mitigation ESS not yet produced nor quantified; Financial service provider (carbon standard) not identified yet; Potential insufficient ESS output; and High transaction costs

**Project bundling.** Other initiatives beyond the Nahal Dalia restoration interventions are currently planned for implementing coastal restoration techniques and putting efforts into experimenting with financial approaches and business models. Shared research goals and geographical scope suggest that synergies among the different projects should be explored, with regards to the possibility of aggregating the different initiatives as a bundled investment proposal. The mechanisms should address the financial barriers of Uncertain ESS performance, ticket size mismatches. For this, the transfer enablers are: Presence of several restoration projects in the area; Homogeneity among restoration initiatives. The transfer barriers are: Provider of financial services (bundling intermediary) not identified yet; lack of revenue generation.

## 10.4. Extension 2: Financial scalability plan

### 10.4.1. Introduction: What does upscaling mean to the pilot

Upscaling for NbS interventions refers to the process of expanding successful NbS practices implemented in the pilot to a broader scale within the pilot's boundaries, adjacent areas outside the boundaries of the pilot or regional applications. It involves addressing environmental, social, and economic challenges at a larger scale from a geographic point of view, or in terms of project management and collaborations with other projects at the regional level. Overall, upscaling NbS interventions aims to achieve greater environmental and socio-economic impact

The main activities that are that are included in this approach are an considered under upscaling efforts are:

1. Rewilding of one fishpond – Conversion of fishponds to wetlands, which will be used to treat the fishery's water effluents and improve its quality. The first phase would be to rewild approximately 100 dunams of fishponds. The temporal horizon of reference to see effectiveness is 5 years. Upscaling plan targets similar ecologic units of 150 ha and considers rewilding of additional fishponds. The restoration status is envisaged and examined theoretically.

2. The Nature and Parks Authority aims to promote a statutory solution that includes the statutory declaration of the estuary and the declaration of the coastal lagoon as a nature reserve. Subsequently, it is proposed to create hydrological connectivity between the estuary and the coastal lagoons to enrich and protect these wetland habitats and to expand the estuary's area.

3. Co-director for projects in the area - Expanding stakeholder involvement from project-oriented involvement to regional perspective. This involves integrating various restoration and management initiatives within the Carmel Coast area to create a shared management body. This includes the restoration project of the Kabara marshlands, and later the cooperation with the Carmel Coast Park master plan team. A process to create a shred management structure with the Kabara restoration project is being initiated these days. This will contribute to Knowledge Sharing and to create financial mechanisms to support long-term restoration and conservation.

### 10.4.2. Overview of barriers preventing upscaling

There are upscaling actions that are making progress, such as the establishment of the joint management authority. The main factors hindering upscaling efforts are related to the limited authority of the Israel Nature and Parks Authority, which is restricted to the boundaries of the water bodies. Factors related to the adaptation pathway evaluation (WP4).

### 10.4.3. Financial strategies for upscaling

Creating a shared management problem with a financial framework involving all actors could help overcome financial barriers and barriers related to reaching agreements with relevant stakeholders and landowners.

# Chapter 11. Rhone Delta Pilot

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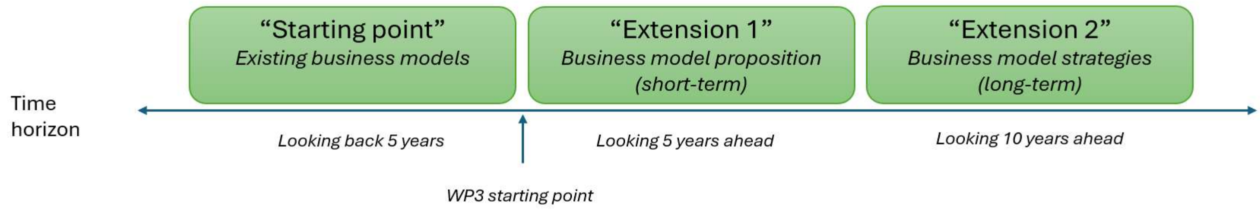
**Readers guide**




**12.1 Introduction**

- **This section provides a general introduction to the Camargue area/Rhone delta case**

**12.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - Coastal restoration of former salt works area into climate buffer area.

**12.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Apply lessons learned of the REST Coast project to different area in Camargue with the ADAPTO+ project. The goal is to create additional climate buffer area by a chosen strategy in order to reduce coastal flooding and erosion.

**12.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Intensification of portfolio of NBS measures in Camargue area

## 11.1. Introduction to the Pilot

The Rhone Delta Pilot is located in the Camargue, south of the city of Arles in southern France, and covers an area of over 930 km$^2$, making it the largest river delta of Western Europe. The River Rhône deposits around 20 million cubic meters of silt into the Camargue delta. Consequently, the coastline of the Camargue undergoes continuous alterations, gradually extending into the Mediterranean Sea (Bravard & Gaydou, 2015). The Camargue serves as an important biodiversity habitat for bird populations including flamingos, herons and various waterfowl species, due to its unique ecosystem and geographical features (Fraixedas et al., 2019). Currently, water resources are under pressure due to the threat of decreasing freshwater input from the Rhône, caused by hotter summers and disappearing alpine glaciers, as well as sea level rise. Sea level rise is projected to significantly decrease the length of beaches or result in the disappearance of certain beach areas (Brunel & Sabatier, 2009).

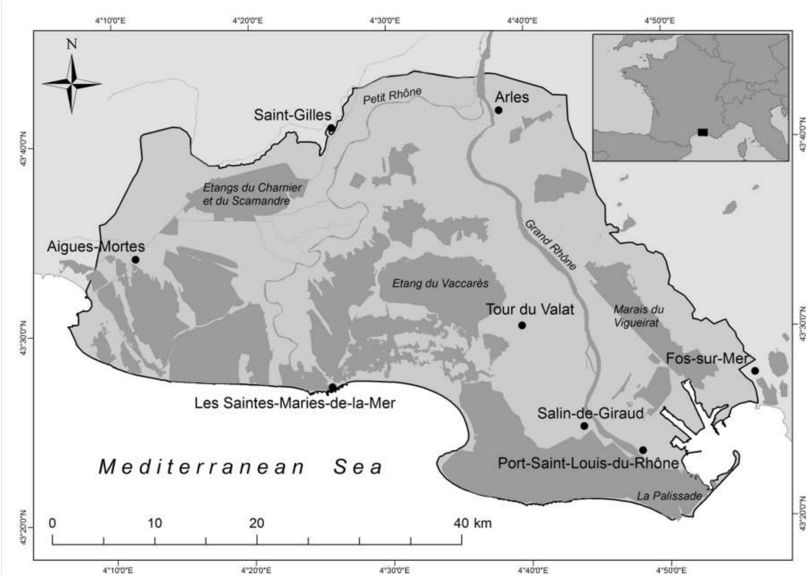



**Figure 68 Camargue area (Leroux & Majd, 2019)**

The Camargue is home to a population of approximately 100.000 inhabitants. With 50.000 people inhabiting the main town of Arles, while the remaining inhabitants reside in adjacent areas such as Port-Saint-Louis-du-Rhône, Saint-Gilles, and Les Saintes-Maries-de-la-Mer. The main economic sectors of the Camargue are rice cultivation, breeding of bulls and horses, tourism, fisheries and salt production. Rice production is one of the most important agricultural crops of the Camargue area with over 11,800 hectares, yielding around 70,000 tons of rice creating nearly 2,000 direct and indirect employment opportunities (Gauvrit, 2019) The Camargue Region produces 75% of all rice produced in France. Both rice growers and grape farmers are affected by climate change. According to a local grape growers' association (the Syndicat de Défense et de Promotion des Vins des Sables de Camargue), in 2021, 600 of the 3,000 cultivated hectares were affected. In 2022, the damage was assessed to 40% of the vines (Beaudouin, 2022).

The Camargue region attracts around 1 million visitors annually, providing income and employment for many stakeholders within the area. The seaside and Camargue national park that provide habitat to flamingos and semi-wild horses make it an attractive nature tourism destination. The area has a long history of water management, significantly changing the landscape by draining large parts of the outer area for agricultural purposes (Mathevet et al., 2015). This transformation involved constructing dikes, cultivating rice paddies, and creating salt pans. The region is a global leader in salt production and has become a major activity in the Camargue, mainly driven by the growing chemical industry. The former salt mine that constitutes the REST-COAST pilot area was no longer profitable due to the increasing costs of water management, such as the maintenance of dikes and the use of hydraulic pumps caused by sea level rise.

## 11.2. Starting point: Current Business Model

The former saltworks site, covering 6,527 hectares in the southeastern Rhone delta, was obtained by the Conservatoire du Littoral (French Coastal Protection Agency) between 2008 and 2012. These purchases were made with the help of the State, the Rhône-Mediterranean-Corsica Water Agency, the European Union (FEDER), the Provence-Alpes-Côte d'Azur Region, and the Bouches-du-Rhône Department. For nearly 50 years, this area was used for industrial salt production until it was sold in 2008 for industrial and economic reasons, including the challenges posed by rising sea levels. The area was initially an industrial salt production location, without any restoration activity the area would be prone to high salinity levels and low water levels due to high evaporation, causing environmental degradation. The high salinity is a remnant since dikes were built in the 1950s to 1970s and converted the areas into salt pans. These modifications transformed some of the lagoons into a hyper-saline ecosystem. After the acquisition, the Conservatoire du Littoral introduced a new management approach with a focus to regulate hydro salinity and restore natural seasonal variation typical of the Mediterranean. The goal is to restore around 300 hectares of coastal lagoons and 60 hectares of Mediterranean scrubs.

Since most of the area (i.e., around 70%) is situated at an altitude of less than 1m above sea level, the territory is exposed to a high risk of flooding. The construction of dikes led to drastically reduced sediment inputs from both the Rhône River and the Mediterranean Sea which had considerable effects on dune formation, erosion and water distribution, in fact *increasing* the vulnerability of the area to flooding (Segura, 2018).

Since 2010, a new strategy has been implemented: the sea dikes that once protected the salt production area are no longer maintained. Instead, the focus has shifted to preserving a dike located about 7 km inland, creating a 4,600-hectare "climate change buffer area" between the old sea dikes and the inland dike and reducing maintenance costs of the dikes significantly. The Conservatoire du Littoral have outsourced the management of the site to three regional organizations: Camargue Regional Natural Park (PNRC), the National Society for the Protection of Nature (SNPN) and Tour du Valat (TdV), who is the initiator of the REST-Coast project. Tour du Valat is a private research institute focussing on the conservation of wetlands and are responsible for multiple restoration efforts in the Camargue area. They also own land in the area which covers a total area of 2,918 ha in two different geographical areas located in the Camargue: 1) The Tour du Valat Estate itself, near the village of Le Sambuc, covering 2,817 ha, including 1,845 ha listed as a regional nature reserve, 1,073 ha of agricultural parcels and buildings, the Verdier marshes, the Petit Badon Estate, and the Commanderie dunes (see map below). 2) The Petit Saint-Jean Estate, situated in the part of the Camargue located in the Gard Department, covering 101 ha, and is about 30 kilometres further west, near the town of Saint-Laurent-d'Aigouze.

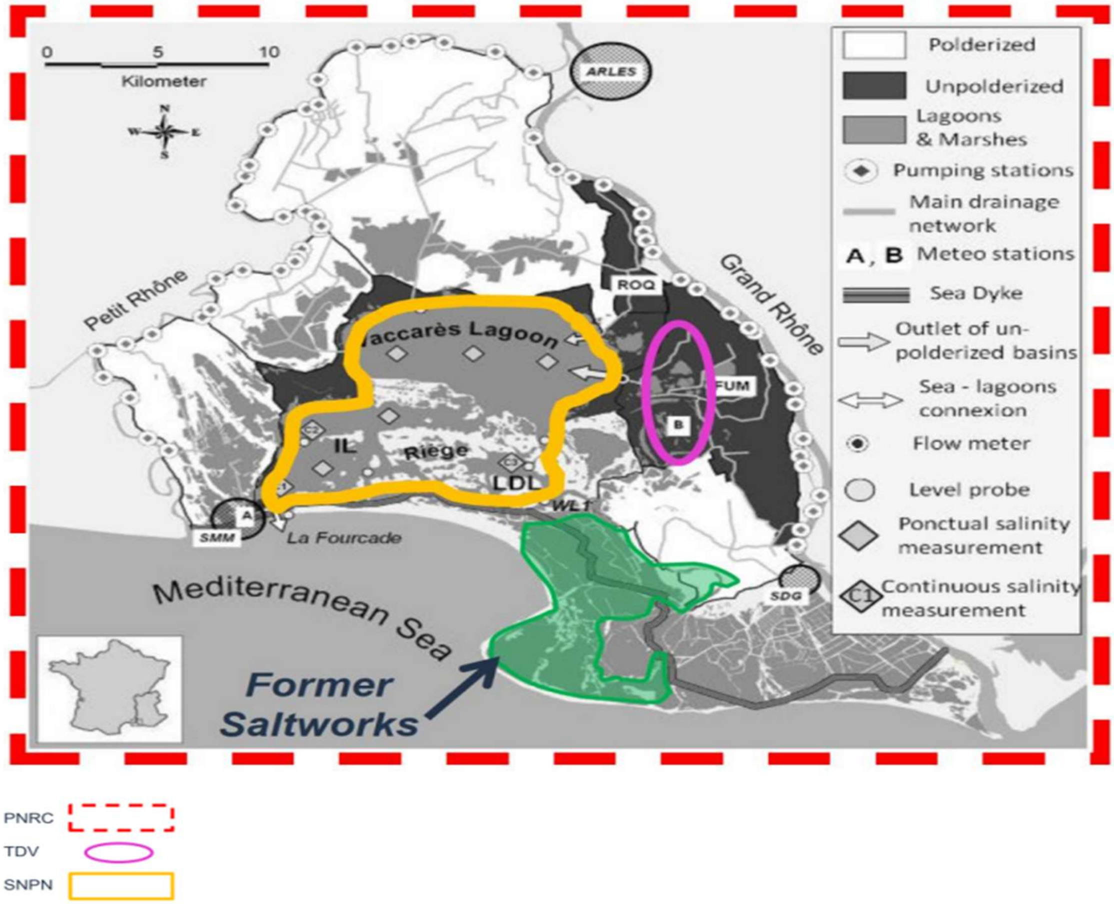



**Figure 69 Map of the Rhone Delta Pilot Site and spatial competencies of the three managing entities Camargue Regional Natural Park (PNRC) - dotted line; National Society for the Protection of Nature (SNPN) – Lagoon area; Tour du Valat (TDV) – round ellipse (Boutron, 2023)**

### 11.2.1. Coastal restoration activities

The strategy of the area from 2010 onwards involved various interventions, such as opening dikes and dredging to establish new connections between the former salt production basins. Additionally, hydraulic engineering has reconnected the site to a nearby agricultural catchment, which is fed by freshwater from the Rhone River, enabling new freshwater inflows into the area. As part of the REST-COAST initiative, the goal is to restore 300 hectares of coastal lagoons and 60 hectares of Mediterranean halophilous scrubs, including Salicornia and other plants that benefit due to the restoration of the area. This will be done by not maintaining the outer dike, opening several dikes and dredging in order to connect the former salt works with the Vaccares lagoon (see yellow Figure 69).

The discontinuation of maintenance of the historic sea dikes and the restoration of natural coastal dynamics are expected to lead to the formation of new beach areas in the southern part of the site through overwash processes as depicted in Figure 70 below. Due to the shifted focus on the inland dike (7 km), a buffer area of around 4,600 has been created. The wave energy is reduced, causing a reduction of pressure on the inland dike upstream and reducing the risk of coastal flooding and coastal erosion. Furthermore, the increased water renewal frequency will result in a reduction of high salinity levels which can reduce environmental degradation and can have a positive impact on local biodiversity.

**Figure 70 New beach area due to overwash process due to non-maintenance of outer dike (Willm & Béchet, 2023)**

#### 11.2.2. ESS and Economic good typology

The main ESS targeted by Tour du Valat are reduction of coastal erosion, reduction of coastal flooding and water quality improvement (Boutron, 2023). A complete overview of the ESS affected by the restoration activity are shown in Figure 71.

Regulating and cultural ESS like carbon sequestration and water purification, are generally public goods due to their low excludability. Fishing is excludable since Conservoitoire du Literal is owner of the area, and the area is not publicly accessible. This is also the case for outdoors activities that are of high value and prevalent in the Camargue area such as kite surfing and tourism. To create value for stakeholders within the local area and increase support, exploring options of assigning a certain amount of the area to these activities can help capture value and increase stakeholder support in the future.

| | | **Rivalry in consumption**<br>High | <br>Low |
|---|---|---|---|
| **Excludability** | High | *Private* | *Club*<br>(6) Outdoor activities<br>(7) Intellectual interactions |
| | Low | *(1) Fish population*<br>*CPR* | (2) Water quality improvements<br>(3) Erosion control<br>(4) Flood risk control<br>(5) Carbon sequestration<br>(8) Habitat protection<br>(9) Geodiversity<br>*Public* |

Descriptions

*(1) The restoration of coastal lagoons and reduction in salinity rates can increase the (edible) fish population such as Angling Seabass which are found in coastal lagoons, estuaries and their associated habitats. (Hunting Office, fishermen are currently involved in management committees related to the site).*

*(2) The area has experienced high salinities in the past. Due to an increase in water renewal times the salinity level is expected to decrease.*

*(3) The increase in vegetation of scrubs and other colonization of plants restore the mud and sand. These habitats have a stabilizing effect that results in the reduction of coastal erosion.*

*(4) The southern area of the restoration project will provide a buffer area to the inland dike (7 km inland). This can reduce the impact of storms and waves during extreme events.*

*(5) Carbon is captured by coastal vegetation such as Mediterranean halophilous scrubs, Salicornia and Seagrass (Zosteranoltei, Ruppia cirrhosa).*

*(6 ) Natural scenery attractive for recreation and tourism such as kite surfing, hiking, boating, excursions, birdwatching, canoeing, stand-up paddling and recreational fishing. (**Kite surfing schools and tourist office** involved in different management committees related to the sites) (incl. hiking, swimming, surfing and bird watching, value currently low since area not accessible)*

*(7) Scientific research/knowledge development on coastal ecosystem restoration*

| |
|---|
| *(8) Improved water quality and vegetation can improve habitat* |
| *(9) Promotion of coastal geodiversity* |

**Figure 71 Changes in ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification**

#### 11.2.3. Funding: granting

Tour du Valat is the main initiator of the REST-COAST project and several restoration activities within the Camargue area. Because of its unique large share of private funding this subchapter will look closer at the funding structure of the organization to understand financial strategies, opportunities and challenges.

Tour du Valat benefits from diverse funding, comprising both private and public sources. The Tour de Valat is currently to 46% funded by revenues from a stock portfolio (ProValat Foundation). In addition, 25% comes from public sources, 8% from the estate incomes and 20% of the revenues comes from various private partners.

This rich private funding base has its origins in the founding of Tour de Valat by Dr. Luc Hoffmann. He was a Swiss ornithologist, conservationist, and philanthropist who also co-founded the World Wildlife Fund (WWF), helped establish the Ramsar Convention for the protection of wetlands. From 2003 to 2022 the MAVA Foundation was funding approximately 50% of the internal budget of Tour du Valat originating from funds from the pharmaceuticals company La Roche, where Hoffman's family is the majority shareholder. As part of their closing strategy, the MAVA Foundation reinvested a large percentage of money into the ProValat Foundation, which maintains a stock portfolio. The returns of this foundation can be used in the future as part of the running cost of Tour du Valat. However, the returns are dependent on the stock market and therefore can be unreliable in years when returns are low. The goal of the ProValat foundation is to maintain its capital over a long period of time (30-50 years).

In addition to the foundation funds, there is also other private funding, which is part of a deliberate strategy. As the MAVA Foundation's work neared its planned conclusion, there was initial stress due to uncertainty about future funding. In response, MAVA started diversifying their funding sources five years before the end of their foundation's timeline. This proactive approach resulted in a large amount of new funding opportunities that came largely through the MAVA Foundation's established connections, including those with the Hoffmann family and other existing relationships. They successfully attracted several funders who provided flexible funds including contributions towards overhead costs or long-term monitoring. In addition, they received funding designated for specific purposes such as restoration and research. The funding generally covers a five-year term, with the hope of renewal. Some of the new funders include the Rolex Foundation, private hunting foundations, and the Coca-Cola Foundation. Therefore, Tour du Valat does not experience funding as a constraint. In fact, a point has been reached where they occasionally decline potential funders due to limited capacity to expand their activities further. Thus, governance and other feasibility issues are becoming more significant bottlenecks than funding itself for their restoration work.

The initial connection with the private partners came via established connections from past work and from the Hoffman family connections. The approach is also maintained by the strategic plan of Tour du Valat and the hiring of a director for partnership, communication and advocacy. The partnership requires the engagement of the researchers for logistics and relationship building. For example, visits on-site, organizing seminars, facilitating meetings on-site and lodging. This is a way of engaging and providing additional value to private funders, presenting results and continuing the relationship and trust building.

Additionally, Tour Du Valat obtains grants through regional, national and supranational (European) projects to support its restoration efforts through initiatives like REST-COAST and WaterLANDS. This adds to maintaining a diversified funding structure which reduces exposure to certain budget cuts, which makes restoration efforts robust. The funding from the local government is low, the main public funding from Provence Alpes Cote d'Azur Region and the Coastal Protection agency have generally been stable.

### 11.2.4. Funding: value capture

The main value captured potential by the project is the reduction of maintenance costs of outer dike for French government organization SYMADREM (dyke management Rhone Delta, see Table 50. The difference in maintenance cost estimates from SYMADREM (the dike manager for the Rhône Delta), and additional cost estimates by CEREMA (National State Engineering), shown in Table 50 indicate a significantly lower cost for the inland dike maintenance. However, at present, the value created by this does not flow back into the restoration or maintenance of the area. The inland dike maintained is assumed to be the same length as the sea dike, this can differ based upon location and scope.

**Table 50 Overview maintenance costs sea dike and inland dike Rhone Delta.**

| | Sea dike (7km) | Inland dike (7km) |
|---|---|---|
| Maintenance costs per meter (SYMADREM) | €633 - €12.105 | €409 - €1.425 |
| Additional cost estimates per meter (CEREMA) | €2.800 | €420 - €3.100. |
| Total costs of dike maintenance (SYMADREM Estimate) | €4.431.000 – €84.735.000 | €582.825-€9.975.000 |
| Total costs of dike maintenance (CEREMA Estimate) | €19.600.000 | €2.940.000 – €21.700.000 |

Currently, food provisioning, water quality improvements, and tourism do not generate a direct value capture mechanism other than enhancing the natural environment within the area. Since the area is barely or not yet open to tourism or fishing activities, there is no existing value capture mechanism. However, these functions can provide significant value in the future and establish value capture mechanisms, as depicted in Table 51 below.

**Table 51 Funding contributions through value capture for the restoration project Rhone Delta.**

| Category | Funding type | | Actor |
|---|---|---|---|
| Reduction of risk | Reduction of both risk and maintenance costs of outer dike for French government particularly SYMADREM (dyke management Rhone Delta). Additionally, the climate buffer area will result in a reduction of cost in coastal erosion. | Taxes | Conservatoire du Littoral supported by Parc Naturel Régional de Camargue, the Société Nationale de Protection de la Nature, and Tour du Valat. |

### 11.2.5. Finance

Financial instruments, such as concessional loans, green bonds, or public loans, were not required. The resources within were made available from within existing budgets.

### 11.2.6. Procurement/implementation arrangements

The site of 6,527 hectares is obtained by the Conservatoire du Littoral, the French Coastal Protection Agency between 2008 and 2012. The area is managed by a partnership of three main organizations which are the Parc Naturel Régional de Camargue, the Société Nationale de Protection de la Nature (SNPN), and Tour du Valat. There are contracts in place with subcontractors for hydraulic works on the restoration site.

#### 11.2.7. Critical funding and financing challenges

The following challenges related to funding and financing are identified for both Tour du Valat and the restoration activity:

One of the main issues is the communication, support and engagement of local stakeholders. Because many of the local community worked at the former salt works, the restoration of the area is not perceived as positive and have communicated their discontent during public municipality meetings. Mainly since it is not creating any direct value towards the local community other than environmental restoration. Furthermore, the area was previously accessible for the workers at the saltworks for leisure activities and is no longer the case currently. This can impact future regional funding opportunities.

The former salt works are co-managed by Camargue Regional Natural Park (PNRC), the National Society for the Protection of Nature (SNPN) and Tour du Valat (TdV). The PNRC had a strong institutional role in the past but has decreased its involvement over the last years. This affects the activities of Tour du Valat since they invest extra themselves to invest in organizational activities within the area.

Even though Tour du Valat benefits from various private funding sources for philanthropic or CSR purposes, maintaining relationships with these private funders can be time intensive. The relationship is maintained through visits on site, organizing seminars, facilitating meetings on site and lodging. This is a way of showing results to private funders and creates trust. Additionally, this is also enabled by the strategic plan of Tour du Valat who hired a director for partnership, communication and advocacy. These activities require a strong time investment through human resources and logistics.

There is general discussion within the organization of the source of private funding and potential greenwashing. Partners that cause environmental degradation with their business activities can be frowned upon within the organization and create low support. A framework of selection for funding sources has to be created in order to deal with this issue in the future to create stability within the organization and funding structure.

### 11.3. Extension 1: Business model proposition and Business plan

#### 11.3.1. Executive Summary

The extension beyond the REST-Coast within the Camargue area has two key aspects. First, the continuation within the REST-COAST area involves monitoring relevant environmental data due to the new hydraulic connections. This will enhance knowledge development of the restoration works, facilitating further local projects and upscaling efforts.

The extended project, discussed in this chapter, focuses on the pilot site in the Camargue area, situated on the right bank of the Petit-Rhone in the commune of Saintes Maries de la Mer (see Figure 74). The project covers two areas: the Brasinvert site (448 ha), owned by the Conservatoire du Littoral, and several communal plots owned by the municipalities. Both areas are vulnerable to rising sea levels, storms, coastal erosion, and flooding due to the deterioration of old dikes and groynes near the coast. A feasibility study will be conducted, followed by a restoration activity (or natural evolution) aimed at creating a natural climate buffer area along the coast. This restoration effort is linked to a European-funded project proposal called ADAPTO+: Mainstreaming Soft Shoreline Management for Coastal Adaptation. ADAPTO+ is a national French project that includes various sites along the French coastline. Like REST-COAST, ADAPTO aims to provide nature-based solutions, develop methods to monitor their implementation, and systematize these approaches. Given the expected increase in storms and rising sea levels due to climate change, this project applies the insights and methods developed during the REST-COAST pilot to a new site in Camargue.

ADAPTO+ is part of the Program for the Environment and Climate Action (LIFE) and continues the work of the ADAPTO project, carried out from 2017 to 2022 by the Conservatoire du Littoral and the French

Geological Survey (BRGM). The project aims to develop a strategic tool focused on capacity building, an insight gained from the REST-Coast project. This tool includes both technical and financial assistance for new coastal restoration efforts, which can improve coastal management in France and Europe and support upscaling efforts. The consortium is led by the Conservatoire du Littoral and includes various organizations, including Tour du Valat. The business model canvas of this restoration activity is presented in Figure 72 Overview of business model canvas for Rhone Delta pilotbelow.

<table>
<tr><td>Value proposition</td><td>Problems addressed<br>-Carbon sequestration<br>-Water quality<br>-Flooding<br>-Coastal erosion<br>-Sea level rise<br>-Loss of biodiversity</td><td colspan="2">Benefits produced<br>-Environmental benefits Increased water quality; erosion control, flood control; Biodiversity improvement; Habitat provision<br>-Economic benefits Reduction of flood costs; reduction of erosion costs; Carbon sequestration; Reductions of maintenance costs; Ecotourism; Agricultural output<br>-Social benefits Safer life; Space of quality<br>-Cultural benefits Maintain use of beach area</td></tr>
<tr><td rowspan="3">Value creation</td><td>Key partners<br>Municipality Saintes-Maries-de-la-Mer<br>Regional dike agency (SYMADREM)<br>PNR de Camargue<br>Tour du Valat</td><td colspan="2">Regulation and Governance<br>There is a project monitoring committee in place for the site consisting of essential stakeholders who jointly create strategy of restoration site</td></tr>
<tr><td>Key resources<br>-Knowledge/Technical expertise<br>-Modelling tools<br>-Agreement of monitoring committee</td><td>Customer segments<br>Tourists</td><td>Stakeholders<br>17 stakeholders: 12 are governmental organizations, 5 organizations from the private sector.</td></tr>
<tr><td>Key activities<br>-Creating climate buffer area by free evolution, rock removal, or sand dune restoration</td><td>Customer relations and channels<br>-Creating communication strategy for local stakeholders<br>-Town hall meetings</td><td>Beneficiaries<br>-Municipalities<br>-Public authorities<br>-Citizens<br>-Tourists and visitors</td></tr>
<tr><td>Value capture</td><td>Costs<br>950.000 €</td><td>Revenue streams<br>- Reduction dike maintenance costs<br>- Eco-tourism (not yet estimated)</td><td>Financing and funding<br>Public funding, grants, private foundations</td></tr>
<tr><td>Transversal categories</td><td colspan="2">Impact indicators<br>- Regulating ESS indicators (Flooding, erosion control)<br>- Biodiversity indicators<br>- Water quality indicators<br>- Knowledge development (scientific publications)<br>- Revenues from eco-tourism</td><td>Risks<br>-Stakeholder support<br>-Failure of dune restoration<br>-Failure of acquiring funding</td></tr>
</table>

**Figure 72 Overview of business model canvas for Rhone Delta pilot**

### 11.3.2. Mission and Objectives of the restoration initiator

The pilot project in the Camargue area is located on the right bank of the Petit-Rhone, in the commune of Saintes Maries de la Mer (see Figure 73). This project is situated significantly east of the former salt work restoration project of REST-Coast. It consists of two main areas, both under public land ownership (red area in Figure 74).

- The first area is the Brasinvert site (448 ha), which is owned by the Conservatoire du Littoral, similar to the former salt works. This area is shown in purple in Figure 74 below.
- The second area is the communal plot of Saintes-Maries de la Mer, located on the west side in Figure 74. This includes areas known as Grand Radeau and Grande Rhee Longue, which fall under the forestry regime (orange area in the red square in Figure 74).


**Figure 73 Location of Saintes-Maries-de-la-Mer in the Camargue area. (Parc Naturel Régional de Camargue, 2023)**

Like the former saltworks the area is vulnerable to increased sea level rise and the increase of frequency and magnitude of extreme weather events such as storms. This can result in significant coastal erosion and coastal flooding in inhabited areas. Additionally, coastal flooding can result in a disruption of the hydraulic function by obstructing the flow towards the sea.

The old dikes and groynes along the sandy coast have not been maintained for several years and are gradually disintegrating. The coastal strategy supported by SYMADREM under GEMAPI aims to improve coastal resilience and the natural environment by implementing nature-based solutions, such as restoring dunes and creating climate buffer areas, rather than restoring the dikes and groynes.

The objective of ADAPTO+ is to experiment and validate adaptive coastal management activities that improve coastal resilience through nature-based solutions. The project has a time frame of 5 years and Tour du Valat is one of the initiators. This ambition can target ESS such as coastal erosion control and reduction of coastal flood risk similar to REST-COAST. One of the lessons learned from the previous ADAPTO project, but also the low support from local stakeholders. Therefore, human resources have been increased for the ADAPTO + project in order to increase social and territorial acceptability. The developed knowledge will feed into global and proven methodology for engineering flexible coastal management for different types of natural coastal environments, integrating all the technical (coastal risks and effects of climate change), environmental, social, political and economic components.

The project first consists of carrying out a feasibility study based on modelling of the long-term evolution of the site according to 3 scenarios: 1) *free evolution* 2) implementation of NbS that actively removes rocks within the area *"in subtraction"* (3) reconstitution of dune barriers *"in addition"* (with cost/benefit analysis in ecological, social and financial terms. The scenario analysis will inform stakeholders and decision-makers on the management plan of the area. Afterwards, a strategy will be chosen and implemented within the project. Even though the initial restoration strategy might differ, the aim remains the same: to create a natural climate buffer area without existing grey infrastructure (that were not maintained anymore) and create various co-benefits for the environment.

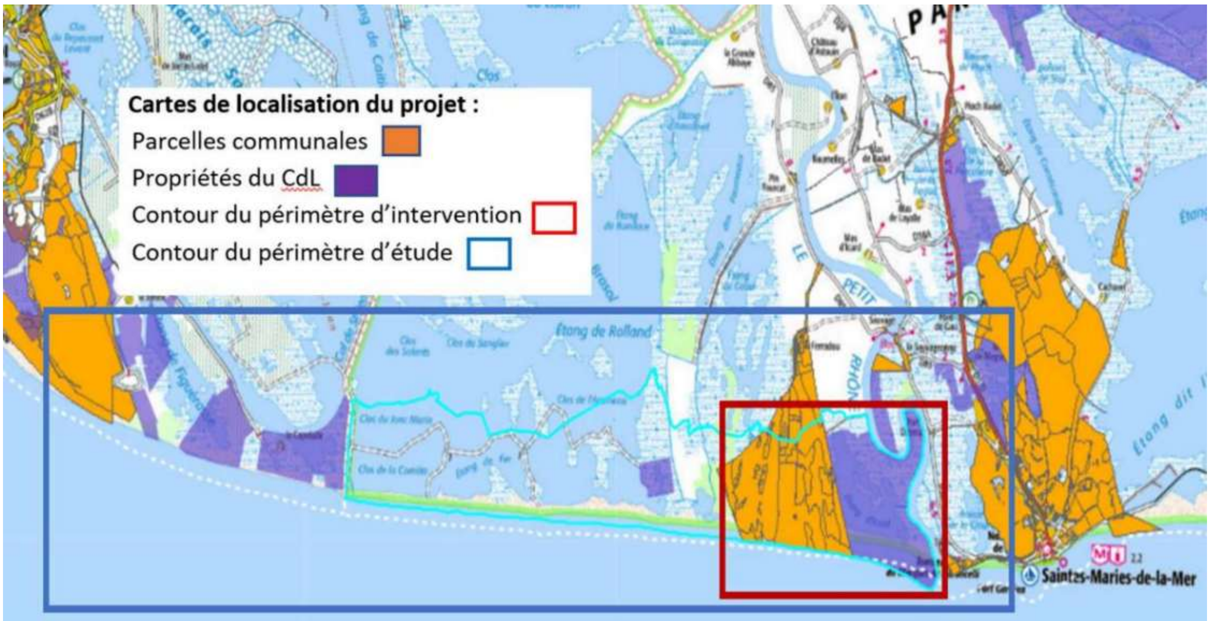



**Figure 74 Location of Saintes-Maries-de-la-Mer in the Camargue area (Parc Naturel Régional de Camargue, 2023)**

### 11.3.3. Stakeholder overview

An overview of stakeholders of the restoration project are shown in the Table 52 below. There is a project monitoring committee in place for the site consisting of the mayor of des Saintes-Maries-de-la-Mer (as institutional and land partner), SYMADREM, coordinator), PNR de Camargue (as site manager) and CEREGE and Tour du Valat (as scientific and technical partners). This partnership supports the understanding by local elected officials of the effectiveness of NbS for climate adaptation. The choice of the management scenario that will be implemented on the land of the Conservatoire du Littoral and the municipality will be made by the monitoring committee.

Unlike the initial REST-COAST project there (J. M. Barbier et al., 2023) are more stakeholders/landowners within the area such as the municipality who strongly value the tourism sector in the area, a local bull breeder and several accommodation sites. These are direct beneficiaries of increased water quality and reduced flooding. Their trust in the effectiveness of restoration is therefore important since they indirectly provide input into the municipality and obtain knowledge of land-use. It is important to maintain clear communication and provide input from these stakeholders to assess feasibility and show future benefits for the area. The regional dyke management (SYMADREM) of the Rhone Delta is already in favour of nature-based solutions due to the high expense of maintaining existing grey infrastructures.

**Table 52 Overview of stakeholders categorized according to legal status and actor category**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| 1 | Conservatoire du littoral | French public organization responsible for protecting natural areas along the coast, rivers or other water areas, part land owner. | Public | National |
| 2 | Municipality | Regional municipality | Public | Regional |

| | | | | |
|---|---|---|---|---|
| 3 | Parc naturel régional de Camargue | Site manager | Public | Regional |
| 4 | Town Hall of Saintes-Maries-de-la-Mer | Institutional and land partner and co-manager of the site | Public | Regional |
| 5 | PACA Region | Regional department of Provence-Alpes-Côte d'Azur | Public | Regional |
| 5 | DDTM | Department for Land and Coastal Management | Public | Regional |
| 6 | SYMADREM | Regional dyke management of the Rhone Delta | Public | Regional |
| 7 | GEMAPI | National management of aquatic environments and flood prevention | Public | National |
| 8 | European Centre for Research and Teaching in Environmental Geosciences of the University of Aix-Marseille (CEREGE) | Scientific institute | Public | Supranational |
| 9 | Office national des forêts (ONF) | French government agency that oversees the management of forests (state, city, reserves) | Public | National |
| 10 | DREAL | Regional Directorate for the Environment, Development and Housing | Public | National |
| 11 | Tour du Valat | Scientific partner | Private | Regional |
| 12 | Local Bull breeder (Manadier) | Land owner who breeds bulls and provides tours within area. | Private | Regional |
| 13 | Private partners/funders | Private parties funding restoration efforts directly or indirectly | Private | National |
| 14 | Representative associations or users of area (fishermen, outdoor activity associations etc.) | Regional committees of stakeholders of certain sectors | Private | Regional |
| 15 | Domaine du Sauvage | Accommodation site within the restoration area | Private | Regional |

| | | | | |
|---|---|---|---|---|
| 16 | Consortium of ADAPTO + project | Knowledge partners and initiators from other pilots within ADAPTO+ project | Public | National |
| 17 | European Commission | Funder/knowledge partner | Public | Supranational |

### 11.3.4. Business model proposition

#### Value proposition

The ESS and type of goods involved remain similar to the initial project (REST-COAST). However, the value proposition is focused on different stakeholders due to the different geographical locations and therefore will also differ in size/value. Additionally, there are different landowners within the area whereas in the initial REST-COAST project Conservatoire du littoral was full owner of the restoration area.

The following values are created through the restoration activities:

- Erosion control: the climate buffer area and vegetation reduce the wave force and have a stabilizing effect, reducing coastal erosion.
- Flood regulation: the climate buffer, dunes and vegetation reduce the wave force that result in the reduction of floods.
- Water quality: fewer marine infiltrations into the Icard pond reduce salinization and improve water quality
- Scientific knowledge development: knowledge on coastal restoration and impact on natural habits, sediment dynamics and water quality will be shared within the ADAPTO+ consortium which are mainly French public and knowledge institutions and with the European Commission (funder).
- Eco-tourism: Increased or maintaining activities in the area such as tourism or leisure activities linked to the beaches, as well as hunting activity on the communal plots.
- Food provisioning: the area can serve as a habitat for fish species by water quality improvement.
- The restoration of nature and improved water quality can improve regional and international biodiversity (birds) in the future.

First, an analysis of the area of a baseline situation will be made by an inventory of sedimentary dynamics such as floods, flood zones and morphological evolution of existing infrastructures, human activities and the ecological stage of the site (identified protected floral fauna). From 2023 the following values be monitored within the project:

- Sediment: monitoring of the evolution of the coastline via the acquisition of topographic and bathymetric data each year in September.
- Natural habitats according to Natura 2000 & threatened species.
- Monitoring of the ecological quality indicator (IQE) of the site.
- Salinity in the water at the Grand Radeau.

The following Table 53 summarises the four types of environmental, economic, social and cultural **benefits** provided by each type of NbS restoration intervention.

**Table 53 Types of environmental, economic, social and cultural benefits provided by NbS restoration.**

| ESS, BdV | ESS /BdV output level | Benefits | | | |
|---|---|---|---|---|---|
| | | Environmental | Economic | Social | Cultural |
| NbS – Seagrass restoration | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Flood regulation | Decrease probability of flood | \ | Reduction of flood damage/ Maintenance cost reduction SYMADREM | \ | \ |
| Erosion control | Reduction of coastline lost | Maintaining dunes and ecological function of area | Maintaining human and environmental land use | \ | Maintaining use of local coastline |
| Water Purification | Salinity level indicator | Increased water quality | Lower cost water-use for bull-breeder | \ | \ |
| Food Provisioning | kg of fish production (due to increased habitat) | \ | Increased fish quantity/quality | \ | Maintaining local agriculture heritage. |
| (Eco)-Tourism | Number of tourists within Saintes-Maries-de-la-Mer/Beach area | \ | Revenue due to increased tourism | \ | Increased number of tourism jobs |
| Biodiversity | Indices of increased BDV, such as the Shannon-Weiner Index/Fish Index (EFI+) | Increase in biodiversity by creating habitat and increasing water quality. | \ | Educational opportunity to learn about species in the ecosystem. | Human-nature experience. |

### Market analysis (demand and supply) and legal requirements

The restoration effort will indirectly create potential revenue for the area:

**Maintenance costs**: the regional dike agency, SYDAREM, is currently not maintaining the coastal dike and groins in the area. This is deemed expensive by local authorities. Therefore, there is a demand from this party to create a nature-based solution to reach the objectives of flood reduction.

**Eco-tourism:** The area on the beach is used for several tourist and recreational activities. The restoration effort does not directly target this area but could provide an opportunity for synergies by maintaining access to the area.

**Water quality:** due to reduced salinization of the restoration effort, the water quality will increase. This water is currently used for both the animals and impacts the land intended for grazing for the local bull farmer. This helps both agricultural output and maintains the (eco)-tourism model of the farmer and accommodations nearby.

### Value creation & delivery

The potential beneficiaries (stakeholders) of the restoration effort and their type of demand are described in **Error! Not a valid bookmark self-reference.** below:

**Table 54 Overview of stakeholders/potential beneficiaries and potential customers**

| Stakeholders/ Potential Beneficiaries | Type of demand | Delivery |
|---|---|---|
| Municipality Saintes-Maries-de-la-Mer | Improved water quality, biodiversity increase eco-tourism, flood control | Cost reduction, increase revenue |
| Dike agency (SYMADREM) | Erosion control, flood control | (maintenance) cost reduction |
| PNR de Camargue (Co manager of site | Improved water quality, biodiversity increase eco-tourism | Cost reduction, increase revenue |
| Local bull breeder | Mainly improved water quality | Increase agricultural and tourism revenue |
| Tour du Valat | Knowledge development coastal restoration | Scientific publications |
| Accommodation sites | Improved biodiversity, increase eco-tourism | Increase tourism revenue |
| European union | Knowledge development, EU compliance nature | Scientific publications |

### Implementation arrangements

The choice of the management scenario to be implemented on the land of the Conservatoire du Littoral and the municipality will be made by the monitoring committee. Which is composed of the Town Hall of Saintes-Maries-de-la-Mer (as institutional and land partner and co-manager of the site), PNR de Camargue (as co-manager of the site), SYMADREM (GEMAPI leader). Afterwards the decision is included in the land management plan (Conservatoire du Littoral and municipality) and in the coastal strategy supported by the Gémapien (Symadrem) within the Camargue delta. The implementation of the NbS is projected to be 2028 (Parc Naturel Régional de Camargue, 2023).

The funder of project is the European Union (60%) and the initiator parties themselves. Many of the initiator parties are national research institutes that are funded through taxes and grants. Tour du Valat funds the specific pilot area through a mix of private funding constituting of ProValat, Credit Mutual, WWF and regional funding. There were no financial instruments applied within this restoration effort. The project was directly funded through grants that had established budget for conservation and restoration efforts.

In 2023 the partnerships were established and is monitoring several environmental indicators. Currently, the project in is the submission phase of additional funding applications (2024-2025). Afterwards the feasibility study will take place (2026-2027). The possible implementation of nature-based solutions is estimated to start at 2028. The current estimated cost/budget for the next 5 years is 950.000. There are several funding sources established, and submission (including ADAPTO+ & Albert II of Monaco Foundation) are taking place.

There are several funding sources specified in the project proposal that can be used for the restoration activities of the area:

Provence-Alpes-Côte d'Azur (PACA) Region: €130.000

Ministère de la Transition écologique, MTECT : €121.000 (acquired)

Total Foundation: €160.000

Conservatoire du Littoral can apply for additional funding when targeting actions related to the agricultural sector when carrying out restoration activities. The following sources can be mobilized: Regional/Departmental funding, ERDF, Water Agency funding, AFITF Fund, Green Fund, Banque des Territoires funding

### Value capture

Value capture mechanisms are currently not in place. However, there are several opportunities in the area (mainly cost avoidance):

Due to the dike no longer being maintained and the buffer area that will be created by the natural environment, the maintenance cost by the French government SYMADREM will decrease.

The climate buffer area that will be created due to the restoration activities will reduce future flooding damage for local inhabitants.

The site includes a bull farm with designated areas for grazing and watering the animals. Reducing saltwater intrusion will enhance agricultural productivity and lower costs in the future.

The tourism sector is an important economic activity for the area of Saintes-Maries-de-la-Mer. Therefore, earmarked tourism taxes towards restoration activities can serve as an opportunity to ensure natural areas for tourists to visit.

### Economic and financial projections

The current estimated cost/budget for the next 5 years is €950.000. There are currently no financial projections related to the ESS provided by the restoration effort. The cost of the restoration activity will change according to the strategy chosen. The benefits of these different scenarios are yet to be modelled and analysed. These will consider the positive and/or negative financial, social and environmental impacts of the site.

### Financial instruments

There are no financial instruments applied within this restoration effort. The project will be directly funded through grants that had established budget for conservation and restoration efforts. There is currently no need within the area for financial instruments, since there is sufficient funding for restoration efforts.

#### Risk and contingency plan

There are several local landowners and stakeholders in Saintes-Maries-de-la-Mer who do not yet understand the effectiveness towards nature-based solutions. Therefore, a partnership of the municipality of Saintes-Maries-de-la-Mer is set up to clearly communicate and increase the understanding of nature-based solutions in tackling environmental problems that are increased by future climate change. A clear communication plan will be developed to inform various governance institutions and inhabitants to ensure local support for current and future restoration efforts.

### 11.3.5. Critical funding & financing challenges

There are no direct funding and financing challenges identified within the project. However, Tour du Valat experiences challenges related to maintaining the existing funding structures:

The source of private funding can be experienced as potential greenwashing. Partners that cause environmental degradation with their business w such as Total Foundation can be frowned upon within the organization and create low support. Therefore, a framework of selection is being explored and created to deal with this issue in the future to create stability in Tour du Valat's funding structure and future restoration efforts.

Established partnerships with public and private funding sources can be time intensive. The relationship is maintained through visits on site, organizing seminars, facilitating meetings on site and lodging. This is enabled by the strategic plan of Tour du Valat who hired a director for partnership, communication and advocacy. These activities require a strong time investment through human resources and logistics which can be costly. Therefore, Tour du Valat has to balance operational costs while maintaining and diversifying their funding structure.

## 11.4. Extension 2: Financial scalability plan

### 11.4.1. Introduction: What does upscaling mean to the pilot

For the Rhone Delta pilot actors, the perception of upscaling is twofold:

1) Tour du Valat prefer to carry on with restoration within the current restoration area where they have ownership and mandate to operate. There is still a lot of restoration to be done within this area. Currently they have circa 12 different restoration projects within the Camargue). They refer to this restoration as **intensification** of the current activities, which comprises about 6,000 hectares. Within the Camargue area restoration projects (implemented by TdV) improved the circulation of the water and restore the wetland ecosystems. However, additional efforts are required to restore wetlands and improve habitats. Measures within the southern area are more feasible since there is lower land-use than upstream areas.
2) The upstream agricultural activity negatively affect the water quality and quantity in the southern natural areas. This impact does not encompass the entire watershed but is limited to areas upstream, specifically in the vicinity of the Camargue. Additionally, this system includes the broader local community, other landowners, and users of this land, many of whom work in and depend on the agricultural sector or were formerly employed by the salt industry. Consequently, they often have a negative perception of nature conservation, since it is viewed as a threat to important economic sectors.

### 11.4.2. Overview of barriers preventing upscaling

The biggest barrier to upscaling as *intensification* of the current activities are the preferences of the funders. For example, Tour du Valat preferred to carry out restoration on land where restoration was already taking place, but the funder wanted them to restore a different area.

The biggest barrier to *upstream upscaling* is the strong economic interests that drive unsustainable land use (mainly agriculture). Upstream lands are owned by farmers who depend on them for their livelihoods. It requires time to provide alternative and sustainable business models for these land users, that have lower environmental impact. Therefore, an integral approach is needed within the Camargue area with a long-term governance structure with a capacity to manage the larger scale, (farm)land ownership, and funding. However, this is a time intensive process.

**Unsustainable agricultural practices**

One of the biggest issues that would need to be addressed for upscaling is unsustainable practices in agriculture. The inflow of pesticides from the surrounding agricultural lands, as well as the water use for agriculture, is done without any consideration for the downstream natural areas. Water is allocated to agriculture and due to a lack of coordination the needs of the natural system are not taken into account. However, changing land use is difficult, as farmers who own the lands depend on them for their livelihoods.

**Lack of awareness of restoration as solution for coastal protection**

It is perceived that the local population would prefer dikes as coastal protection solutions as there are fears of the risks from coastal erosion and flooding. Additionally, local inhabitants prefer that protection is managed by a trusted party (i.e. the state) instead of a restoration partner (Tour du Valat). Nature based solutions are not considered as an alternative for coastal erosion and flooding, since it is not deemed sufficiently safe There is an increasing need of awareness of the benefits of NbS with the local population including alternative solutions involving retreat and restoration.

**Conflicts between nature conservation vs local population**

The relationship between nature restoration stakeholders and other local stakeholders is conflicted at times. For example, inflation, bad harvests, changes to the CAP (Common Agricultural Policy) resulted in less funding for the rice farmers and increased electricity prices after COVID has led to frustration, targeting Tour de Valat and other environmental actors. This is not a reaction based on real events, but merely triggering polarised sentiments between stakeholders. As the economic situation improves, relationships tend to improve as well.

**Political changes affecting sustainable development**

The Camargue Regional Nature Park is managed to balance the three pillars of sustainability: economic, social and environment. The Park is the authority that is supposed to oversee the whole territory, integrate different agendas and organize the dialogues and contact with the local stakeholders. The political structure remained the same for a long period of time (20 years). In the past, the park successfully united all stakeholders to develop a common charter for the Camargue. Additionally, a Delta contract was signed, where all parties committed to a five-year plan detailing how the park should be managed and outlining specific objectives. Due to changes in the political direction of the park authority, the resources and mandate of the CRNP have reduced by the new policy direction. The current institutional structure of the Camargue Regional Nature Park is not considered by the interviewees to be functional. For NbS upscaling purposes, the area requires a responsible institution with a long term environmental strategy.

### 11.4.3. Financial strategies for upscaling

**Organic farming – a fine balance with salinization**

Solutions have been suggested to address pesticide use in agriculture, including reducing conventional rice production that uses large quantities of pesticides. The extension of organic farming and reduction in rice farming in the Camargue would however result in salinization (Lopez-Ridaura et al., 2012). This is because irrigation water that enters through pumping from the Rhone-River plays a key function to maintain the level of water and salt concentration of the central lagoon of the Camargue, the Vaccarès (Delmotte et al., 2010) With diminishing rice cultivation, there will be less fresh water flushing from irrigation and for downstream natural areas. Less irrigation of the rice fields also means less fresh water to downstream natural areas, which also means challenges for natural ecosystems, that cannot tolerate too much salt.

Salinization is already a serious issue for both rice farmers and nature conservation, and it is increasing due to drought and higher temperatures leading to higher evaporation. When it rains and the ditches and canals are well maintained, the fresh water blocks the salt. But when it doesn't, the salt wins. The local actors believe that the increasing salinization is due to climate change, but they also blame the environmental sector and its approach of restoration applying connectivity approaches with the Mediterranean Sea.

However, some reductions in rice farming would be possible in certain areas, also in terms of managing the salinization, where the region could maintain its economic productivity while decreasing the potential harmful effect on the environment by changing the land use. Estimates have suggested changing rice-cultivated surfaces from 20,000 ha to 7,000 (J. M. Barbier et al., 2023).

**Salinity challenges – an opportunity to bring stakeholders together**

Salinization is thus a common problem area for restoration and agricultural actors, which could bring these stakeholders together.

When land become too salinized, farmers would be willing to sell their land to Conservatoire du Littoral, since the land is not productive from an agricultural point of view. Such reduction in agricultural land reduces pesticides to downstream natural areas. For example, outside the Camargue, in an area called Les Alpes, TdV is working with a local farmer who considers that agriculture is not feasible in the future and instead wants to re-wet the land. Successful evidence-based cases such as this are needed to create support for this type of conversion and will in turn enable upscaling.

**Improving communication with external stakeholders**

Communication strategies focused upon the local population can be set up and improved to create understanding of restoration activities and the benefits it provides beyond biodiversity. An example of this could be to clearly communicate that restoration approaches are aligned with the national strategy of France when it comes coastal erosion and flooding. This is often not known to the local population. Currently, TdV creating a planning document for Camargue area focused on the REST-COAST site, that shows the benefits of a natural area for coastal erosion. Therefore, TdV is offering a solution with this project of restoration since there were no maintenance activities planned to reinforce the protection of this area.

Effective communication can improve local stakeholder perception of the restoration benefits for recreation and tourism. One opportunity is to include the transition towards more ecotourism, saline-tolerant agriculture, or aquaculture in the long-term planning documents. Thus, potential barriers can be transformed into opportunities. The goal for the site is to create new recreational areas that support ecotourism and offer economic development opportunities for local communities.

TdV is active in many of the committees and the working groups in the region and in the Camargue. TdV is an actor in all the committees in the park or in the environmental sector. This helps over the long term to build relationships to other stakeholders and communicate.

Additionally, top-down support in the form of policy, environmental objectives or frameworks from both the national or European level can support the acceptance of restoration efforts within the area.

**Integrated management plan can align various objectives**

An important actor in this context is the authority responsible for pumping and canal and water management dedicated for agriculture. It would be a central actor to discuss and consult on improving water management including water for nature for the Rhone delta, and the problem of salinity.

An organization would be needed to bring together and integrate all objectives; economic, social and environmental and coordinate stakeholder interests. The regional Park of the Camargue was identified as the authority that is supposed to oversee the whole territory, integrate interests and organize the dialogues with the local stakeholders. For example, reconciling the interests of agriculture and restoration.

However, in the current situation the Park authority may not have sufficient capacity. Therefore, a regional coordinator would be feasible, although part of the Camargue area lies is outside it. Tour du Valat is not considered as a suitable organization since they are not deemed impartial by local stakeholders. A municipality would not be feasible since the Camargue is divided into two municipalities.

# Chapter 12. Sicily Lagoon Pilot

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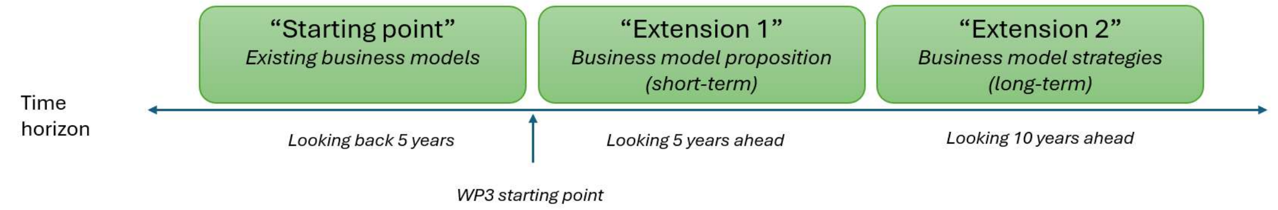
## Readers guide




**13.1 Introduction**

- **This section provides a general introduction to the Siciliy lagoon case**

**13.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - n.a.

**13.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Salt marsh restoration, artificial islands, dune revegetation, connectivity

**13.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Expand NBS such as salt marsh restoration on provincial level

## 12.1. Introduction to the pilot

Cuba-Longarini is a swamp lake or wetland located in the southeast coast of Sicily between the territory of two municipalities (Ispica and Pachino), and the provinces of Ragusa (RG) and Syracuse (SR). The whole Sicilian southeast swamp lakes area includes about 10 different swamp lakes (locally called "Pantani") and it is part of Natura 2000 as Special Areas of Conservation (SACs ITA090003) and Special Protection Areas (SPAs ITA090029). It is the southernmost Italian wetland complex and one of the most important coastal wetlands of southern Europe. Being located along the Central Mediterranean bird migratory route, its swamp lakes are used by millions of birds as resting and feeding hotspot every year, and, due to the local climatic conditions, they also represent important wintering sites for many species of water birds, raptors and passerines. Despite its importance and protection status, the swamp area has been badly affected for decades by poaching, illegal fishing, illegal dumping, overgrazing, fires and many other illegal activities.

The Cuba-Longarini lagoon complex has undergone significant reshaping over the past decades, affecting both wetlands and water body surfaces. On the Southern side, deep channels were dredged to accommodate a former fish culture plant. The natural expansion surface of the Cuba lagoon (and part of Longarini) is now occupied by a small residential area, resulting in a complete interruption of sea-lagoon connectivity. Furthermore, the Longarini lagoon was subdivided into two distinct water bodies, each with separate discharges to the sea. Additionally, road construction works have encroached upon the wetland area, reducing the connection between the two lagoons to a small, poorly maintained channel, which was essentially non-functional due to the presence of waste debris.


**Figure 75 Smaller lagoons indicated make out the pilot site. Source: REST-COAST Pilot Fact sheet.**

In order to end this habitat misuse and ongoing destruction, the German foundation Stiftung Pro Artenvielfalt - Foundation Pro Biodiversity, hereinafter SPA, specialized in biodiversity conservation and restoration of wetland habitats, started purchasing the largest and most important swamp lakes, named «Pantano Cuba» and «Pantano Longarini» and bordering wetland and farmland as of November 2023.

An overview of the NbS interventions in the Sicily Lagoon pilot, distinguishing the current restoration activities, the upscaling plan (extension #1) and the landscape scale plan (extension #2) is provided in Table 55.

**Table 55 NbS restoration upscaling levels targeted by REST-COAST tasks**

| Level of upscale/ extension | Area of NbS restoration interventions | Status of restoration | Business model | Business Plan | Horizon (years) |
|---|---|---|---|---|---|
| Current | 410 ha of salt marshes coastal fringe, with already 250 ha restored (Cuba-Longarini) | Ongoing and partially concluded. | Grants (public funding) | Identified | 3-6 |
| Extension #1 | Additional 32 ha for expanding restoration in Cuba-Longarini (5 ha) and wetland restoration of Baronello (28 ha + 5 ha pond creation, native vegetation restoration + sand dune restoration) | Planned | Identified | Identified | 1-5 |
| Financial Scalability Plan<br>Extension #2 | Other sites, e.g. Riserva Fiume Ciane/Saline (SR), plus Saline Priolo (SR), Pantano Gariffi (RG), covering an area of, respectively, 48 ha+ 13 ha + 100 ha (heterogeneity of environmental setting) | Envisaged | Not applicable | Not identif ied | 5-10 |

## 12.2. Starting point: Current Business Model

This section briefly describes the business model that is currently in place in the Sicily Lagoon. More detailed information is available in Favero et al. 2022.

### 12.2.1. Coastal Restoration Activities

In 2022 and 2023 The initiator of the restoration interventions is the German foundation Stiftung Pro Artenvielfalt - Foundation Pro Biodiversity (SPA) carried out works to reopen the channels connecting Cuba and Longarini, thereby re-establishing ecological and hydraulic connections between the two lagoons. Moreover, on the South-East side of the Longarini lagoon, a new connection was established by creating a ~30-meter-wide opening between the fish culture ponds and the lagoon. Considering that the Longarini lagoon covers 122 hectares, and the new connection with the ponds (10 hectares) and the Cuba lagoon (60 hectares) provides an additional 70 hectares connected, the improvement in connectivity can be estimated at 57%.

Moreover, in 2023, artificial islands were constructed within the lagoons with the primary objective of increasing bird biodiversity. For this purpose, the distance of sediment relocation was minimized by using sediments deriving from the building of migratory birds' niche channels realized close to the artificial islands. The combined artificial islands-birds niche channelling interventions have been implemented promoting nature-based irregular shapes, which will enhance the duration of the performed interventions.

The current NbS restoration activities conducted by SPA include:

1. Purchase and fencing of properties. As of the end of August 2022, SPA reports a property ownership of 397 hectares where a total of 7 km of fences were set up and are frequently patrolled by the foundation's «Bird Guards» to stop all kinds of illegal habitat and biodiversity manipulation and destruction activities.
2. Reclamation of illegal dumps and large volumes of garbage, (including toxic waste such as asbestos, old tyres, household appliances, electronic waste, greenhouse plastic foils, old cars, etc. which were

removed by foundation staff and volunteers and properly disposed. The bottom of swamp lakes was reclaimed as well. To date, the collected waste accumulated to a total of approx. 370 m'. All costs incurred were paid by SPA.

3. Soil recovery by removing greenhouses and illegal buildings, recovering almost 7 ha of soil in Pantano Cuba and 2,5 ha in Pantano Longarini.
4. Planting about 1400 Mediterranean scrubs (Lentisk, Dwarf palm, Wild olive tree, Arbutus, Juniper, Myrtle, etc.), 600 Olive trees, Almond trees, and Carob trees, 150 Poplar trees (Populus nigra and P. alba) and 40 *Pinus halepensis*, often using local germplasm and covering a total surface area of about 7 hectares.
5. Creation of new nesting/breeding niches, more than 100 nesting boxes, insect hotels, bat boxes and floating nesting platforms were placed for the benefit of birds, bats and solitary bees. Creation of rocky islets, small ponds, stone and wood piles to help birds, amphibians, reptiles and small mammals (Basioli et al., 2011).
6. Biodiversity monitoring. From 2015, weekly bird census, and monitoring of the local population of Sicilian pond turtles (*Emys trinacris*), dragonflies, butterflies, spiders and wild orchids were initiated and paid for by SPA in the area.
7. Anti-poaching surveillance, starting from December 2014, was continuously performed in the area every winter, from December to early February, both in Pantano Cuba and Pantano Longarini.

The restoration activities for the pilot project in Sicily (Italy) took place in the Cuba and Longarini lagoons, located in the southeast of the island. Several activities have been initiated in recent years with the overall objective of counteracting habitat degradation, safeguarding endangered species, and improving the ecological status of the area, including schemes to promote biological and eco-sustainable agriculture and sustainable land use change. The restoration interventions included anti-poaching measures, the removal of alien and invasive species, land use regulation, wildfire prevention, habitat fencing and waste dump removal.

The **business model** supporting the ongoing restoration activities is mainly based on grants provided by the European Union, e.g. the LIFE programme and the Horizon 2020 funding programmes. Currently, no financing arrangements have been established. The entire upfront costs for the construction of the islands, the improvement of the channels and breeding niches are covered by means of public and philanthropic grants. The current and future ESS generated by the pilot include biodiversity enhancements, water quality improvement, flood risk reduction, and erosion risk reduction. Part of the touristic value attached to these ESS is already captured through voluntary donations by visiting school excursions and ecotourists to the pilot initiator. Activities are managed by SPA with procurement arrangements to different actors to acquire the goods and services needed for restoration.

### 12.2.2. ESS and Economic good typology

The current ESS generated by the pilot include biodiversity enhancements, water quality improvement, flood risk reduction, and erosion risk reduction.

### 12.2.3. Funding: granting

As indicated in Favero et al. (2022) restoration activities in the current restoration area are co-funded by EU grants provided by the LIFE programme and the Horizon 2020 programme. The LIFE grants (Marble duck PSSO) are used to pay for construction activities such as the creation of artificial islands, ecological niches, and the reintroduction of native species. Horizon 2020 funds are used to cover the costs for gathering and analysis of scientific data. Private donations from supporters of the Foundation for Species Diversity have been used to purchase the land on which the restoration is taking place and to fund operation and maintenance activities.

#### 12.2.4. Funding: value capture

The initiator, SPA, as a non-profit organisation, is not interested in implementing revenue-generating value capture mechanisms, especially if these are meant for third-party profit. Part of the touristic value attached to the ESS above listed is already captured through voluntary donations by visiting school excursions and ecotourists to the pilot initiator.

#### 12.2.5. Finance

Currently, no financing arrangements have been established.

#### 12.2.6. Procurement arrangements

Procurement arrangements for restoration activities established by SPA are based on a segmented procurement model to acquire the goods and services needed for restoration. SPA is supported by different actors for the implementation of restoration. Private partners for the implementation of morphological restoration works and the provision of monitoring instruments were contracted through tendering. The University of Catania was contracted to conduct research on restoration methodologies and the analysis of collected data.

#### 12.2.7. Critical funding and financing challenges

The main financial barriers identified by Fausto & Hinkel (2023) include the following:

**Tourism user fees.** The implementation of this mechanism should address the financial barrier of (Long) time lag for impact. For this, the transfer enablers should consider the improvements in water quality and biodiversity; a clear identification of beneficiaries; and pre-existing hospitality facilities. The transfer barrier is social acceptance.

**Virtual Adoption of birds**. The Sicily Pilot is located on a key juncture of the Eurasian main bird migratory route. As a consequence, this area is exceptionally rich in terms of its biodiversity. The implementation of this mechanism should address the financial barrier of Low excludability. The main transfer enablers include biodiversity and ESS improvements; the presence of iconic/rare bird species (e.g. flamingos, herons etc.); and alignment with NbS initiator's customary financial model. The transfer barrier is that the provider of financial services (transaction structuring, donation platform) is not identified yet.

### 12.3. Extension 1: Business model proposition and usiness plan

This section describes the business model, developed through the business model canvas (Figure 77) and the business plan for upscaling restoration (extension #1), described in each of its subsections.

#### 12.3.1. Executive Summary

This business plan describes the management, business and financial strategies for upscaling saltmarshes restoration of 32 ha in the wetland of Cuba-Longarini, wetland restoration of Baronello restoration 28 ha and 5 ha pond creation, native vegetation restoration and sand dune restoration. The upscaling will incorporate lessons from the ongoing restoration of 410 ha of salt marshes coastal fringe in the wetlands of Cuba-Longarini. The business plan considers a time horizon of five years. The upscaled restoration plan targets different interconnected problems (i.e. coastal erosion, sea level rise, loss of biodiversity, land abandonment/degradation flooding, sedimentary deficit, water quality/scarcity, overexploitation of groundwater), improving five main ESS and biodiversity which produce a large variety of environmental, economic, social and cultural benefits of to multiple stakeholders and beneficiaries.

SPA will manage a set of coastal saltmarsh restoration projects, including the creation of artificial islands for biodiversity, supported, through procurement arrangements, by several implementing organizations of scientific (UNICT) and technical competence. The high required costs for upscaling restoration will necessitate of a robust financial strategy that goes beyond public funding (granting arrangements) and that can gather private investments through innovative financing arrangements and value capture arrangements, e.g. connected to economic activities in eco-tourism and educational activities.

An overview of Sicily Lagoon NbS Business Model Canvas is provided in the figure below:

<table>
<tr><td>Value proposition</td><td>Problems addressed<br><br>-Water scarcity<br>-Over-exploitation of groundwater<br>-Water quality<br>-Low fish and crop yield…<br>-Sediment deficit<br>-Flooding<br>-Coastal erosion<br>-Sea level rise<br>-Land abandonment<br>-Loss of biodiversity</td><td colspan="2">Benefits produced<br><br>-Environmental benefits Better water quality, sediment entrapment, flood surge attenuation, Biodiversity improvement, Availability of new ecological niches for wildlife, complementary to salt marshes<br>-Economic benefits Ecotourism; Opportunities for bio-agriculture practices conversion; Reduction of flooding, coastal erosion damage costs; Educational activities.<br>-Social benefits Safer life; Space of quality<br>-Cultural benefits Maintain cultural landmarks</td></tr>
<tr><td rowspan="3">Value creation</td><td>Key partners<br><br>Stiftung Pro Artenvielfalt (SPA)<br>UNICT<br>Companies</td><td colspan="2">Regulation and Governance<br><br>The governance structure is quite clear. Several departments are involved (Water District Authority, Regional Dept of Water, Energy Waste, Agriculture, Rural Development and Fishing Department, etc). A general legislation framework exists, in some cases local communities have fought against the establishment of natural reserve areas at the fellow pilot.</td></tr>
<tr><td>Key resources<br><br>-Knowledge/Technical expertise<br>-Technical means and tools</td><td>Customer segments<br><br>Tourists and visitors</td><td>Stakeholders<br><br>26 stakeholders: 16 are governmental organizations, 2 research organizations, 5 NGOs and 3 organizations from the private sector.</td></tr>
<tr><td>Key activities<br><br>-Coastal saltmarshes restoration<br>--Creation of artificial islands for biodiversity improvement<br>-Water level management and hydraulic connectivity<br>-Dune revegetation/reconstruction</td><td>Customer relations and channels<br><br>-Creating awareness through social campaigns and educational activities<br>-Organizing demonstration activities to key stakeholders</td><td>Beneficiaries<br><br>-Farmers<br>-Citizens<br>-Tourists and visitors<br>-Municipalities<br>-Public authorities<br>-Companies</td></tr>
<tr><td>Value capture</td><td>Costs<br><br>NbS1 - 236.000 €<br>NbS 2 - 106.000 €<br>NbS3 - 57.000 €<br>NbS4 - 32.000 €</td><td>Revenue streams<br><br>-Eco-tourism<br>-Birdwatching<br>-Specialized nature photography hides rental<br>-Educational activities:</td><td>Financing and funding<br><br>Grants. Donors.</td></tr>
<tr><td>Transversal categories</td><td colspan="2">Impact indicators<br><br>Improvements of ESS output/level<br>Indices of increased BDV<br>Impact on human (increased knowledge) and produced capital (revenues from eco-tourism, education, GDP)</td><td>Risks<br><br>-High water levels in summer impacting marshes restoration;<br>-Land purchase fail of targeted lagoon/land portions, impacting artificial islands creation</td></tr>
</table>

**Figure 76 Business Model Canvas for NbS in the Sicily Lagoon (NbS 1 = salt marsh restoration, NbS 2 = creation of artificial islands, water level management, and dune restoration**

### 12.3.2. Mission and Objectives of the restoration initiator

The mission of SPA, initiator of the upscaling NbS restoration activities in the swamp area of Cuba-Longarini is to secure the conservation of biodiversity and improve conservation status and populations of endangered wildlife species and their natural habitats. In line with such a mission, the overall objective of upscaling restoration consists in strengthening restoration of ESS (provisioning, regulating, supporting and cultural) in Cuba-Longarini in order to deliver and amplify environmental, social, and economic benefits to a broad target of stakeholders from the public and private sector including the civil society.

More specifically, the upscaling plan proposes the following restoration objectives:

1) to contrast the erosion process and the negative trend of loss of sediments in the wetland;
2) to create new habitats for wildlife, in particular for birds (including new species, ground-nesting birds, etc.) and vegetation (e.g. wild orchid species);
3) to increase benefits from biodiversity improvements (stimulating biodiversity education
4) to attenuate the impact of flooding in the area and exposed elements at risk and at the same time ensure proper water levels inside the lagoons in summer;
5) to increase unpolluted soil surface availability;
6) to mitigate the effects of climate change and the storage of $CO_2$.

### 12.3.3. Stakeholder overview

The pilot core team at UNICT has identified 26 stakeholders that will be impacted by upscaling NbS restoration in the southeast of Sicily Lagoons, most of them within the CORE-PLAT with whom an interlocution has been activated. The list of stakeholders includes 18 stakeholders from the public sector and 8 from the private sector, grouped into the following categories:

Public sector

- o n.16 Governmental organizations, 2 at national and regional levels (the Water District Authority of the Sicilian Region who administrates water bodies from source to the estuary, in terms of quality and use of resource; the Government Commissioner against hydro-geologic hazard, responsible for the implementation of priority and urgent interventions to mitigate hydrogeological risk in the Sicilian Region), 8 organizations at supralocal level (Sicilian Region - Assessorato del Territorio e dell'Ambiente, responsible for administrative functions of environmental matters on a regional scale; Sicilian Region - Servizio 2 – Natural reserves, protected areas and environmental tourism, that is in charge of the maintenance and protection of natural reserves; Dipartimento dell'Ambiente; ARPA-MARE, regional environmental protection agency to monitor and protect aquatic ecosystems; the Civil Protection Authority responsible for preparedness and response to natural and/or anthropic disasters; Soprintendenza di Siracusa and Soprintendenza di Ragusa, two authorities for Cultural Heritage conservation in the Provinces of Siracusa and Ragusa; Libero Consorzio Comunale di Siracusa, associating several municiplities within the Province and responsible of the management of the Fiume Ciane and Saline di Siracusa oriented natural reserve); and 6 at local level operating as planning and managing authorities (Municipality of Siracusa, Ispica, Pachino, Noto, Portopalo di Capopassero and the Protected Marine Area of Plemmirio responsible for the Marine Protected Area close to Syracuse);
- o n.2 Research institutions and high-level education (Catania University or UNICT and ISPRA)

- Private sector

- n.5 NGOs including:
    - Stiftung Pro Artenvielfalt (SPA) is a German private pro-biodiversity foundation that acquired Cuba-Longarini lagoons to operate restoration measures for improving habitat quality and biodiversity. SPA is a site manager
    - Legambiente Sikelion Ispica
    - WWF Sicilia, Voluntary association
    - Ente Fauna Siciliana, Voluntary association, in charge of managing access to Vendicari reserve
    - LIPU, Lega Italiana Protezione Uccelli, Manager of Saline di Priolo Reserve
- Several tourist operators
- Several economic associations, including bio-farmers and farmers operating intensive agriculture (e.g. Consorzio IGP Pomodoro Pachino)

**Table 56** Stakeholders in the Sicily Lagoon pilot

| ID | Name of the organization | Mandate, role and responsibilities | Legal nature | Category | Level |
|---|---|---|---|---|---|
| 1 | Water District Authority of the Sicilian Region | Administrates water bodies from source to the estuary, in terms of quality and use of resource. | Public | Government | Public |
| 2 | Municipality of Ispica | Responsible for all administrative functions concerning the population and the municipal territory in the sectors of social services, planning, land use and economic development in the South-East of Sicily area. The Cuba-Longarini lagoon area lies partially within this municipality. | Public | Government | Public |
| 3 | Municipality of Pachino | Responsible for all administrative functions concerning the population and the municipal territory in the sectors of social services, planning, land use and economic development in the South-East of Sicily area. The Cuba-Longarini lagoon area lies partially within this municipality. | Public | Government | Public |
| 4 | Municipality of Noto | Responsible for all administrative functions concerning the population and the municipal territory in the sectors of social services, planning, land use and economic development in the South-East of Sicily area. The Vendicari lagoon area lies in Comune di Noto | Public | Government | Public |
| 5 | Government Commissioner against hydro-geologic hazard | Government Commissioner for the contrast of hydrogeological instability and the implementation of priority and urgent interventions to mitigate hydrogeological risk in the Sicilian Region | Public | Government | Public |
| 6 | ARPA – MARE | Regional environmental protection agency to monitor and protect aquatic ecosystems | Public | Government | Public |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Sicilian Region - Assessorato del Territorio e dell’Ambiente – Dipartimento dell’Ambiente | Responsible for administrative functions of environmental matters on a regional scale. | Public | Government | Public |
| 8 | Catania University | In charge of the CORE-PLAT building, manages the survey and monitoring plan, carry out research and disseminate results. | Public | Research institutions and education | Public |
| 9 | Regional Department of Civil Protection | Governmental aid in preparation for (or immediate aftermath) of natural or anthropic disaster | Public | Government | Public |
| 10 | Stiftung Pro Artenvielfalt | German Private pro-biodiversity foundation that acquired Cuba-Longarini lagoons to operate restoration measures to improve habitat quality and biodiversity. | Private | NGOs (environmental) | Private |
| 11 | Sicilian Region - Servizio 2 – Natural reserves, protected areas and environmental tourism 32 | Regional institution in charge of the maintenance and protection of Natural reserve of Vendicari lagoons. | Public | Government | Public |
| 12 | Legambiente Sikelion Ispica | | Private | NGOs (environmental) | Private |
| 13 | WWF Sicilia | Voluntary association | Private | NGOs (environmental) | Private |
| 14 | Ente fauna Siciliana | Voluntary association, in charge of managing access to Vendicari reserve | Private | NGOs (environmental) | Private |
| 15 | LIPU | Lega Italiana Protezione Uccelli. Manager of Saline di Priolo Reserve | Private | NGOs (environmental) | Private |
| 16 | Farmers | Farmers (bio production) | Private | Economic association (farming, fishing, hunting, etc.) | Private |

| | | | | | |
|---|---|---|---|---|---|
| 17 | Consorzio IGP pomodoro Pachino | Farmers (intensive production) | Private | Economic association (farming, fishing, hunting, etc.) | Private |
| 18 | Tourist operators | Touristic activities | Private | Company | Private |
| 19 | Soprintendenza di Ragusa | Authority for Cultural Heritage conservation in the Ragusa Province | Public | Government | Public |
| 20 | ISPRA | National Institute for Environmental Research. Involved in environmental monitoring and restoration activities | Public | Research institutions and education | Public |
| 21 | Libero Consorzio Comunale di Siracusa | Association of municiplities in the Syracuse Province. Responsible of the management of the Fiume Ciane and Saline di Siracusa reserve | Public | Government | Public |
| 22 | Municipality of Syracuse | Responsible for all administrative functions concerning the population and the municipal territory in the sectors of social services, planning, land use and economic development in the South-East of Sicily area. | Public | Government | Public |
| 23 | Municipalitie of Portopalo di Capopassero | Responsible for all administrative functions concerning the population and the municipal territory in the sectors of social services, planning, land use and economic development in the South-East of Sicily area. Several unrestored lagoon areas lies in this municipality | Public | Government | Public |
| 24 | Soprintendenza di Siracusa | Authority for Cultural Heritage conservation in the Syracuse Province | Public | Government | Public |
| 25 | Protected Marine Area of Plemmirio | Marine Protected Area close to Syracuse | Public | Government | Public |
| 26 | Dipartimento dell'Ambiente | Responsible for all administrative functions concerning the environment in Sicily | Public | Government | Public |

Concerning the alignment with the NbS paradigm (analysis made in synergy with the work executed in WP5), 12 stakeholders (Catania University, Stiftung Pro Artenvielfalt , Sicilian Region - Servizio 2 – Natural reserves, protected areas and environmental tourism 32, Legambiente Sikelion Ispica, WWF Sicilia, Ente fauna Siciliana, LIPU, Soprintendenza di Ragusa, ISPRA, Libero Consorzio Comunale di Siracusa, Soprintendenza di Siracusa, Protected Marine Area of Plemmirio) have a very-high alignment and they are all engaged in the CORE-PLAT; 4 governmental stakeholders (Water District Authority, Government Commissioner against hydro-geologic hazard, ARPA – MARE and Municipality of Noto) are partially aligned with the NbS paradigm; the supralocal and local governmental stakeholders as well as tourist operators remain instead somehow skeptical towards the NbS paradigm (the Municipalities of Ispica, Pachino and Noto, Sicilian Region - Assessorato del Territorio e dell'Ambiente – Dipartimento dell'Ambiente and the Civil Protection Authority); then the communities of farmers are mainly positioned as opponent to the implementation of the NbS paradigm in the territory.

Assessing the level of influence/interest of stakeholders (using a ranking scale from 1/lowest relevance to 5/highest relevance), the map in Figue x hows the positioning of the stakeholders involved in restoration upscaling in the Sicily Lagoon pilot. The map, in the upper right quadrant, highlights SPA - who is the initiator of the current restoration activities in the Cuba-Longarini Lagoon – among the stakeholders that can play a key role for upscaling restoration by developing the business plan, followed by the two Departments of Regione Sicilia who are respectively responsible for environmental matters (Dipartimento Ambiente) and natural reserves (Dipartimento dello sviluppo rurale e territoriale). ARPA-MARE and UNICT, in the lower right quadrant, although sharing the same highest level of interest (scored as 5) have a weaker capability to influence decision-making.

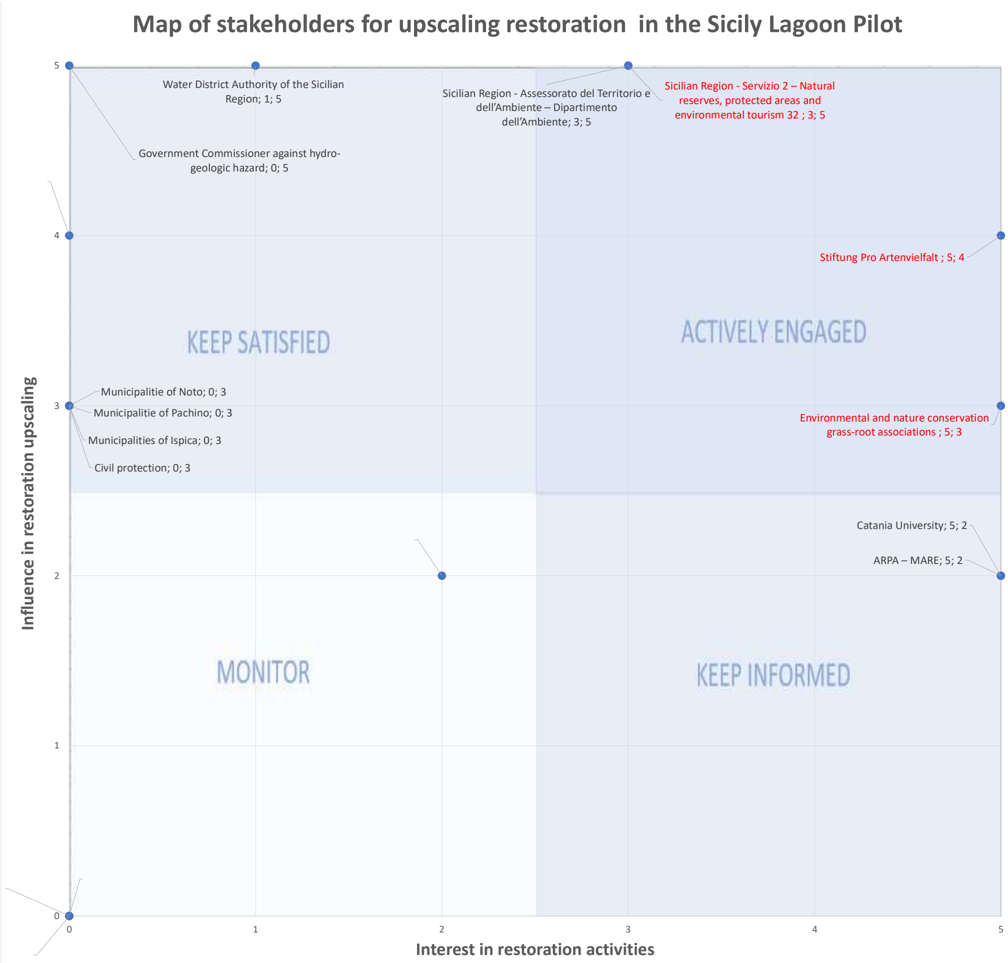



**Figure 77 Stakeholder map of Sicily Lagoon NbS restoration plan**

#### 12.3.4. Business model proposition

The business model proposition is described in its three main components, as follows: i) the value propositions derived by coastal restoration; ii) the activities and the organizations engaged in creating and delivering the value propositions; iii) the value capture mechanisms that will allow to generate revenues and get funding in order to sustain the restoration investments. The business model canvas (figure x) provides a concise overview of the business model proposition co-developed with stakeholders in the Sicily lagoon.

##### Value proposition

This section describes the value that NbS restoration aim to create for different stakeholders and beneficiaries. Such a value is determined by assessing the relevance of the problems requiring restoration and the contribution that upscaling restoration objectives can provide to solve the problems.

Several **problems** emerged from the assessment undertaken by the Sicily Lagoon pilot team and the main stakeholders including:

Groundwater exploitation - Groundwater in the pilot area has become more saline during the previous decades, probably related to the decrease of precipitation and therefore reduced freshwater intake in the aquifer. This mainly affects farmers, which require saline groundwater for irrigation and affording costs for energy needed for pumping water.

Flooding is a major problem for the area, as a village was built in the 1970s in the natural expansion surface of the lagoons, i.e. in between the beach dune and the saltmarshes. This development, combined with increased risk of flash floods, intensity and frequency of wave storms and the absence of a water level regulation, has led to frequent flooding of the village from both the sea and the lagoon side. This affects both roads and houses. In Granelli, one of these villages, the local population of less than 30 permanent residents in the summer increases dramatically to several hundreds. In addition, the road SP44 is frequently flooded.

Coastal erosion – This is another major problem, probably related to reduced sediment flux from the lagoon and the dune belt being degraded by village constructions.

Loss of biodiversity as the lagoon/wetland area has been reduced in favour of urban area and greenhouses.

The pilot Core Team and their stakeholders were requested to assess the **relevance of the improved ESS and Biodiversity** triggered by four main types of NbS restoration interventions, for addressing the above-listed problems, including:

1. Coastal saltmarshes restoration
2. Creation of artificial islands for biodiversity.
3. Water level management and hydraulic connectivity
4. Dune revegetation/reconstruction.

Following the description of the problems identified and the contribution that NbS restoration can provide to solve them by improving ESS and biodiversity, the following table summarises the four types of environmental, economic, social and cultural benefits provided by each type of NbS restoration intervention.

**Table 57 Types of environmental, economic, social and cultural benefits provided by each type of NbS restoration interventions**

| ESS, BdV | ESS /BdV output level | Benefits | | | |
|---|---|---|---|---|---|
| | | Environmental | Economic | Social | Cultural |
| RFF (Reduction of Flood Risk)<br>RCE (Reduction of coastal erosion)<br>WP (Water Purification)<br>BDV (Biodiversity) | Habitat surface increase. | Better water quality, sediment entrapment, flood surge attenuation.<br>Reduction of damage costs from flooding.<br>Land property value enhancing the attractiveness of the place<br>Availability of new ecological niches for wildlife, complementary to salt marshes (e.g. littoral forests, traditional med-crop species as carobs, sand dunes). | Risk reduction, Eco-tourism.<br>Reduction of damage costs from erosion.<br>Eco touristic activities.<br>Reduction of costs for solid waste recovery.<br>Circular-economy activities.<br>CSR benefits. | Safer life; Space of quality. | Maintain landscape.<br>Educational activities. |
| BDV | Habitat surface increase, or bird census | Biodiversity improvement | Eco-tourism (birdwatchers) | Safer life; Space of quality. | Educational activities to learn about species. |
| BDV, RCF | Retained water levels.<br>Flooding reduction. | Biodiversity improvement | Eco-tourism (birdwatchers)<br>Increase water availability | Safer life; Space of quality. | Eco-tourism |
| BDV, RCE, RCF | Flooded area reduction. | | Reduction of costs for infrastructure repairment. | Safer life; Space of quality. | |

All NbS restoration interventions are interconnected and contribute to deliver the above-mentioned type of benefits.

The most important, or primary value proposition of the NbS restoration intervention refers to:

biodiversity improvements, including creation of new habitats; return of bird species; and return of flora species, invertebrates' species.

Reduced coastal erosion (reduction of costs associated to damages induced by coastal erosion).

flooding risk reduction (reduction of costs associated to flood- generated damages).

The secondary (co-benefits) value proposition of the NbS restoration interventions refers to:

- Opportunities for sustainable tourism or eco-tourism
- Opportunities for educational activities

The economic benefits associated to the five main ES and Biodiversity can be described in terms of economic goods and can be classified according to the feasibility of their exclusion and rivalry, as indicated in Table 58.

**Table 58 Overview of the ESS delivered (E- Excludable; R – Rival; NE – Non- Excludable; NR- Non-rival)**

| ESS/BdV | E- Excludable; R – Rival |
|---|---|
| Water Quality Purification [WP] | NE + NR |
| Reduction of coastal erosion risk [RCE] | NE + NR |
| Reduction of coastal flooding risk [RFR] (upstream) | NE + NR |
| Biodiversity [BdV] | NE + NR |
| Eco-Tourism [TOU] | E + NR |

Market analysis (demand and supply) and legal requirements

The main sectors of the market demand that will be relevant for generating potential revenues are represented by:

Eco-tourism (focusing on eco-tourism, including bird watching and other activities that have shown increasing demand in Sicily. Birdwatching can be considered as a key activity that although targeted to a narrower market can yield higher fees per visitor/visit. Nature photography is related to an even narrower target but can yield extremely higher fees (up to 150,00 per person per day); of course, related capacity is accordingly relatively much lower (5 to 8 hides per day, no more than 100 days per year).

Educational activities on nature restoration (focusing on post-graduate education with the organization of a master to train professionals in the design and realization of NbS, as well as on the assessment of eco-system services).

Value creation & delivery

This section specifies how SPA (the initiator) will engage with other implementing organisations, through the management strategy, procurement/contractual arrangements and a business strategy, in order to achieve the NbS restoration objectives and perform the restoration interventions proposed in the business plan.

The **initiator** of the restoration interventions is the German foundation Stiftung Pro Artenvielfalt - Foundation Pro Biodiversity (SPA) that already purchased the two swamp lakes of most important swamp lakes of Pantano Cuba and Pantano Longarini and that aims to increase the extension of the protected area. SPA is responsible for designing, planning, implementing and monitoring a set of five main restoration interventions, collaborating with several implementers, in particular:

- Universities/researchers/professionals carrying out monitoring studies, design, environmental assessments
- Companies hired to perform cleaning operation in the areas to be restored.
- Companies hired to make morphological changes of the area (dredging companies, etc.)
- Farmers working on eradication of alien/invasive species and replantation of selected species
- Maintenance workers.

The **main NbS interventions** are described below:

1. Coastal saltmarshes restoration. Through tailor made interventions of wetland expansion (soil excavation) this action aims at restoring important portions of the lagoons to the original natural conditions after anthropogenic interventions over the last decades.
2. Creation of artificial islands for biodiversity. As a result of coastal saltmarsh restoration, a huge quantity of excavated soil is available and best possible use is to create artificial islands inside the lagoons. Such newly created ecologic niches are the best suitable and at the same time rarest habitat for many endangered bird species to breed.
3. Water level management and hydraulic connectivity: this intervention will be executed through gate barriers that can be improved/enhanced
4. Dune revegetation/reconstruction. Another suitable option to re-use on site the excavated soil (action 1), which is sandy material, is to restore the once-widespread sand dunes This helps re-creating one of the rarest habitats in the area with large improvements for biodiversity (flora and insects in the first place).

In addition to the above-listed four NbS restoration interventions, important synergies can be identified with two main restoration interventions planned by UNICT in the coastal area of Cuba-Longarini consisting of;

*Posidonia oceanica* meadow replantation, contributing to improve flooded area reduction and shoreline retreat reduction

Sand nourishment of the Granelli beach, not only to rebuild beach and dune habitats, but also to have a larger beach that represent a more efficient defence measures against sea-level rise and wave storm impacts.

An overview of the NbS restoration interventions including their duration by each phase is provided in Table 59.

**Table 59 Details on NbS restoration activities including duration by phase**

| | | | Phase | | | |
|---|---|---|---|---|---|---|
| **#** | **NbS restoration interventions** | **Size impacted area** | **Activities start/ End** | **Planning start/ end** | **Implement start/ end** | **Monitoring start/ end** |
| 1 | Coastal saltmarshes restoration | 57 Ha | 09/2024 - 12/2026 | 09/2024-05/2025 | 06/2025-12/2025 | 01/2026-12/2026 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Creation of artificial islands for biodiversity | 25 Ha | 09/2024 - 12/2026 | 09/2024-05/2025 | 06/2025-12/2025 | 01/2026-12/2026 |
| 3 | Water level management and hydraulic connectivity | | 09/2024 - 12/2026 | 09/2024-05/2025 | 06/2025-12/2025 | 01/2026-12/2026 |
| 4 | Dune revegetation/reconstruction | 5 Ha | 09/2024 - 12/2026 | 09/2024-05/2025 | 06/2025-12/2025 | 01/2026-12/2026 |

An overview of the main stakeholders, beneficiaries and potential customers is provided by Table 60.

**Table 60 Overview of stakeholders, beneficiaries and customers**

| Stakeholders/ Beneficiaries | Potential Customers | Type of demand |
|---|---|---|
| Intensive farmers | Farmers | Farmers for irrigation purposes using less saline groundwater. Clients of farmers are already asking for compliance of farmers with regulations supporting biodiversity when undertaking activities and agricultural practices. |
| Bio farmers | Public | Creation of eco-labelled agricultural products |
| Public (including citizens) | | Purchasing products and bio-products from farmers (e.g. “prodotti del Simeto”). |
| Citizens (including students) | Local residents and house owners whose houses/properties will not be damaged by flooding or accumulation of sand to be removed at their premises. Value of properties raised. | Avoiding damages costs from flooding or sand accumulation.<br>Increasing values of their property by an increasingly more valuable and attractive context. |
| Students | Improving scientific and technical knowledge of NbS. | Certificated scientific and technical knowledge. |
| tourism/ recreation operators | Tourists and visitors attracted by eco-touristic activities | Eco-touristic visits/tours |
| Municipalities | Road and transportation managers: Flooding risk in | Saving costs |

| | | |
|---|---|---|
| | the correspondence of bridges and roads | |
| Public authorities | Responsible for water treatment | Saving costs |
| Public authorities | Responsible for coastal erosion control | Saving costs |
| Companies | Enhancing company reputation. | Achieving certifications |
| Companies | Developing activities based on circular-economy by reusing waste | Selling goods and services from recycled materials. |

Implementation arrangements

This section briefly illustrates the various procurement arrangements through which the initiators will engage several implementers in the execution of the NbS interventions and the key resources needed.

All payment for services related to NbS restoration interventions are based on contracts issued by SPA to each implementer. It is foreseen the involvement of UNICT and its pilot team already engaged in the current restoration activities in Cuba-Longarini.

The management strategy will be defined by SPA engaging the team of UNICT through procurement arrangements. UNICT, already engaged in the current restoration activities will thus continue supporting the work of SPA, by providing them with data from monitoring and modelling, quantifying potential benefits of restoration actions and building a supporting network for the actions (also through acquisition of new grants).

**Key resources** for planning, implementing and monitoring NbS interventions include knowledge and technical expertise, mainly provided by UNICT. Moreover, the availability of technical means and tools for environmental monitoring is necessary to carry out the interventions effectively.

From a **regulation and governance** perspective it shall be noted that:

The governance structure shall consider the various public institutions involved at national, regional and local level. There are several public departments involved on the management and protection of natural resources (e.g. Water District Authority, Regional Dept of Water, Energy Waste, Agriculture, Rural Development and Fishing Department, etc.) who are not clearly coordinated.

Although a general legislation framework supporting restoration exists, in some cases local communities have fought against establishment of natural reserve area.

"Sovrintendenza dei Beni Culturali" in charge of protecting landscape and cultural heritage has no power on active restoration measures, acting just as controller of possible abuse.

Mutual recognition about the priority of restoration interventions is limited to areas where Regional Natural Reserve are established.

Focus by present institutions involved is only biodiversity and ecosystem protection. No awareness on its potential for risk reduction.

The current governance structures respond to an assessment of the state of the ecosystem that is carried out by the Environmental Agency at Regional scale. In the area of active restoration, no environmental parameters are systematically recovered by the EA. Moreover, in general for the management of wetlands there is not a direct response of the current governance structure to the outcome of the assessment.

Town and land planning in the area do not include nature restoration. Regulation on sediment management is very strict. Dredged sediments may be considered as waste. Water levels concern is exclusively related to avoid damages/risks to infrastructures, not at all at keeping high water levels in the lagoons in summer to safeguard biodiversity.

#### Value capture

This section briefly describes the direct versus indirect value capture (funding), identifying the potential/targeted grantors.

The two main direct value capture streams identified and capable to generate revenues include:

- Eco-tourism
- Birdwatching
- Specialized nature photography hides rental
- Educational activities

#### Economic and financial projections

The business plan's economics is projected over a 5-year period, considering costs and revenues.

**Lifecycle costs** include all costs to be afforded for all three stages of NbS restoration, i.e. planning, implementing, and monitoring, considering their duration, as illustrated in Table 61.

**Table 61 NbS restoration costs in Sicily Lagoon**

| # | NbS restoration interventions | Activities (start/end) | Planning | Implement | Monitor | Total |
|---|---|---|---|---|---|---|
| 1 | Coastal saltmarshes restoration | 09/2024 - 12/2026 | 15.000 € | 205.000 € | 16.000 € | 236.000 € |
| 2 | Creation of artificial islands for biodiversity | 09/2024 - 12/2026 | 9.000 € | 85.000 € | 12.000 € | 106.000 € |
| 3 | Water level management and hydraulic connectivity | 09/2024 - 12/2026 | 15.000 € | 35.000 € | 7.000 € | 57.000 € |
| 4 | Dune revegetation and reconstruction | 09/2024 - 12/2026 | 7.000 € | 20.000 € | 5.000 € | 32.000 € |

The availability of funds is currently highly dependent on donors. The business plan is forecasting potential revenue generation from eco-touristic activities and education activities.

The high touristic value of the Lagoons represents a strong asset for the potential future implementation of further value capture arrangements. Currently, visitors are invited to voluntarily donate to SPA. These could possibly be integrated with user fees (e.g. targeting birdwatchers, for the general access to the site or for specific events), such as the one already implemented in the benchmark site Vendicari Lagoon. The following table provides with an estimation of the main potential revenue generated by biodiversity based on data and analyses conducted by SPA in the area and elsewhere.

**Table 62 Main potential revenues generated by biodiversity.**

| Economic benefits | Indicators | metric | metric | Total revenues |
|---|---|---|---|---|
| Eco touristic activities (e.g. guided visits) | | Number of visitors (per year) | Entry fee | Number of visitors * Entrance in natura reserve area with ALQ (aesthetic landscape quality) |
| | | 200 | 10,00 € | 2.000,00 € |
| Birdwatching | Observation of species in the area<br><br>Increase in BDV | Number of visitors (per year) | Entrance in birdwatching site (adults/child) | Number of visitors * Entrance in birdwatching site |
| | | 100 | 15,00 € | 1.500,00 € |
| Birdwatching | | Number of hides per day (5) X available suitable days per year (80) | Hide daily fee | Number of hides per day (5) X available suitable days per year (80) X Hide daily fee |
| | | 400 | 150,00 € | 60.000,00 € |
| Educational activities | | Number of students potentially interested | price of the master | Number of students potentially interested* price of the master |
| | | 30 | 3.500,00 € | 105.000,00 € |

In addition to this, the possibility to develop and deploy educational activities including masters dedicated to PhD students and professionals is also contemplated.

Other potential economic benefits can be expected in terms of costs reduction due to the mitigation of the impact of flooding events and coastal erosion in the area or to improvement of water quality and soil:

- Reduction of damage costs from flooding
- Reduction of damage costs from erosion
- Reduction of costs for water purification for agricultural uses
- Reduction of cost for solid waste recovery/treatment

However, a proper economic assessment of the potential savings is not done yet: also, these benefits do not represent a direct saving for SPA, but for other stakeholders, such as local governments and agency in charge of environmental risk protection.

From a holistic perspective, the various types of economic benefits would be a starting point to build a diversified financial strategy, with contributions from both public stakeholders (municipality, environmental agency) and private (e.g. tourism operators. However, the business strategy cannot rely on any existing mechanisms or organization that can enable to re-distribute revenues generation on order to benefit the initiator.

### Financial instruments

The funding strategy is primarily based on the LIFE funding program; given the number of financial resources needed, the LIFE program represents the ideal lever to maximize the potential of donation fund raising. The collection of donations for SPA happens on a regular and systematic basis and refers to a consolidated population of donors in Germany and Switzerland. This donation flow however is expected to finance all SPA's activities throughout Europe: additional contributions required, e.g. from EU or other public granting programs for biodiversity and nature conservation.

Concerning the role that the potential investors/funders can have in the Sicily Lagoon pilot site, in order to maintain the restoration interventions and preserve the nature over time, they can act as:

Buyers of ESS, i.e. organizations which want to purchase (or rely/benefit from) ESS and biodiversity (such as the case of biodiversity credits once this financial scheme would be available) for corporate goals.

Investors of capital, i.e. institutions like banks and funds, high net worth individuals or businesses seeking a monetary return. Repayable debt or equity investments, including short-term loans. However, at the current stage of the project, there are no expected fundings or investors from this category;

Donors of fund, i.e. grant funders, public bodies, or entities acting with philanthropic purpose. This was the existing business model for SPA in the ongoing restoration activities.

### Risk and contingency plan

This section defines risks and mitigation strategies for achieving the NbS upscaling restoration objectives (“extension 1”)

**Table 63 Overview or risks and mitigation solutions.**

| NbS | Type of risk | Likelihood | Impact | Mitigation solution |
|---|---|---|---|---|
| Coastal marshes restoration/ | High water levels in summer | Medium | Medium | Long term planning including several summers |
| Artificial islands creation | Land purchase fail of targeted lagoon/land portions | Medium | High | Alternative sites/ portions to be restored |

## 12.4. Extension 2: Financial scalability plan

### 12.4.1. Introduction: What does upscaling mean to the pilot

The "landscape scale" in the Sicily Lagoon pilot will consider other potential sites, including for example Riserva Fiume Ciane/Saline (in the province of Syracuse), Saline Priolo (in the province of Syracuse), and Pantano Gariffi (in the province of Ragusa), (RG), covering an area of, respectively, 48 ha, 13 ha and 100 ha. The three potential restoration sites are located in the Southern-Eastern part of Sicily and present some heterogeneity of environmental / bio-physical setting. Moreover, their socio-economic context and the related regulation and governance aspects are different from the Cuba-Longarini restoration site (current and extension #1).

### 12.4.2. Overview of barriers preventing upscaling

The main barriers currently preventing upscaling include lack of secure funding, a missing vision for coastal planning, conflicting interest in the surf zone, poor policymaking is mainly preventing upscaling, lack of data and of technical knowledge.

### 12.4.3. Financial strategies for upscaling

The following considerations should be taken in order to overcome existing barriers for extension #2: availability of more data on the performance of NbS, scientific and technical support for selecting restoration options, better coordination among different actors, improved governance of protected areas.

# Chapter 13. Venice Lagoon Pilot

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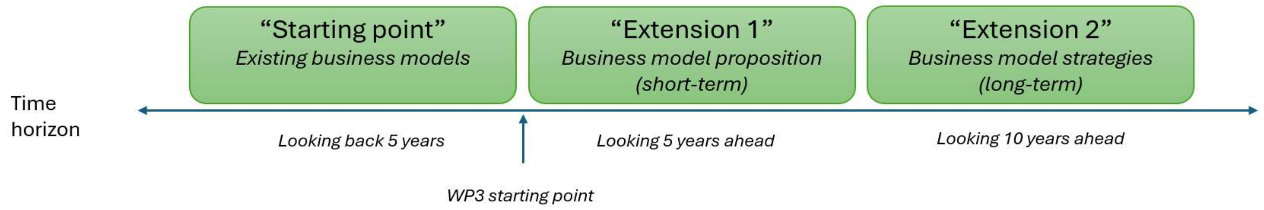
## Readers guide




**14.1 Introduction**

- **This section provides a general introduction to the Venice lagoon case**

**14.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - Restoration of existing salth marshes and mud flats in Venice lagoon

**14.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Continued and additional salt marsh restoration

**14.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Continued and additional salt marsh restoration

## 13.1. Introduction to the pilot

With a surface area of about 55,000 ha, the Venice Lagoon is the largest lagoon in the Mediterranean region, located in the northern Adriatic Sea between 45.18 and 54.57 N latitude and 12.12 and 12.63 E longitude. The lagoon is connected to the Adriatic by 3 inlets – Lido, Malamocco, and Chioggia – physically separated through two barrier islands and two splits. Moreover, the lagoon receives freshwater discharge from eleven major tributaries from the drainage basin (200 km$^2$), plus several minor rivers and a number of human regulated channels primarily used for agriculture. In the Lagoon there are 6,000 ha of seagrass meadows, 6,800 ha of natural saltmarshes and mudflats and 1,600 ha of "artificial" saltmarshes and mudflats, implemented over last three decades by the Venice Water Authority (Provveditorato interregionale per il Veneto, Trentino Alto Adige, Friuli Venezia Giulia , a local office of the Ministry of Infrastructure, hereafter, Provv. OO. PP.).

In addition to flooding, a major problem in the Venice Lagoon over the last hundred years has been erosional processes, leading to a deepening of the lagoon, as well as general sediment loss from the shallow areas to the Sea and the lagoon channels. This is due to long term antropogenic use leading to increase in mean water depth, the erosion of mudflats, the shrinking of salt marshes, the silting-up of secondary tidal channels and the disappearance of tidal creeks (Zonta et al., 2018).

Contaminant fluxes to the lagoon originate from different sources and activities, including the agriculture in drainage basin, a large industrial area (Porto Marghera), increased port activities, growing fishing and aquaculture, and unprecedented levels of tourism. In the pilot area the current NbS restoration interventions of "active maintenance" aim to counteract the erosion of the edges of the saltmarshes' and accelerate the "naturalization" processes for increasing priority habitats and biodiversity. Naturalisation is an essential part of the long-term plan for maintaining the intertidal Lagoon habitat. Within the planned works in the pilot, two main phases can be identified. Phase I consists of interventions to protect the edges of degraded artificial saltmarshes, intending to set the ground for upcoming active restorations. Phase II of the works will transfer sediments to the saltmarshes. Results from the two phases created suitable conditions for the subsequent naturalization process of the morphological structures (e.g. colonization by vegetation and use of the habitats from different wildlife species).

The current restoration plan within REST-COAST considers three executive approved projects that focuses on 11 saltmarshes, for a total of 11 saltmarshes and 138 hectares.

Furthermore, in the H2020 WaterLANDS project, 3 additional saltmarshes, located in the same area,-for an overall area of 21 ha will be considered for modelling the potential restoration upscaling in the lagoon. Considering the two projects, the broader pilot area to be used as a basis for modelling the upscaling restoration plan in the Venice Lagoon consists of about 160 ha of saltmarshes.

The **upscaling plan** is aimed at evaluating the possibility of extending the NbS to the 1,600 ha of artificial saltmarshes and mudflats. The decision regarding the type of interventions and where to implement them in the lagoon will be made through modelling, experts' evaluation and listening the stakeholders' opinions. An overview of the NbS interventions in the Venice Lagoon pilot, distinguishing current restoration, upscaling plan (extension #1) and landscape scale plan (extension #2) is provided by Table 64.

**Table 64 NbS restoration upscaling levels targeted by REST-COAST tasks**

| Level of upscale/extension | Area of NbS restoration interventions | Status of restoration | Business model | Business Plan | Horizon (years) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Current | 11 saltmarshes (from REST-COAST) plus 3 saltmarshes (from WaterLANDS) summing to 159 ha. | Ongoing<br>(Phase I - interventions to protect the edges- and Phase II - transfer of sediments) | Grants (public funding) | Identifie d | Phase I: 1,5.<br>Phase II: 1 |
| Extension #1 | Restoring artificial saltmarshes and mudflats among the 1.600 ha created in the past 30 years in the Venice Lagoon. Areas to be decided through modelling / expert evaluation. | Early stage of planning | Identified | Identifie d | 1-5 years |
| T3.3.3 Financial Scalability Plan<br>Extension #2 | Creating additional artificial saltmarshes and mudflats to the already existing 1.600 ha in the Venice Lagoon | Envisaged | Not applicable | Not identifie d | 5-10 years |

## 13.2. Starting point: Current Business Model

This section briefly introduces the business model that is currently in place in the Venice Lagoon and the main ongoing restoration activities. More detailed information about the current business model and the two extensions described in the next sections is available in Pernice et al., 2024.

### 13.2.1. Coastal restoration activities

As mentioned in section 11.1, the current saltmarshes restoration activities, planned and ongoing in the central-southern part of the Lagoon within REST-COAST, foresee two phases, of ca 5 years completed by the naturalization process:

Phase I is initiated by Provv OO. PP. (Ministry of Infrastructures)

Phase II is initiated by the Port Authority of Venice (Ministry of Infrastructures).

More specifically, the NbS restoration activities currently ongoing in the Venice pilot are below described:

Phase I: Interventions to protect the edges of the saltmarshes:

- Recovery of waste (wood, scrap, boulders) by means of a pontoon with a mechanical excavator of adequate power, including loading and water transport to land for the disposal to an authorized landfill.
- cutting and removal of the damaged boundary palisade and the entire hydraulic network.

- removal of damaged big clods (in Italian “burghe/buzzoni”) and transportation to land for disposal in a controlled landfill.
- creation of a filtering wall to protect the salt marshes boundary.
- surface cleaning of the saltmarsh perimeter (approximately 10m strip along the boundary) by removing the residual materials and non-biodegradable waste
- biocompatible "anti-worm" treatment with Iron Oxide against biological degradation, applied to wooden piles to be used for the construction of filtering walls for the containment of sediments pumped on the saltmarshes or to protect their margins.
- Supply and underwater installation (including anchoring) up to a depth of 2.00 meters from the m.s.l. of box mattresses with a thickness of 10-12 cm, consisting of a polyester geotextile filled with pebbles and/or gravel ranging from 20 to 30 mm.
- Preparation of the laying plan for textile structures (burghe) behind the degraded saltmarsh boundaries.
- Supply and installation of cylindrical-shaped textile structures with a length of 3 m and a diameter of 60 cm (burghe), consisting of a high-tenacity polyester textile geogrid filled with pebbles and/or gravel.
- Importantly, as part of the improvements introduced thanks to the REST-COAST project, the creation of more water-permeable margins and openings to favour the entrance of the water and the related development of small canals called “ghebi” has been done, as well as the reshaping of the high elevated areas of the saltmarshes being covered by a vegetation not typical of the natural saltmarshes, also consisting of a invasive alien species (e.g. Baccharis halimifolia).

Phase II: Nourishment of the salt marshes with new sediments coming from the dredging of canals:

- Large-section underwater excavation of lagoon channels (6 to 12 m depth) including transport from the area of excavation to the area of delivery and unloading of sediment.
- Screening of dredged material by means of appropriate grilled frames with the aim of separating the sediment from any waste or gravel that cannot be used for the nourishment.
- Pumping of sediment coming from the excavations of the lagoon channels on the saltmarshes by means of floating and fixed pipes and reorganization of the sediment nourished.

Figure 78 provides an image of a saltmarsh border section detailing the different activities performed during Phase I.

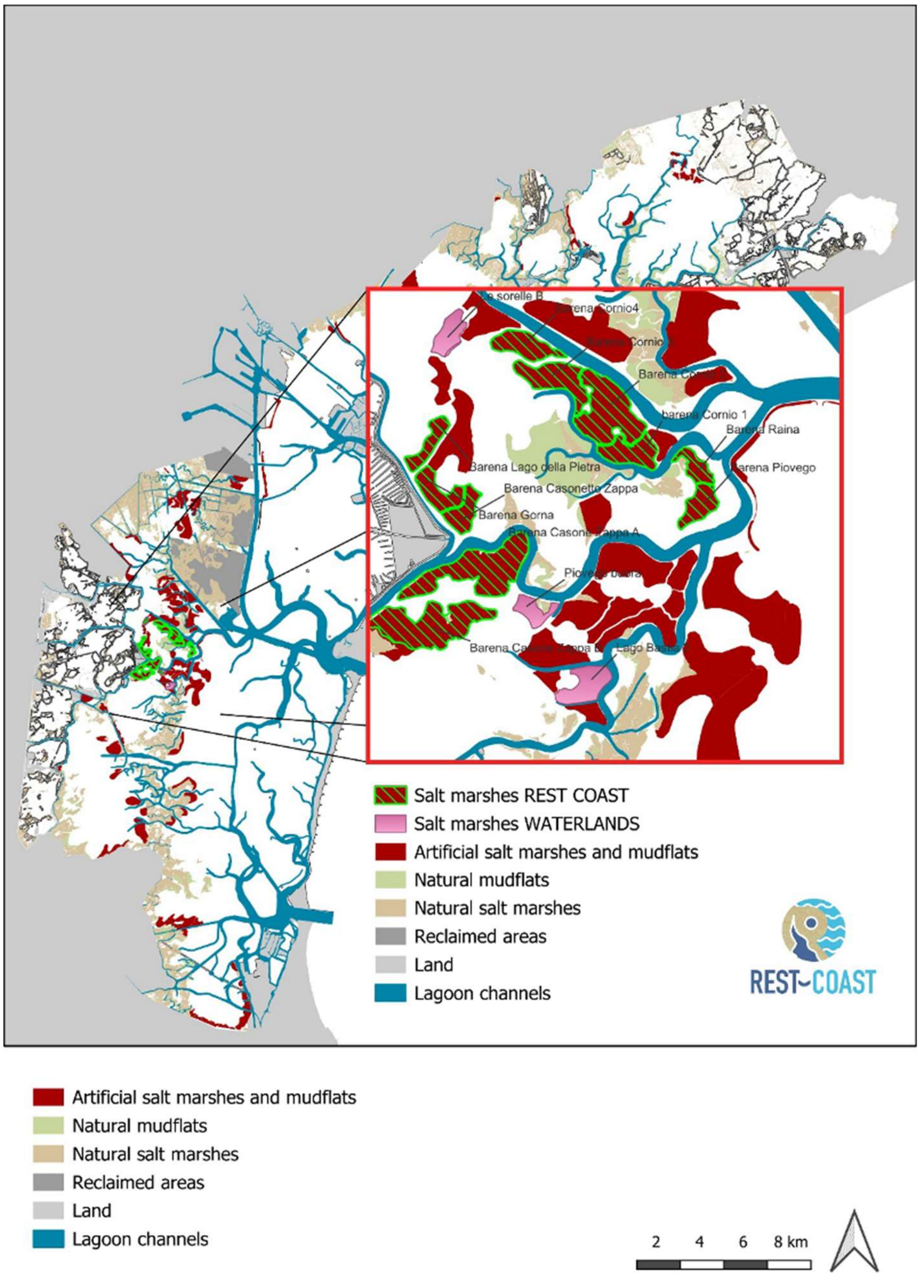



**Figure 78 Representative image of a saltmarsh border section detailing the different activities performed by the two projects REST-COAST and WaterLANDS.**

Monitoring activities have been implemented through a procurement by Provv. OO. PP. for vegetation, sedimentation, and water quality indicators; the latter is implemented with the support of University of Padova. The monitoring of seagrasses and birds community was procured by the Consortium for coordination of research activities concerning the Venice lagoon system (CORILA); all the monitoring activities and consequent analysis have been assigned to high specialized companies operating in the lagoon of Venice. All the partners and LTPs, including CORILA, Euro-Mediterranean Center on Climate Change (CMCC), the University of Padua and the Ca' Foscari University of Venice, are involved in the data analysis, modelling and stakeholders' engagement.

The business model supporting the ongoing restoration activities is only based on granting arrangements with the national government, the Ministry of Infrastructure and Transport which provided grants for restoration activities in phase I (budget of Provv. OO. PP) and grants for restoration activities in phase II (budget of the Port Authority of Venice). In phase I of the pilot, the procurement of restoration activities is done by the initiator Provv. OO. PP., partially through its in-house delivery is the Consorzio Venezia Nuova (CVN), with the exception of monitoring activities which are procured through a segmented procurement. A similar procurement approach is adopted for phase II.

There are no financing arrangements and value capture arrangements currently in place. In phase II, however, the Venice Port Authority will execute the delivery and deposition of sediments required for the restoration of the artificial salt marshes. These sediments will be sourced from the Authority's regular dredging activities to maintain the accessibility of Venice’s ports. The reuse of those sediments in the saltmarshes, when they are of good quality, instead of storing them in expensive landfills, will result in cost savings.

#### 13.2.2. ESS and Economic good typology

The current ESS generated by the restoration activities in the pilot site include biodiversity enhancements, food provisioning (fish resources), water quality improvement (filtering function of the salt marshes), flood risk reduction, erosion risk reduction, carbon capture and storage.

#### 13.2.3. Funding: granting

The restoration activities in phase I are based on granting arrangements with the national government, the Ministry of Infrastructure and Transport (MIT) and partially (for the restoration of the “Raina” and “Piovego” salt marshes) on granting from Piano Europa, as part of the mandatory compensation measures required by the European Commission following the infringement procedure 2003/4762 addressing the negative environmental impacts of the “MOSE” system specifically. EU Grants from the Horizon 2020 program are funding part of the monitoring (partly funded by the Provv. OO. PP.) and all data analysis activities for all restoration actions. Funds for restoration activities in phase II arrive from the Port Authority of Venice as it is in charge of the delivery and deposition of the sediments required for the restoration of the artificial saltmarshes.

#### 13.2.4. Funding: value capture

There are currently no value capture arrangements in place.

#### 13.2.5. Finance

No financing arrangements are currently in place

#### 13.2.6. Procurement arrangements

In phase I of the pilot, the procurement of restoration activities is done partially through a segmented procurement, and partially through in-house delivery by the initiator Provv. OO. PP. the to Consorzio Venezia Nuova (Piano Europa” activities). In phase II, the initiator Venice Port Authority executes the on-the-ground construction activities with its own resources through a segmented procurement .

The monitoring activities are carried out by Provv. OO. PP., directly with its own resources adopting an in-house procurement model, while the remaining monitoring activities are delivered by CORILA, assigned to specialised company through public procurement, and the University of Padova. The University Ca’ Foscari of Venice and CMCC are partners of Rest-Coast project for the analysis of data and other research activities

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### 13.2.7. Critical funding and financing challenges

The main financial barriers identified in Fausto & Hinkel (2023) include the following:

Tourism user fees. The mechanisms that should be implemented should address the financial barrier of the (Long) time lag for impact. For this, the transfer enablers include: Water quality and biodiversity ESS produced; Beneficiary identified; and Pre-existing hospitality facility. The transfer barrier is social acceptance.

Carbon credits. The restoration of salt marshes in the Venice Pilot is expected to deliver climate mitigation ESS. However, carbon sequestration, taking into account GHG emissions, should have to be quantified and monitored with dedicated surveys. The implementation of the financial mechanism should also address the financial barrier of Low excludability. For this, the transfer enablers are: Stated interest from key stakeholders and Planned activities to enhance ESS. The transfer barrier are: Climate mitigation ESS not yet produced nor quantified; Financial service provider (carbon standard) not identified yet; Potential insufficient ESS output; and High transaction costs.

Project bundling. The REST-COAST Venice Pilot is not the only restoration project operating in the Venice lagoon. Several initiatives are currently implementing wetland restoration techniques and putting efforts into experimenting with innovative financial approaches and NbS business models. Common project goals and geographical scope suggest that synergies among the different projects should be explored, in particular with regards to the possibility of aggregating the different initiatives as a bundled investment proposal. The mechanisms should address the financial barriers of Uncertain ESS performance, ticket size mismatches. For this, the transfer enablers are: Presence of several restoration projects in the area; Homogeneity among restoration initiatives. The transfer barriers are: Provider of financial services (bundling intermediary) not identified yet; Lack of revenue generation.

## 13.3. Extension 1: Business model proposition and Business plan

### 13.3.1. Executive Summary

This business plan describes the management, business and financial strategies for upscaling saltmarshes restoration to 1,600 ha of artificial saltmarshes and mudflats already existing in the Lagoon of Venice through the envisioned modelling of the impact of 138 ha of saltmarshes currently under restoration. The business plan involves experts' evaluation and stakeholders' opinion and considers a time horizon of five years. The upscaled restoration plan will target different interconnected problems (i.e. erosion, damages from flooding, subsidence, loss of sediments, loss of habitats and biodiversity, wave motion, water pollution and solid waste) allowing the improvement of five ESS as well as biodiversity that will produce a large variety of benefits of environmental, economic, social and cultural type to multiple stakeholders and beneficiaries.

Two public bodies, Provv. OO. PP and Venice Port Authority (VPA), will jointly manage a set of interventions to protect the edges and nourish the saltmarshes with sediments coming from the dredging of the canals, supported, through procurement arrangements, by several implementing organizations of technical competence. The significant amount of estimated costs necessitates a financial strategy that goes beyond public funding (granting arrangements) by catalysing private investments through innovative financing arrangements and value capture arrangements, stimulated by economic activities in eco-tourism, eco-labelled products, complemented by educational activities with economic return and compensated by significant amount of costs savings.

| **Value proposition** | **Problems addressed**<br>-Erosion<br>-Damaged from flooding | **Benefits produced**<br><u>Environmental benefits</u> Natural (re)vegetation dynamics; Habitat and enhanced biodiversity; Carbon capture; Higher self-depuration capacity; |
|---|---|---|

| | | | |
|---|---|---|---|
| | -Subsidence<br>-Loss of sediments<br>-Wave motion<br>-Water pollution and solid waste<br>-Loss of habitats and biodiversity | Protection and nursery; New areas colonized by autochthonous vegetation.<br>Economic benefits Ecotourism; Reduction of flooding, coastal erosion damage costs; Educational activities.<br>Social benefits Safer life; Space of quality; Traditional fishing.<br>Cultural benefits Traditional fishing techniques; Maintain cultural landmarks | |
| **Value creation** | **Key partners**<br><br>Provv OO. PP. and Port Authority of Venice (initiators), supported, through procurement arrangement, by several implementers of scientific (CORILA, CMCC, UNIVE and UNIPD) and technical competence. | **Regulation and Governance**<br><br>UNESCO World heritage site. Three legal systems: ordinary, special, and commissarial. Three policy levels: EU, National, Regional.<br>New Venice Lagoon Authority foreseen to replace in the restoration works Provv OO. PP.<br>Governance structure is moderately clear.<br>Multiple administrative levels.<br>Although roles of institutions are defined, some topics involve more than one single institution leading sometimes to the block of processes. | |
| | **Key resources**<br><br>-Scientific and technical expertise (director of works, multidisciplinary team, RUP, CSP, CSE)<br>-Technical means (equipment needed by the contracting companies)<br>-Tools (e.g. monitoring instruments) | **Customer segments**<br><br>No direct customers<br>-Eco-tourists (birdwatchers, nature lovers, passionate about recreational fishing, etc.)<br>-Students for educational activities<br>-Entrepreneurs contributing to restoration activities | **Stakeholders**<br><br>38 stakeholders (25 private and 13 public) split into 7 categories:<br>10 Gov org., 4 Research org., 9 Companies, 4 NGOs 7 Economic associations, and n.4 Environmental associations |
| | **Key activities**<br><br>-Phase 1. Interventions to protect the edges of the saltmarshes<br>-Phase 2: Nourishment of the salt marshes with new sediments coming from the dredge of the canals | **Customer relations and channels**<br><br>-Wide range of means and social media<br>-Series of attractions reward NbS-friendly actions and services<br>-Annual advanced training course<br>-Basic e-learning courses<br>-Events, seminars, etc. | **Beneficiaries**<br><br>-Tourists and visitors<br>-(social) entrepreneurs<br>-Owners / managers of "valli di pesca"<br>-Artists and cultural organizations<br>-Schools<br>-Citizens and local communities<br>-Policy makers) |
| **Value capture** | **Costs**<br><br>Costs for phase 1 (362 € cost per linear meter)<br>Costs for phase 2 (19 € cost per m3 of sediment nourished) | **Revenue streams**<br><br>Ecotourism (€250.000)<br>Educational activities<br>Carbon credit (not estimated yet)<br>Avoided costs of dredging activites | **Financing and funding**<br><br>Taxation, Public grants |
| **Transversal categories** | **Impact indicators**<br><br>-Improvements of ESS output/level<br>-Indices of increased BDV<br>-Impact on human (increased knowledge) and produced capital (revenues from eco-tourism, education, GDP) | | **Risks**<br><br>-Emissions for sediment transport<br>-Delay for changes in responsibilities<br>-Additional funding availability |

**Figure 79 Business Model Canvas for salt marsh restoration in the Venice Lagoon**

### 13.3.2. Mission and Objectives of the restoration initiator

This section defines the overall mission of the initiator (Favero et al. 2022) (organisation(s) committed to *extending* NbS restoration) in the pilot area and *extending* NbS restoration objectives ("extension 1")

Restoration in the Venice Lagoon is dictated by a set of precise laws (e.g., L. 171/73, L. 798/84, L.360/91, and L.139/92), requiring the safeguarding of Venice and its Lagoon. These laws affect responsibilities, instruments, measures and financial resources for carrying out the restoration activities. Two public bodies, Provv. OO. PP and VPA have jointly provided, up to now, the recovery and maintenance of the Lagoon's habitats and morphology, according to their institutional mission. Provv. OO. PP, responsible for the safeguarding and management of the Venice Lagoon, by intervening in the Lagoon with ordinary and extraordinary maintenance works through its concessionaire or private companies that won the tender procedures relative to specific projects; VPA, responsible for planning, coordinating, promoting and controlling port operations in the Venice Lagoon, by dredging the Lagoon canals in order to guarantee safety of navigation to ships. In the coming future, at a date not yet defined, the Provv. OO. PP. will be replaced by the Venice Lagoon Authority.

The main upscaling restoration **objectives** include:

- to avoid the disappearance of the degraded morphological structures (both natural and artificial);
- to contrast the erosion process and the negative trend of loss of sediments in the lagoon;
- to attenuate the wave motion and reduce its effects on the shores;
- to favour hydrodynamic exchanges within the lagoon;
- to filter nutrients and pollutants thus improving water quality;
- to create new habitats for wildlife, in particular for vegetation and birds, thus improving and safeguarding the biodiversity;
- to create nursery, protection and provision areas for fish and increase yields of fisheries;
- to attract, in a regulated and sustainable manner, visitors and tourists all year round;
- to capture atmospheric carbon ($CO_2$) and sequester it in the soil.

### 13.3.3. Stakeholder overview

The pilot core team has identified 38 stakeholders from a list of more than 70 stakeholders that will be affected by upscaling NbS restoration in the Venice Lagoon, most of which are included within the REST-COAST CORE-PLAT (COastal REstoration PLATform), established as a platform for dialogue and collaboration to foster the exchange of knowledge, and ultimately develop a shared vision for the future of the lagoon.

**Table 65 List of the stakeholders engaged in the Venetian CORE-PLAT (list updated up to August 2024).**

| ID | name of the organization | Mandate, role and responsibilities | Legal nature | Category | Level |
|---|---|---|---|---|---|
| 1 | Amici del Parco di San Giuliano | Local Association operating in environmental protection | Private | Environmental association | Local |
| 2 | Ass. Coldiretti Veneto | Trade organization operating in agri-food and related activities in the Veneto region. | Private | Economic association | Supralocal |

| | | | | | |
|---|---|---|---|---|---|
| 3 | Ass. Laguna Venexiana Onlus | Environmental protection, cultural heritage, and community engagement. | Private | Environmental association | Local |
| 4 | Ass. Legambiente Venezia | Safeguarding the environment | Private | NGOs (environmental) | Local |
| 5 | Ass. Venice Lagoon Plastic Free | Environmental protection | Private | NGOs (environmental) | Local |
| 6 | Ass. We Are Here Venice | Environmental protection | Private | NGOs (environmental) | National |
| 7 | Ass. Wigwam | Safeguarding the environment through collaboration with local communities in the global Wigwam network. | Private | Environmental association | Local |
| 8 | Autorità Portuale di Venezia | Planning, coordinating, and controlling port operations in the Northeast area. | Public | Government | National |
| 9 | CMCC - Centro Mediterraneo Cambiamenti Climatici | Provides full analyses of climate impacts on socio-economic systems and supports policymakers in setting and assessing costs, mitigation, and adaptation policies. | Public | Research institutions and education | International |
| 10 | Comune Cavallino Treporti | Planning and Managing authority | Public | Government | Local |
| 11 | Comune Codevigo | Planning and Managing authority | Public | Government | Local |
| 12 | Comune Venezia | Planning and Managing authority | Public | Government | Local |
| 13 | Confraternita Serenissima (Studio Battaglierin s.r.l.) | Protection of the lagoon environment. | Private | Company | Local |
| 14 | Consorzio di Bonifica Veneto Orientale | Land reclamation and water management in the Veneto region. It operates in agriculture, environmental protection, and water resource management. | Public | Government | Supralocal |

| | | | | | |
|---|---|---|---|---|---|
| 15 | Consorzio Venezia Nuova | Concessionaire of Provv OO.PP. for the implementation of the interventions for the protection of Venice and the lagoon. | Private | Company | Supraloc al |
| 16 | CORILA | Association between Ca 'Foscari University of Venice, IUAV University of Venice, University of Padua, National Research Council and National Institute of Oceanography and Experimental Geophysics. | Private | Research institutions and education | National |
| 17 | Fam. Roncato | Owner and manager of Valle Zappa, in the central lagoon of Venice, where hunting and fishing are practiced. | Private | Company | Local |
| 18 | Greensea Soc. consulenza ambientale | Scientific research and consultancy focusing on aquatic and transition ecosystems. | Private | Company | Supraloc al |
| 19 | Isole Native S.a.s. | Morphological recovery of the island "Isola del Prà" in the Venice lagoon. | Private | Company | Local |
| 20 | Provveditorato Interregionale OO.PP. Triveneto | Venice Water Authority responsible for the works in the Venice lagoon. | Public | Government | National |
| 21 | Regione Veneto | Planning and Managing authority. It deals with Natura 2000 Network, the Special Law for Venice and that on tourism and fishing. | Public | Government | Supraloc al |
| 22 | SELC Soc. Coop. | Environmental and bioengineering fields at regional, national and international level. | Private | Company | Supraloc al |
| 23 | Soprintendenza Archeologia, belle arti e paesaggio per il Comune di Venezia e Laguna | Safeguarding and protection through the control, regulated by legislative devices, of building and land management activities. | Public | Government | Supraloc al |
| 24 | University Ca' Foscari of Venice | Key role in preserving and advancing Venice's cultural heritage while contributing to various fields of study through innovative teaching and research initiatives, even in environmental field. | Public | Research institutions and education | National |

| | | | | | |
|---|---|---|---|---|---|
| 25 | University of Padua | Multi-disciplinary institute of higher education, the University aims to provide its students with professional training and a solid cultural background | Public | Research institutions and education | National |
| 26 | WWF | Safeguarding the environment | Private | NGOs (environmenta l) | National |
| 27 | Venezia birdwatching (VE BW) | Promotes dissemination of birdwatching and protection of avifauna and monitor changes in the environments or avifauna. | Private | Environmental association | Supraloc al |
| 28 | Vela al terzo | Organizes nine “regate” a year for traditional boats and non-competitive social sailings; collects and systematize the data of all the traditional boats still circulating in the lagoon; organizes, exhibitions and conferences on traditional seafaring topics; participates in teaching sailing courses. | Private | Economic association | Local |
| 29 | Associazione Settemari | Spreads the sporting discipline of Venetian rowing; contributes to the implementation of sporting, cultural, social or recreational initiatives within the framework of the Venetian traditions to preserve the way of life and the perpetuation of Venetianness. | Private | Economic association | Local |
| 30 | Lazzaretti Veneziani | Project promoted by the Ekos Club and Archeoclub d'Italia Sede di Venezia associations, in collaboration with institutions, local, national and international entities, based in the island of Lazzaretto Nuovo in the Northern Lagoon of Venice. The island has been regenerated from abandonment and brought back to the community through a non-profit initiative. It is now an ecomuseum dedicated to the territory and its community and is part of the 20% of the most visited cultural and environmental assets in Italy. | Private | Economic association | Local |

| | | | | | |
|---|---|---|---|---|---|
| 31 | Associazione Operatori del Turismo Sostenibile della Laguna di Venezia (OTS) | Protection and promotion of sustainable tourism within the territory of the "Venice Lagoon". | Private | Economic association | Local |
| 32 | ATN Laguna Sud | It is the tourist and navigation promotion agency of the company "Valle Cornio S.p.A". | Private | Economic association | Local |
| 33 | Agriturismo La Barena | Farmhouse is in the northern lagoon of Venice recognized as a sustainable tourism operator (OTS). | Private | Company | Local |
| 34 | Veritas S.p.A | Public waste management company providing environmental services to citizens and businesses. | Public | Government | Supralocal |
| 35 | Stari Ribar | Massimo Marchiori, in art Stari Ribar, is a Venetian artist who creates his works thanks to the collection and reuse of waste collected along the coast and in the lagoon, educating the public to respect the environment, encouraging them to recycle and collect waste correctly. | Private | Company | National |
| 36 | Il Cerchio | Social cooperative pursuing, through the activities of its members, the general interest of the community, human solidarity, social integration of citizens and of promoting sustainable development. | Private | Company | Local |
| 37 | Società Cooperativa San Marco - Pescatori di Burano | Includes approximately 90 members. It deals with shellfish farming and small-scale coastal fishing, offering a fishing tourism activity. | Private | Economic association | Local |
| 38 | Veneto Agricoltura | Instrumental body of the Veneto Region, which carries out support activities for the Regional Council in the context of policies for the agricultural, agri-food, forestry and fishing sectors. | Public | Government | Supralocal |

Of the 38 stakeholders, 25 are from the private sector, while 13 are from the public sector. Based on the alignment and engagement of the stakeholders with NbS (an analysis made in synergy with the work executed in WP5), 19 out of 38 stakeholders (16 from the private sector, representing research institutions, NGOs, environmental/economic associations and companies; and 3 from the public sector, all research institutions) have a very-high alignment. Two stakeholders included in this group (i.e., WWF and Agriturismo La Barena) are site managers. The remaining 19 stakeholders are partially aligned with the NbS paradigm. Of this group, 10 are public governmental organizations, of which 9 are site managers.

Assessing the level of influence/interest of stakeholders, using a ranking scale from 1/lowest relevance to 5/highest relevance, the map in Figure 80 shows the positioning of the stakeholders involved in restoration upscaling in the Venice Lagoon pilot.


**Figure 80** Stakeholder mapping in Venice lagoon (interest/influence)

The map, in the upper right quadrant, highlights the two governmental organizations (i.e. Provv. OO. PP. and VPA) who are the initiators of the current restoration activities in the Venice Lagoon, followed by CVN who is the concessionaire of Provv. OO. PP. for the implementation of the interventions to protect Venice and the lagoon all four research organizations and most part of NGOs/Environmental associations. The engagement strategy is to actively engage in co-shaping the business plan and in planning, implementing and monitoring the restoration interventions, through dedicated project meetings and workshops, but also through dissemination and communication events.

### 13.3.4. Business model proposition

The business model is described in three main components: i) the value propositions derived by coastal restoration; ii) the activities and the organizations engaged in creating and delivering the value propositions; iii) the value capture mechanisms that will allow to generate revenues and get funding in order to sustain the restoration investments. The business model canvas (figure 80) provides an overview of the proposed business model co-developed with stakeholders in the Venice lagoon (Pernice et al, 2024).

#### Value proposition

This section describes the value that NbS restoration aim to create for different stakeholders and beneficiaries. Such a value is determined by assessing the relevance of the problems requiring restoration and the contribution that upscaling restoration objectives can provide to solve the problems.

Several problems that can be addressed by salt-marshes restoration were identified from the assessment undertaken by the Venice Lagoon pilot team and the main stakeholders. In particular erosion, damages from flooding and subsidence are the three main problems that can lead to:

- Loss of land, threatening the stability and altering the shape and size of emerged land.
- Morphological changes: coastal and lagoon erosion can cause significant changes in landscape, influencing sediment distribution and hydrodynamics.
- Increased vulnerability to storms: eroded Lagoon areas are more susceptible to storm impacts, including flooding, accelerated erosion due to wind, and damages to infrastructure.
- Damage to ecosystems: natural habitats are degraded, resulting in biodiversity loss and degradation of delicate ecosystems such as saltmarshes and mudflats.
- Impact on fishery: fishing activities, especially the traditional ones by local communities, may be affected by erosion, reducing habitat availability for the fish community.
- Risk to buildings and infrastructure: the erosion creates risk to buildings and infrastructure, requiring costly protection and need of maintenance.
- Impact on tourism: eroded habitats can diminish the attractiveness of the environment, negatively impacting local economies and residents reliant on tourism.
- Loss of cultural heritage: erosion threatens historical and cultural sites, resulting in the irreversible loss of cultural and archaeological heritage and in the need of maintenance works

In addition, the following problems were also considered:

- Loss of sediments mainly affects the central-southern part of the Venice lagoon, due to the amount of material annually lost through the inlets, which cause a deepening and “marinization” of this area. Sediments that can be used for the morphological reconstruction of the artificial structures of the lagoon mainly come from the dredging of navigable channels which may be polluted. The two authorities that are responsible for the maintenance works and restoration interventions in the lagoon, namely the Provv. OO. PP. and VPA are therefore the ones more affected by this issue.
- Water pollution and solid waste are present in the whole lagoon. Besides affecting the inhabitants' health and quality of life of people that use the lagoon, these two problems affect mainly the stakeholders that have an economic activity inside the lagoon (such as fishermen, mussel farmers, tourism companies, NGOs etc.).
- Loss of habitats and loss of biodiversity mainly concern the environmental associations, fishermen and hunters, mussel farmers, the tourism sector and people working with nature or nature lovers (e.g. birdwatchers).

The pilot Core Team and their stakeholders were requested to assess the **relevance of the improved ESS and Biodiversity** for contributing to solving the above-listed problems. It emerged that saltmarshes and mudflats (both natural and man-made) provide essential ESS that are listed below:

- They favour hydrodynamic exchanges (e.g., water currents) within the entire lagoon;
- They filter nutrients and pollutants improving water quality;
- They dissipate waves and mitigate erosion during storms;
- They enhance biodiversity and provide a unique habitat for a variety of transitional and indigenous biota;
- They provide a significant part of coastal primary production;
- They are areas for fish (juveniles) and increase yields of fisheries;
- They are beautiful and attractive habitats able to attract visitors and tourists all year round;
- They have a strong capability to capture atmospheric carbon (CO2) – blue carbon and sequester it in their soil.

Moreover, according to the pilot team perspective, restoring artificial saltmarshes not only increases biodiversity and provides several ESS, but also opens the possibility for using NbS interventions as "laboratories" to introduce improvements that can be internalized in future restoration works in the lagoon, in the upscaling restoration process.

Following the description of the problems identified and the contribution that NbS restoration can provide to solve them by improving ESS and biodiversity, the following table summarises the four types of environmental, economic, social and cultural benefits provided by each ESS.

**Table 66 Environmental, economic, social and cultural benefits associated with the restored saltmarshes occurring alongside the provisioning of ES and BdV improvements, according to the pilot Core Team and their stakeholders**

| ESS, BdV | ESS /BdV output level | Benefits | | | |
|---|---|---|---|---|---|
| | | **Environmental** | **Economic** | **Social** | **Cultural** |
| NbS #1 – Saltmarsh restoration | | | | | |
| Reduction of coastal flooding risk [RCF] | Reduction of wave energy considering a larger restored surface and the proximity of additional restored saltmarshes from the ancient city and other inhabited areas | Potential for natural (re)vegetation dynamics in the saltmarshes | Reduction of damage costs from flooding.<br>Eco touristic activities.<br>Corporate Social Responsibility activities. | Safer life | Maintain cultural landmarks.<br>Educational activities |
| Reduction of coastal erosion [RCE] | Change in saltmarsh extent and shape (enhanced hectares of restored saltmarshes) | Habitat availability and enhanced biodiversity | Philanthropic activities.<br>Educational activities | Space of quality, higher sense of attachment/<br>Identity. | |

| | | | | | |
|---|---|---|---|---|---|
| Carbon sequestration/Climate change regulation [CCR] | Mean Carbon stock in 1 m topsoil (Mg/ha) | Capture of carbon, reduction of CO2 in the air | | | |
| Water purification [WP] | Lower concentration of pollutants and nutrients in the water. | Higher self-depuration capacity | Higher survival of commercial and not commercial species and improvement of water use for aquaculture[7] purposes. | Opportunity to exploit an improved lagoon environment from the water quality perspective for social purposes. | |
| Fish provisioning [FP] | Abundance of fish | Offering protection and nursery areas | Increase in availability of fish of economic value.<br>Recreational fishing.<br>Experiencing traditional fishing. | Traditional fisheries. Social inclusion through fishing associations. | Traditional (artisanal) fishing techniques (artisanal) |
| Biodiversity [BdV] | Number of species of interest (e.g. Habitat and Bird Directives) and abundance, especially birds. Decrease in alloctone and invasive species abundance (e.g. Baccharis halimifolia). | Availability of new areas colonized by autochthonous species of vegetation; habitats for feeding, roosting and breeding birds | Eco-tourism<br>Circular-economy derived activities.<br>Educational opportunity.<br>CSR activities for NbS.<br>Philanthropic activities | Educational opportunity.<br>Space of quality, higher sense of attachment/, identity<br>Improvement of human health. | Human-nature experience Maintain/<br>conserve landscape. |

It is worth specifying that no additional environmental initiatives related to carbon sequestration in the Venice Lagoon are envisaged. This is because the performed interventions are considered quite expensive,

[7] Due to the salinity of the transitional water of the lagoon, there is no significant use of water for irrigation purposes.

and the sequestration potential the restored area is hard to evaluate. It is therefore hard to predict how long it would take to reach a net positive carbon balance and therefore properly estimate any economic benefit.

Other economic and environmental benefits include:

The reuse of the sediments dredged from the lagoon channels for the saltmarshes refilling, besides being a form of circular economy, may reduce the costs for VPA as alternatively they should be transferred to an authorized landfill (once moved, the sediments are considered hazardous waste), also leading in this way to a significant environmental impact due to the emissions linked to the sediments' transport by water and by land;

- eco/green-labelled products, such as saltmarshes honey and other local specialties following the emerging trend of sustainable marketing and branding.

The economic benefits associated to the five main ES and Biodiversity can be described in terms of economic goods and can be classified according to their exclusion and rivalry, as indicated in Table 67.

**Table 67 Overview of the ESS delivered (E- Excludable; R – Rival; NE – Non- Excludable; NR- Non-rival)**

| ESS/BdV | E- Excludable; R – Rival |
|---|---|
| Food Provisioning [FP] | E +R |
| Climate Change Regulation [CCR] | NE + NR |
| Water Quality Purification [WP] | NE + NR |
| Reduction of coastal erosion risk [RCE] | NE + NR |
| Reduction of coastal flooding risk [RFR] (upstream) | NE + NR |
| Biodiversity [BdV] | NE + NR |
| Eco-Tourism [TOU] | E + NR |

The primary value relies on the benefits with highest ranking value provided by the Core Team, based on the restoration upscaling, therefore considering the whole lagoon, i.e. mitigation of soil erosion and improvement of hydrodynamic exchanges, enhancement of water purification, improvement of biodiversity, favouring a sustainable tourism.

The secondary value relies on the ESS with lower ranking value, including reduction of flooding risk and climate change regulation.

Market analysis (demand and supply) and legal requirements

The value proposition, consisting of specific interventions for saltmarshes restoration shall take into consideration the potential market demand that beneficiaries/customers can express for those products and/or services derived by economic activities that benefit from the improvements in ES and biodiversity triggered by NbS restoration. These benefits may generate potential economic transactions for several stakeholders impacted by saltmarshes restoration.

The main sectors of the market demand that will be relevant for generating potential revenues are represented by:

- Eco-tourism (including bird watching, recreational boating, recreational fishing, etc.).

- Educational activities on nature restoration
- Economic activities of organisations contributing to implement NbS interventions. These organizations from one side act as implementers of restoration activities, thus representing a cost for the initiator. From the other side since they benefit from being engaged in restoration works, can counterbalance the income generate by supporting restoration investments
- Economic activities linked to eco-labelled products

Value creation & delivery

This section describes how the two initiators, the Provv. and VPA, will engage other implementers in upscaling restoration. The engagement will be done through the implementation of a management strategy, procurement/contractual arrangements and business strategy.

The **initiators** of the upscaling NbS restoration intervention will be the same institutions as for the current pilot action (Provv OO.PP. and VPA), until the establishment of the new Lagoon Authority. With the establishment of the new authority, the lagoon government system will undergo some changes. It is anticipated that the Authority will assume some of the responsibilities of the Provv. OO. PP. and its concessionaire CVN, besides promoting studies and research aimed at safeguarding Venice and its lagoon and fostering activities in applied research, information dissemination, and education.

The **NbS restoration interventio**n planned in the Venice pilot is saltmarsh restoration that includes the active maintenance of artificial morphological structures already existent, upscaling the activities described in the two main phases of the current restoration intervention in the upscaled area of 1.600 ha, as indicated in the table below.

**Table 68 Duration of NbS restoration in the Venice lagoon (total and for each phase of the works)**

| Restoration activities | Duration | Planning | Implementing | Monitoring |
|---|---|---|---|---|
| Phase I - Interventions to protect the edges (this phase also includes the activity of recovery of waste (wood, scrap, boulders), including loading and water transport to an authorized landfill). | ~ 5 years | ~ 2 years | 1 year | 1 year |
| Phase II. Nourishment of the saltmarshes | ~ 5 years | ~ 2 years | 1 year | 1 year |
| Naturalization process reaching the optimum condition for biodiversity after 3 to 10 months | Up to 10 years | | It starts between 2 months to 1 year from the end of the works | |

In particular, the upscaling restoration interventions will affect the following **Stakeholders** and **beneficiaries**:

- Economic associations in terms of:
  - Fishermen and valley owners/managers, as the improved water quality will provide higher quantity of fish (also of commercial interest) of higher quality,
  - Hunters, as the restored surface will attract more birds in terms of thousands, even huntable (e.g. ducks) providing roosting and feeding sites for them,

    - Eco-tourism, as an improved lagoon ecosystem will attract a higher number of tourists and visitors providing higher income for touristic agencies and other business sector.

- Research institutions and education as they will provide support to the Provv. OO. PP. in planning, implementing and monitoring the restoration interventions, also having a return in terms of funding.
- Companies, especially the local ones already specialised in restoration interventions that will benefit from the upscaling restoration plan by being involved in the implementation of the restoration works and in the monitoring activities of the effects of the NbS on biodiversity and other environmental variables.
- Environmental associations and NGOs. Their main objective is to protect and safeguard the environment and associated biodiversity and ESS. Therefore, they will benefit from the upscaling restoration interventions as it fits with their vision and goals.
- Government bodies such as the VPA and the Provv. OO.PP. will be significantly impacted by the upscaling restoration plan, as they bear responsibility for maintenance and restoration interventions in the lagoon. It's worth noting that Venice and its lagoon are UNESCO World Heritage Sites, underscoring the global importance of preserving their ecological integrity. Therefore, upscaling restoration interventions will not only benefit local stakeholders but also contribute to the preservation and enhancement of this globally recognized heritage site.

According to the perspective of the pilot team, stakeholders willing to pay for any benefit/co-benefit (good/services) related to ESS/BdV improvement in the Venice lagoon pilot can include:

- Tourists and visitors. There is a growing trend towards sustainable tourism / niche tourism to avoid super crowded sites and mass tourism and enjoy nature and wildlife. As a consequence, tourists and tourist agencies may be available to financially support the improvement of the environment through the upscaling restoration. At the end of the restoration works, as the re-naturalization process will be matured, the restored saltmarshes will start to provide ESS, a part of which may be of economic value, returning into a sustainable tourism cycle or into recreational fishing purposes.
- Owners and managers of business activities located in the Lagoon and along its borders will benefit from the upscaling works thanks to an increased number of visitors who will pay for different kind of services during their stay, such as: fishing, hunting, birdwatching, etc during their stay in the Lagoon. Importantly, some of these companies may pay for compensating the urbanization works and landscape changes undertaken in the territory. For example, the Venice airport company SAVE S.p.A. implemented in the past different works for expanding the runway, and in general the entire airport complex, taking away from the territory surfaces that were previously used for other purposes (for example agriculture). SAVE could be interested in compensating the environmental impact though financially supporting environmental restoration interventions in the Lagoon of Venice
- Social enterprises, associations and cooperatives could benefit from the upscaling restoration works in the Lagoon as they could employ the weaker categories of society (disabled, immigrants etc.) to carry out the works, with a positive boost not only for the companies but also and above all for the people involved who, once trained, could retrain and find employment.
- People from all over the world, NGOs and private companies (local and globally) might be willing to support restoration activities in the Lagoon of Venice through fundraising, given the uniqueness of the ancient city and its lagoon. Also in this case, the communication efforts must be significant to engage the general public in the topics and goals to be reached.
- Artists and cultural organizations. The unique setting of the Venice Lagoon provides a rich source of inspiration for artists and cultural practitioners. The enhanced environmental quality and the preservation of the Lagoon's unique landscape can attract artists, who may contribute through exhibitions and performances. Additionally, artists can utilize materials found in the saltmarshes, such as driftwood and recyclable plastics, for their works of art. Cultural festivals and events can also

be organized to promote the restored areas, generating revenue and awareness, and fostering a cultural connection with the Lagoon.

- Schools. The schools may be willing to contribute for educational opportunities and guided tours in the Lagoon.
- Citizens and the local community might be willing to pay a little bit more in taxes if the territorial institutions provide services that have a positive impact on the environment and related biodiversity and ESS (commonly known as “Green VAT”). To reach this target a strong communication effort should be addressed to sensibilize and educate the people on the importance of protecting the environment. Also, the interventions should be very concrete and tangible to be easily perceived.
- The owners/managers of “valli da pesca” (fishing valleys). Indeed, the farmer benefits indirectly from the improved environmental standard of the Lagoon as the water entering the valley is of superior quality with positive effects on the fish they raise. Furthermore, an “improved” Lagoon will attract more birds (some of which huntable) who will also use the valley, leading to a higher number of hunters willing to pay for this service. For these reasons, the core team believes the owners/managers of “valli da pesca” could pay for the restoration upscaling as they could have a revenue in terms of higher number of hunters frequenting their property.
- Policymakers in general, may have a direct interest in the restoration activities as they provide positive impacts also in terms of reduced risk and mitigation of the CC effects. Furthermore, they have a positive return in terms of image. Therefore, policymakers could potentially support the upscaling / improvements of the ecosystem.

There are no real customers of the initiators of the works, especially for what regards the Provv. OO. PP, being a public body that operates as an operational arm of the Ministry of Transport (MIT) and therefore of the State. However, the implementation of the restoration upscaling can bring benefits to all those small enterprises that carry out the works in the lagoon or that offer specialized services such as environmental monitoring, telemetry, etc. in addition to the social cooperatives that could employ the marginalized or disadvantaged people, once trained, in the works. The knowledge on the importance of biodiversity conservation and of environmental restoration to combat climate change will be spread through training, dissemination and awareness-raising activities using a wide range of means and social media channels, including those of the stakeholders engaged in the CORE-PLAT, for example the touristic agency promotion of the Venice municipality. With this regard, research institutes may organize: an annual advanced course on key aspects of environmental protection and restoration targeting master or PhD students and practitioners; a basic training course consisting of video lessons configured as "knowledge pills" on key aspects of environmental protection and restoration; thematic posters could be created and hung around the city of Venice; participation to events, workshops, seminars and public debates to train and raise awareness among the general public.

#### Implementation arrangements

Until the establishment of the new Lagoon Authority, the procurement arrangements for restoration interventions in the lagoon will follow the current models, explained above, regarding the works’ initiators (i.e. the Provv. OO. PP. and VPA) and the implementers.

Concerning the **management structure** (involving initiators and implementers) allowing the implementation and maintenance of upscaling restoration interventions it shall be noted that, although in the Venice lagoon multiple human activities with an impact on the environment and on the related biodiversity take place (transportation, tourism, fisheries, agriculture and industries), corresponding to multiple competent authorities and stakeholders, the only one that really has the power of deciding and implementing the restoration activities is the Provv. OO. PP., as local office of the MIT. Indeed, the safeguard of Venice and its lagoon is of national interest. Since 1992, the Provv. OO. PP. implemented a variety of interventions to contrast the evolutionary trends in progress in the lagoon (loss of sediments and marinization) and the disappearance of the lagoon's unique habitats. More in detail, it created morphological structures (artificial saltmarshes and mudflats) for a total surface of 1.600 ha in the whole lagoon and performed interventions aimed at protecting the edges of existing saltmarshes and eroded mudflats for an extension of about 40 km.

The task of the VPA is to direct, plan, coordinate, promote and control port operations carrying out the maintenance of the common areas, maintaining the lagoonbed, supervising the provision of services of general interest, exclusively administering the areas and state property, and planning the development of the port territory. Importantly, it has the responsibility of dredging the canals to make them safe and navigable. The management strategy considers a pilot team that includes the Provv. OO. PP., who is the initiator of the works in the Lagoon, plus research institutes, consortia, and universities which play a role by providing scientific knowledge through literature review (e.g., considering the past virtuous experiences as the LIFE project), data analysis, and modelling. The pilot team aims to participating in the planning process for upscaling restoration interventions, together with relevant stakeholders participating in the CORE-PLAT, by identifying NbS to be implemented and the most suitable locations for intervention in the Lagoon. The pilot team may also provide technical expertise and indications throughout the implementing and the monitoring phases. The engagement of stakeholders will be guaranteed through CORE-PLAT workshops. Hopefully, the CORE-PLAT will grow in the future by involving more stakeholders interested in conserving the Lagoon ecosystem and in co-designing the future intervention works.

Key **resources** for planning, implementing and monitoring NbS interventions include:

- **Knowledge/Technical expertise** - Scientific knowledge is needed in particular to evaluate the best technique suitable for each site, prioritize the areas of intervention and secure the future effectiveness of NbS interventions. This will be done using knowledge based on previous experiences, literature review, experts' judgment, monitoring, data analysis and modelling. To achieve this aim, various figures are needed: a multidisciplinary team of researchers with in-depth knowledge and long experience in the Lagoon environment, a director of the works to design and then follow the implementation of the interventions, a project manager (RUP) and Safety Planning Coordinator (CSP) and Safety Coordinator of the Execution phase (CSE) of the works that ensure the completion of the public intervention within the deadlines and in compliance with the expected objectives, one or more contracting companies that will carry out the works. In particular, researchers with expertise in the lagoon ecosystem can provide suggestions on the NbS to be used to be greener and impacting less in the environment. For example, in the Venice pilot action, the REST-COAST team has offered a list of suggestions to enhance current restoration activities. These recommendations are based on expert knowledge, ongoing monitoring of restoration interventions, and the evaluation of results, all aimed at establishing an evidence-based approach. In addition, within REST-COAST, the upscaling plan of NbS in the Lagoon will be developed under current and future climate conditions using a data-driven approach and modelling.
- **Technical means -** These include all the equipment needed by the contracting companies that will carry out the interventions in the Venice Lagoon, such as machinery, natural and artificial materials that should be sourced as sustainably as possible but also as resistant as possible as they must resist to wind, storm surges, erosion etc. This entails minimizing the use of plastics and sourcing materials locally to reduce transportation emissions. Additionally, the use of less impactful boats and other transportation means is essential for reaching the delicate pilot site. These vehicles should be chosen to minimize sediment resuspension, thereby mitigating any potential negative impacts on the surrounding ecosystem. The list of equipment/effort needed sorted by phases of the project is quite broad and can include:
    - Planning (e.g. surveys, assessments and investigations to support the project design; Expeditious monitoring and survey on the morphological/ecological state of the saltmarshes;

Charges for the preparation of graphic documents and CME; Laboratory costs and technical checks)

  - Implementing (e.g. Coordination for safety during the execution of works (CSE); Support to the RUP for the supervision and coordination of the CSE and Director of the works; Pontoon with a mechanical excavator of adequate power to recover waste and to create a service channel; Boat to transfer the materials resulting from waste recovery, excavations of any kind, demolitions, dredging to landfill; several specific equipment for the containment of margins /nourishment of salt marsh, etc.)
  - Monitoring (e.g.topo-bathymetric surveys)

- Tools (e.g., multiparametric probes for evaluating water quality, soil sampling cores, drones for birds' monitoring, sediment trap, (kaoline) markers for sediment compaction). It is of utmost importance continuing biological monitoring over the long term to ensure the naturalization process continues as expected. In some cases, it may be possible to decrease the frequency of monitoring (e.g. vegetation and seagrasses every 3-5 years). The monitoring activity allows for the verification that the ecosystem is moving in the desired direction.
- Collaboration among the stakeholders is strongly desirable in order to co-plan and design the restoration interventions in the lagoon and reach a shared and common vision for the "desired lagoon" (CORE-PLAT vision).

From a **regulation and governance** perspective it shall be noted that:

The legal framework of Venice Lagoon's governance is the result of overlapping 3 legal systems: 1. ordinary: application of EU Directives on various subjects (habitats, species, water quality, ports, mobility, use of sediments, etc), regulatory and policy instruments of national, regional, provincial and municipal competence; 2. special: national interest of safeguarding the city of Venice and its Lagoon (first Law n. 171 /1973); 3. "commissarial": dealing with different types of socio-economic, environmental, and hydraulic emergencies, due to the redevelopment of the site of national interest of Porto Marghera, sludge management, hydraulic risk in eaves settlements and water traffic.

At present, these laws do not provide a coherent planning and programming framework, nor they do propose co-planning devices or governance models. The "special" legal system sets different responsibilities of the different levels of administration (national and local) and requires their cooperation. After almost 50 years of the implementation of the first law, it is necessary to define a more coherent planning and programming framework.

The Governance structure is moderately clear and documented. Its structure is composed by 9 municipalities, 2 provinces (Venice and Padua) + Metropolitan City of Venice; Venice municipality is responsible for urban restoration and social vitalization; Veneto Region: responsible for de-pollution of the drainage basin; the Italian State, responsible for the physical safeguard from sea and rivers and port functioning; Ministries & Local Administration Committee ("Comitatone") with the functional task of coordination among the main actors.

Together, the regulations contribute to defining a "Lagoon law", with origins in the institution of the "Magistrato alle Acque di Venezia" (Venice Water Authority), now "Provveditorato alle Opere Pubbliche del Triveneto", during the Republic of Venice in 1501. A new Venice Lagoon Authority is foreseen to be established in the upcoming period (e.g. a year). The new Authority will constitute a centralized entity for all the decisions inherent Venice and its lagoon favouring and streamlining the planning and management processes of the interventions at the lagoon level. The new Lagoon Authority has been established with the D.L. 104 of 2020 and will try to solve the problems concerning the protection of the Venice lagoon through its staff. For these activities, the Authority will make use of a Management Committee (in which there will be representatives of the Ministries, the Region, the Municipality of Venice) and an Advisory Committee (in which there will be representatives from the Harbor Master's office, the Port Authority, the Region, the Municipalities of Chioggia and Venice, Basin Authority, ISPRA). The birth of the new authority will involve a review of the current governance.

Value capture

Concerning revenues, these can be distinguished between direct and indirect value capture streams.

Direct value capture streams can be linked to ESS/BdV improvements that can be monetized and/or to economic activities that are based on such improvements and generate economic transactions.

In our case ESS improvements related to RCE and RFC and leading to cost savings will mainly benefit governments such as municipalities in the Venice Lagoon but not directly the two initiators of upscaling restoration (i.e. Provv. OO. PP. and VPA).

Moreover, the two public organizations, contrary to other stakeholders (e.g. Companies, Economic and Environmental associations) do not execute economic activities that are directly linked to such improvements for which some economic activities can be generated, and more specifically:

- Eco-tourism (including bird watching, recreational boating, recreational fishing, etc.).
- Economic activities of organisations contributing to implement NbS interventions
- Economic activities linked to eco-labelled products
- Educational activities on nature restoration

None of these economic activities is conducted by the initiators. Therefore, any revenues generated by these stakeholders cannot directly contribute to directly compensate costs afforded by the initiators. However, the economic transactions will generate taxation (such as VAT, green VAT, etc). Moreover, there is a significant positive impact in several economic sectors impacted by restoration activities. In addition, there is a positive fallout in terms of employment and GDP.

Economic and financial projections

The business plan's financial estimates are projected over a 5-year period, considering costs and revenues. Lifecycle costs include all costs to be afforded for all three stages of saltmarshes restoration, i.e. planning, implementing and monitoring. The estimation of costs is based on the analysis of the metric calculations of the three executive projects considered for the saltmarshes from the REST-COAST project (P1061, P1073, P1079). The resulting amount was validated by the Provv. OO. PP., as responsible authority and initiator of the works. These costs are described for each stage as follows:

Planning/Study: this stage includes costs for surveys, assessments and investigations to support the project design, (e.g. expeditious monitoring and survey on the morphological/ecological state of the saltmarshes, lab costs and technical checks), supervision of works, coordination for safety during the design, execution and testing phase of the works. The planning phase corresponds indicatively to the 13% of the total amount of the works (not considering the contingencies, other expenses and VAT).

Implementation: this stage includes costs for two phases of work, the 1st phase of works for interventions to protect the edges, considered 362 € cost per linear meter; the 2nd phase of works for nourishment of the saltmarshes, considered 19 € cost per $m^3$ of sediment nourished. The estimate is related to the regional price list for 2023. To these values a 20% must be added to consider the increased cost of materials registered in 2024 (see regional price list for 2024 https://prezziario.regione.veneto.it/). For a detailed explanation of the activities included in the two phases, please refer to the ‘Introduction to the pilot’ section.

Monitoring/Control: this stage includes costs related to multiparametric probes, top-bathymetric surveys, monitoring of terrestrial vegetation and sedimentation, monitoring of birds and seagrasses, and are estimated as 2.900,00 € per hectare of saltmarsh.

**Table 69 Costs structure of NbS upscaling restoration plan.**

| Restoration activities | Total duration (years) | Planning (years) | Implementation (year) | Monitoring (year) | Total costs |
|---|---|---|---|---|---|
| 1st phase - Interventions to protect the edges | 5 | 2 | 1 | at least 1 year | 362€/LM |
| 2nd phase - Nourishment of the saltmarshes | 5 | 2 | 1 | at least 1 year | 19€/m$^3$ of sediment nourished |
| Monitoring/Control phase - It also follows the naturalisation process that reaches the optimum condition for biodiversity after 3 to 10 years | Up to 10 | | Between 2 months and 1 year | at least 1 year | 2.900€/ha of saltmarsh |

No revenues can be defined due to the absence of direct value capture mechanisms affecting the two initiators. Indirect value capture mechanisms such as taxation are not received by the initiators either, but by other public bodies.

Financial instruments

Carbon credits have been identified as a potential financial instrument. There is interest from stakeholders to deploy this instrument, however further monitoring data is needed. Further relevant instruments are eco-labels and ecotourism user fees. Financial instruments, such as concessional loans, green bonds, or public loans, are currently not yet discussed.

Risk and contingency plan

The main risks to implementation are those related to governmental restraints. In particular, this regards the "new Sludge Protocol" (i.e. DM 86/2023), dictating new regulation for sediment reuse. The sediments now have to be characterized not only in the place of dredging but also in the place where they will be deposited, before the refilling phase can start. This will limit the general sediment availability for refilling the saltmarshes. Regardless, the VPA will continue to dredge the channels to keep them navigable and this could lead to the risk for the port to sustain additional expenses for the transport of the dredged sediments to the landfill (once moved, the sediments are considered hazardous waste), leading to a further environmental impact due to the emissions linked to the sediments' transport by water and by land.

Another risk may consist in the introduction of the new Lagoon Authority that could lead to some changes in the definition of responsibilities and roles and some delays in the full operation of the Lagoon management and planning, as well as and in the implementation of works in the Lagoon.

With regards to the biophysical risks, these are related to the tipping points (which are yet to be quantified for the most part) as well as the suitability of the habitat to be restored. This includes aspects such as sea level rise, water quality, etc.

### 13.3.5. Critical funding and financing challenges

The financial challenges identified in Fausto & Hinkel (2023) and already reported in the section of the current business model, are also applicable in extension #1.

## 13.4. Extension 2: Financial scalability plan

### 13.4.1. Introduction: What does upscaling mean to the pilot

In the Venice pilot, the landscape scale refers to the whole Lagoon and the theoretical exploration of the possible upscaling of restoration interventions in a spatial and temporal horizon longer than extension #1, i.e. from 5 to 10 years. The upscaling is considering the concept of a desired future, and the various strategies that could be implemented to attain this future for the Venice Lagoon.

The current restoration under the REST-COAST project focuses on the pilot site, considering 138 ha of artificial saltmarsh restoration in the central-southern lagoon. The upscaling plan will focus on the 1,600 ha of artificial saltmarshes and mudflats already existing in the lagoon, considering not only the historical habitat configurations and suitability of the area to these habitats, but also the desired future for the Venice Lagoon. The desired future for the Venice Lagoon, as well as the possible strategies to reach it, will be defined according to legislation and the CORE-PLAT stakeholders' opinion. Adaptation interventions would not only consider saltmarsh restoration, although - considering the scope of the REST-COAST project - this measure will remain the primary focus of the modelling work and establishment of the adaptation pathways. Following the identification of these strategies, interventions will be assessed by WP4 in order to evaluate their effectiveness with regard to the provisioning of ESS, thereby quantifying the adaptation pathways.

### 13.4.2. Overview of barriers preventing upscaling

Delays in the execution of restoration are primarily occurring due to governance issues, the failure to approve the Piano Morfologico (2020) and the change in regulation concerning the movement of sediments in the lagoon area. Indeed, the DM 86/ 2023, i.e. the "Regulation containing provisions for the issuing of authorizations for the movement, in sea areas located within the lagoon border of Venice, of the sediments resulting from the excavation of the seabed of the lagoon border", has entered into force and published in July 2023. The sediments have now to be characterized not only in the place of dredging but also in the place where they will be released before the refilling phase can start. This may lead to delays in the execution of the second phase of the works.

The introduction of a new Lagoon Authority: 'governance changes are often slow and, specifically, delays between the implementation of new institution and the start of their actual activities may be reflected in delays in the works and the decision making.

Other factors identified to hinder restoration, both in the present and likely in their upscaling, include primarily financial barriers. For instance, the relation between the scale of intervention and the higher costs, as well as the larger requirements in terms of quantities of materials; primarily associated with the issue regarding sediment availability. Regarding the first financial barrier, a larger scale of intervention would require a larger initial investment, which in the current system is limited by the lack of funding. However, through the application of a business plan as the one presented here, this might be overcome.

Another factor that hinders the restoration is the limited availability of data, in particular the absence of continuous and complete data series regarding both biotic and abiotic factors involved in restoration limiting the predictability of saltmarsh evolution both in space and time.

Finally, limited societal trust in governmental institutions and politics strongly influence the public opinion regarding restoration, this disconnect is fed by the limited dissemination from scientific findings towards the general public.

In relation to the concept of developing adaptation pathways (RESTCOAST - WP4) the main barriers identified relate to the absence of long-term plans and quantitative objectives, as well as the limited quantitative knowledge about the tipping points and ESS provisioning of various NbS interventions. Without these tipping points it might be complicated to establish the timeline for the implementation of NbS, as well as the duration of their functioning which makes it difficult to temporally plan the sequencing of interventions. Similarly, the lack of quantitative objectives limits the development of the pathways as the end goal remains elusive and thus its unclear how many interventions should take place to reach this goal. Through a planned workshop with the CORE-PLAT a set of scenarios will be developed to reach a desired future for the Venice Lagoon, allowing for the exploration of various strategies and thus evaluating the different pathways in terms of comparative ESS provisioning.

#### 13.4.3. Financial strategies for upscaling

Improved dialogue between the stakeholders, scientific community and governmental institutions allow for the perceived legitimacy of restoration works. Various past projects have been completed successfully (LIFE VIMINE, LIFE SeResto, LIFE REFRESH), and ultimately also REST-COAST, highlighting the effectiveness of such collaborations to implement restoration. Establishing a more permanent dialogue between these actors facilitated by a relevant institution could benefit the collaboration and interactions. Moreover, improved knowledge and modelling capability would change the understanding of the processes, dynamics and threats faced by the Lagoon, through this improved knowledge and modelling it will be possible to make more informed policy decisions about the spatio-temporal scale of restoration.

Additional funding will be needed to allow Provv. OO. PP. to address the financial gap for upscaling restoration interventions. The financial strategy to securing funding for upscaling saltmarshes restoration will consider public (e.g. grant programs) and private investments.

- Public funders could include those with a high interest in preserving the lagoon landscape. For instance
  - The Superintendence of Archaeology, Fine Arts and Landscape for the Municipality of Venice and Lagoon may be interested in restoration interventions in the Lagoon as this works may prevent or lower expenses in landscape extraordinary maintenance.
  - Coldiretti and Veneto Agricoltura, whose core business is to improve the competitiveness of businesses and production chains in the agricultural, agri-food, forestry, and fishing sectors, could see benefits from an upscaling plan of restoration interventions in the Venice Lagoon as a means for improving the productivity of the area.
- Another source of public funding may derive from EU projects that can support the upscaling restoration interventions.

- Private investors, on the other hand, expect returns on their investments.
  - Investors could be big brands with headquarters or storefronts in the city.
  - Investors might be private companies involved in tourism that could be encouraged to invest if they foresee economic returns in terms of an increased number of tourists and visitors, thanks to the improved lagoon ecosystem.
  - Private investors can also include companies that aim to offset the impact of their activities and projects. An example could be "Gruppo SAVE S.p.A," which, in anticipation of a possible expansion of Marco Polo Airport in Venice, intends to improve the surrounding environment by financing morphological recovery projects.

# Chapter 14. The Vistula Lagoon Pilot

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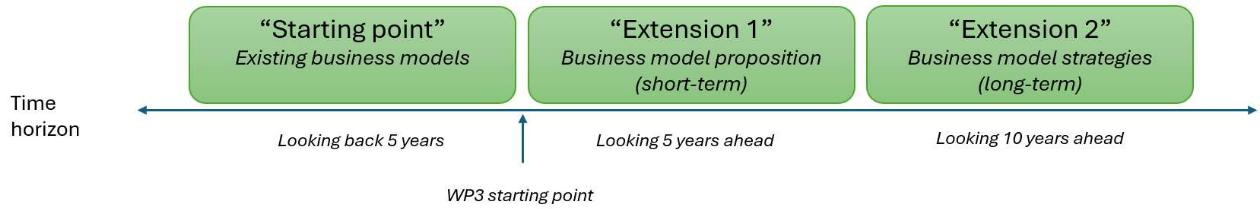
**Readers guide**




**15.1 Introduction**

- **This section provides a general introduction to the Vistula lagoon case**

**15.2 Current Business Model**

- **This section presents the existing business models ("Starting Point")**
- **The NbS discussed:**
  - Construction of Artificial Island due to construction of Polish Passage into Vistula split for deposition of Sediment and compensation for Natura 2000 area

**15.3 Business Model Extension and Business Plan**

- **This section presents the business model propositions ("Extension 1")**
- **The NbS discussed:**
  - Exploration of Artificial Floating Islands, in order to reduce eutrophication and improve ecosystem services of Vistula Lagoon.

**15.4 Financial Scalability Plan**

- **This section presents the business model strategies ("Extension 2")**
- **The NbS discussed:**
  - Landscape scale ecosystem restoration. Consider building a marina in the Elbag area to boast Socio-Economic development and couple potential revenue to Artificial Floating Islands (AFI

## 14.1. Introduction to the pilot

The Vistula lagoon is a Brackish water lagoon located on the Baltic Sea that covers a surface area of approximately 838 km$^2$ and is about 90 km long and 5-17 km wide. The lagoon spans across Poland, as well as Russia shown in Figure 81 (Andrulewicz, 1997). The Polish area around the Vistula lagoon encompasses a diverse array of protected areas, each playing a crucial role in preserving its natural heritage. These areas of the Vistula Lagoon are designated as preserved areas under the Natura 2000 program.

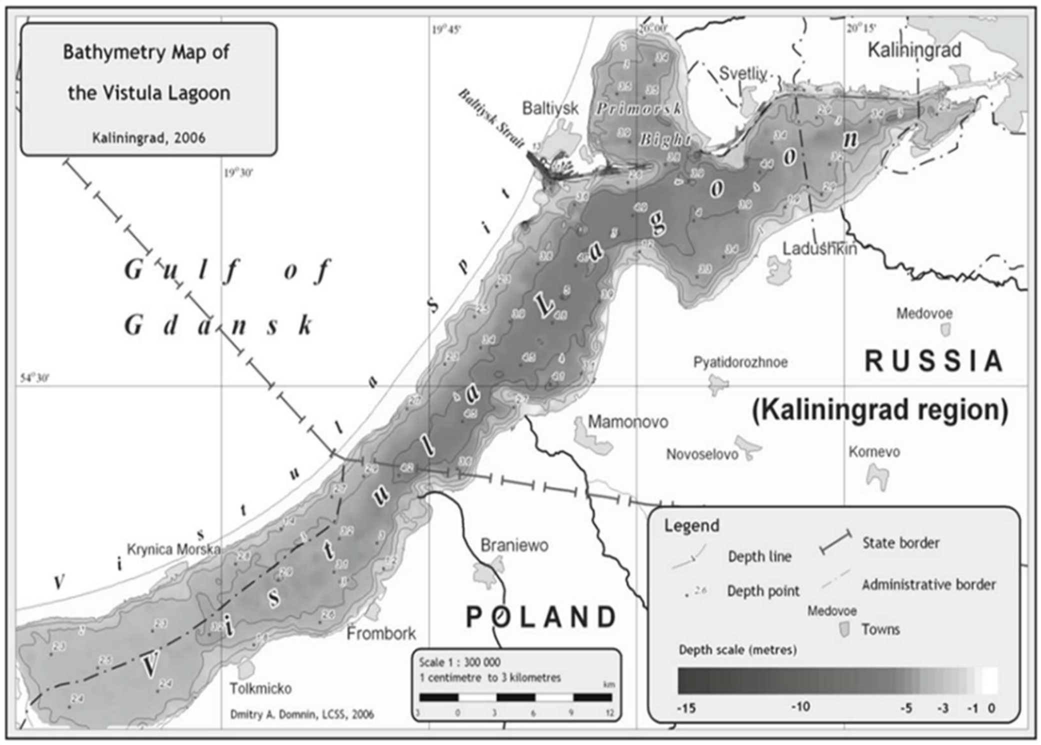



**Figure 81 Bathymetry and border overview Map of Vistula Lagoon (B. V. Chubarenko et al., 2017)**

The northern province established a well-developed tourism sector, drawing millions of visitors annually to the Vistula spit. However, the southern region of the Vistula lagoon faces significant socio-economic challenges. Its economic development grows much slower than thriving areas like Gdansk, resulting in a large amount of the young population seeking better economic opportunities in larger cities (Koza, 2015). The southern area struggles with unemployment, low investment and transboundary issues that hamper development (Bielecka & Rózyński, 2014). This resulted in the decline of Elblag's population from 130.000 to 110.000 over recent decades. For both provinces the Vistula lagoon is a relatively low priority and cooperative restoration activities are difficult to establish. Furthermore, the lagoon also serves as a crucial waterway, and fisheries hub with significant regional economic value (Andrulewicz, 1997).

The Maritime Office in Gdynia is a governmental agency exercising full jurisdiction in Polish coastal areas, including Vistula Lagoon. Additionally, the local authorities are relevant stakeholders for the socio-economic and environmental development of the region. The transboundary character of the area means the lagoon is subject to multiple issues and problems related to sustainable management, such as nutrient inputs and navigation permits.

The Vistula Lagoon is facing several environmental challenges and the most pressing is strong eutrophication, primarily stemming from historical agricultural practices including high use of fertilizers (Aleksandrov, 2010). Consequently, the lagoon experiences frequent algal blooms, creating a thriving population of mosquitoes. This can have a negative impact on fish populations and other ESS within the Vistula lagoon (B. Chubarenko, 2008; Karstens et al., 2018). Beyond its ecological implications, the Vistula Lagoon's eutrophication significantly affects the region's socio-economic development. The turbid water and mosquito infestations are creating an unattractive environment for recreational activities and tourism development. The restoration of water quality is expected to take decades before a substantial water quality improvement will be established. Also, a major regional issue influencing the Lagoon is the eutrophication and deoxidation of especially deeper parts of the Baltic Sea.

The Vistula Lagoon will be affected by future climate changes since the water regime and ecological status are highly dependent on the river inflow coming from its catchment. A scenario analysis revealed a projected overall increase in precipitation, as well as in temperature, which causes diverse changes in discharge, water temperature, dissolved nutrient concentrations and loads coming from the rivers. However, scenarios built on current monitoring are challenging as the catchment contains more than 20 rivers and only a few of them are gauged (Hesse et al., 2015).

## 14.2. Starting point: Current Business Model

This section will describe the current business model for the starting point of what was part of the REST-COAST project. The starting point of the REST-COAST project is an **artificial island** (180 ha) that has been constructed in the Vistula Lagoon from sediments that were a by-product of digging a new passage to the Lagoon.

### 14.2.1. Coastal restoration activities

The incentive to develop the artificial island in Vistula lagoon is both socio-economic, environmental and political. The initial entrance of the Vistula lagoon was located on Russian territory, and this was posing significant challenges for Polish vessels that were destined for the Polish port of Elblag. These vessels relied on obtaining authorizations subject to prolonged bureaucratic processes and could often be revoked. The alignment of policies on maritime transport and environmental management suffers from tension due to the strained diplomatic relations between Russia and EU member states, further complicating matters. Therefore, the Polish central Government decided to add an additional access point to the Vistula lagoon in order to establish independence and ensure the stability of the economy of Elblag. The construction of this passage was finalized in September of 2022.

The infrastructural works of developing the channel would lead to an excess amount of sand and sediment which had to be deposited somewhere. To create a win-win situation this sediment was used for the creation of an artificial island which serves as a bird sanctuary. The island will not be open to visitors and will provide a favourable habitat and safe haven for endangered birds and therefore designated as a Natura 2000 site.

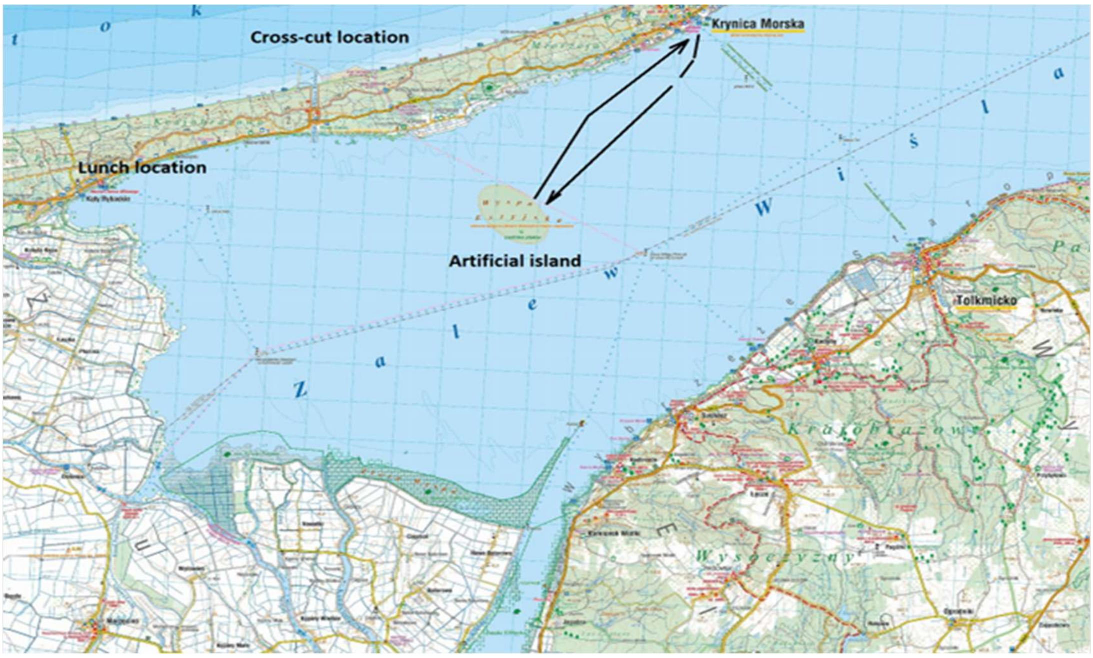



**Figure 82 Geographical overview of artificial island and passage constructed within Vistula Lagoon**

#### 14.2.2. ESS and Economic good typology

The main restoration goal was to establish habitat for certain species of birds, improving the biodiversity of the area. Additionally, the island can provide future habitat for local fishes due to the introduction of reed. The natural establishment of spawning grounds surrounding the island is projected to amplify the potential fish yields for fishermen. The vegetation on and around the island can result in carbon sequestration. However, this is not the main goal of the restoration effort and the objective is not to add too much vegetation since it will attract birds that are not targeted. The island is closed for public access however, the bird habitat can provide value for local bird watchers.

| | | **Rivalry in consumption** | |
|---|---|---|---|
| | | High | Low |
| **Excludability** | High | Private | Club<br>(3) Outdoor activities<br>(4) Intellectual interactions |
| | Low | *(1) Fish population*<br>CPR | (2) Carbon sequestration<br>(5) Biodiversity<br>Public |

Descriptions

*(1) The island banks can provide habitat for local fish species (bream, pike and perch)*

*(2) Carbon is captured by vegetation on and next to the artificial island*

*(3 ) The increased habitat can provide value for bird watching (relatively low since area not accessible)*

*(4) Scientific research/knowledge development on artificial islands/habitat restoration*

*(5) Promotion of biodiversity*

**Figure 83 Changes in ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification**

### 14.2.3. Funding: granting

To expedite the process, a funding structure was devised, where the national government was the lead in funding and financing both the passage and the island. The costs incurred from the project are from constructing the cross-cut connecting the Baltic Sea to the Polish part of the Vistula Lagoon. Additionally, the project was part of a larger investment including the expansion of the Elbląg port, the modernization of the Elbląg river, the construction of a bridge in Nowakowo, and the establishment of a waterway as shown in Table 70.

**Table 70 Overview of funding contributions for cross-cut in Vistula Split and other activities**

| Funder | Amount | Activities | Type of funder | Type of funding |
|---|---|---|---|---|
| Polish government | €437.000.000 | The entire investment, including the expansion of the Elbląg port, the modernization of the Elbląg river, the construction of a bridge in Nowakowo, and the establishment of a waterway. | Public, national | Public Funding |
| Polish government | €228.160.000 | Establishing the cross-cut in Vistula Split | Public, national | Public Funding |
| Polish government | €20.000.000 | Construction of Artificial island | Public, national | Public Funding |

### 14.2.4. Funding: value capture

This funding mentioned above was drawn directly from the national budget, sourced by tax revenues, ensuring a fast implementation of the project. The crosscut would lead to "waste" sediment. This is also a potential cost reduction. An opportunity cost you do not need to make.

The entrance port and the locks are owned by the state, which charges fees for ships crossing the passage. However, these fees are not expected to provide a return on investment in a reasonable timeframe. The primary goal is the economic development of the port in Elbląg city by increasing the volume of goods, attracting small and mid-size businesses, and allowing the Elbląg port to become a feeder port delivering goods to the major hubs in Gdańsk and Gdynia. The ports in Gdańsk and Gdynia are already congested and can no longer handle the volume of goods, necessitating further transportation by rail or truck.

**Table 71 Funding contributions through value capture in Vistula lagoon**

| Category | Funding type | | Actor |
|---|---|---|---|
| Reduced costs | Dumping of muddy sediments inside the Gulf of Gdańsk was not possible due to both transportation costs and possible environmental impact since Polish legislation treats dredged sediments as waste material. Dumping on land would be both expensive and troublesome due to bureaucratic reasons, making it difficult to obtain permits. Therefore, the concept of artificial island | Reduction of national budget expenses | National polish government, The Maritime Office in Gdynia |

| | |
|---|---|
| | created a feasible solution and synergy with NATURA 2000 creation. |

#### 14.2.5. Finance

There were no financing instruments for restoration activities at the starting point (Favero et al., 2022).

Financial instruments, such as concessional loans, green bonds, or public loans, were not required. The resources within the (co-) funding arrangements were made available from within existing, and/or earmarked budgets. Further, these resources were made available at the start of the projects, this was mainly due to the political incentive of the decision.

#### 14.2.6. Procurement arrangements

Procurement arrangements for restoration activities at the starting point.

The Maritime Office in Gdynia is a governmental agency exercising full jurisdiction in Polish coastal areas, including Vistula Lagoon and is responsible for its maintenance. The Maritime office procured several contracted to support in project planning, constructing and maintenance of the NDI Group, EKO-Konsult, Institute of Hydroengineering of Polish Academy of Sciences and the Polish Society for the Protection of birds.

#### 14.2.7. Critical funding and financing challenges

There were no major funding or financing challenges for the construction of the artificial island due to the high support from central government. Consequently, relevant synergies, continuation, and development of environmental status of the area are also unclear and does not invite for further exploration.

The anticipated enhancement and stabilization of biodiversity can indirectly advantage the maritime office of Gdynia. The natural establishment of spawning grounds surrounding the island is projected to amplify the potential fish yields for fishermen, leading to heightened sales of licenses and equipment rentals. Therefore, the Maritime Office of Gdynia may have financial interest in maintaining and possibly intensifying the Nature based Solution of the artificial island. However, this process will be long, slow and hard to quantify.

The artificial island does not target other environmental and socio-economic problems within the region. These are mainly the low water quality due to eutrophication and the relatively slow economic development of the southern area.

### 14.3. Extension 1: Business model proposition and Business plan

A business plan is not applicable as the case needs to be built before a business plan can be submitted. However, the following section outlines a proposal for going forward with an idea for floating artificial islands that can address the water quality problems.

#### 14.3.1. Executive Summary

The artificial island in Vistula Lagoon (described above) is unlikely to be replicated in the Lagoon, since it was a very large investment due to a unique political situation. Therefore, another solution was sought for the extended business model framework. In collaboration with the pilot coordinator Grzegorz Różyński, it was decided to explore an additional angle: artificial floating islands as NbS combined with the hypothetical business case for a winter marina.

This can be an attractive business opportunity due to the lower costs for potential clients in Poland relative to other countries such as Denmark and Germany. The marina could also provide socio-economic development opportunities for the southern region of the Vistula lagoon while simultaneously generating taxes to fund the environmental challenges of the lagoon. This marina would also have synergies with the construction of the crosscut of the barrier that allows for improved vessel transport to the Vistula lagoon. However, establishing a marina holds promise for driving socio-economic development, yet it falls short in addressing the pressing environmental concerns of the Vistula Lagoon, particularly its severe eutrophication. Therefore, a tourism fee to visitors in the area or revenue coupling of the winter marina for Artificial floating islands is explored as an opportunity. This could provide value capture revenue via the fees, and with the fees could contribute to the restoration activities or maintaining the NbS which in turn would lead to less eutrophication. This proposal can be used to give input into an upscaling strategy for NbS for the Vistula Lagoon. Artificial floating islands would have potential for addressing the main challenges in the Lagoon of eutrophication which can provide several co-benefits.

<table>
<tr><td>Value proposition</td><td>Problems addressed<br><br>-Water quality (eutrophication)<br>-Socio-economic development<br>-Biodiversity</td><td colspan="2">Benefits produced<br><br>-Environmental benefits (increased water quality, carbon sequestration, biodiversity improvement)<br>-Economic benefits (Eco-tourism, bird watching)<br>-Social benefits (Space of quality; socio-economic development)<br>-Cultural benefits</td></tr>
<tr><td rowspan="3">Value creation</td><td>Key partners<br><br>Scientific institutes<br>Subcontractors</td><td colspan="2">Regulation and Governance<br><br>Lack of long-term environmental strategy for Vistula lagoon. Explore synergies water framework directive (WFD)</td></tr>
<tr><td>Key resources<br><br>-Knowledge/technical expertise of artificial floating islands</td><td>Customer segments<br><br>Tourists</td><td>Stakeholders<br><br>Maritime office<br>National government<br>Local inhabitants<br>Tourists</td></tr>
<tr><td>Key activities<br><br>Artificial floating islands creation for nutrient uptake reducing eutrophication</td><td>Customer relations and channels<br><br>Creating awareness of eutrophication issues within lagoon and benefits of reducing issue.</td><td>Beneficiaries<br><br>Municipalities<br>Local inhabitants<br>Tourists and visitors</td></tr>
<tr><td>Value capture</td><td>Costs</td><td>Revenue streams<br><br>None</td><td>Financing and funding<br><br>Public funding</td></tr>
<tr><td>Transversal categories</td><td colspan="2">Impact indicators<br><br>Indices of increased BDV<br>Knowledge development (scientific publications)<br>Revenues from eco-tourism</td><td>Risks<br><br>Uncertainty nutrient uptake artificial floating islands<br>Long time horizon and investment costs<br>Low institutional support due to economic priorities<br>Different transboundary environmental objectives</td></tr>
</table>

**Figure 84 Business model canvas for floating islands in the Vistula lagoon**

### 14.3.2. Mission and Objectives of the restoration initiator

The mission of the restoration initiator would be to install several artificial floating wetlands in the Vistula Lagoon. These islands, resembling artificial wetlands, are engineered to enhance water quality by utilizing specific water plants to absorb nutrients and pollutants (Chang et al., 2017). Therefore, contributing to ESS such as water purification (Kong et al., 2019; Nakamura & Mueller, 2008). While also providing resting grounds for biodiversity which can provide an aesthetic value that indirectly positively impacts tourism (Calheiros et al., 2020). The area would have to be decided by the initiator based on feasibility and available funding. Restoration objectives include to address eutrophication of the Vistula Lagoon. To confront these challenges and synergize with the objectives of the REST-COAST initiative, which aims to scale up NbS, this case proposes integrating a winter marina with artificial floating islands (AFIs) to mitigate eutrophication.

**Artificial floating islands or wetlands**

A floating wetland consists of a buoyant platform planted with emergent wetland plants that can float on the surface of a slow-moving waterbody like a pond or lake (Figure 85). Plants installed in these systems grow hydroponically, meaning without soil; plant shoots grow above the water while plant roots extend downward into the water column. The floating platforms are anchored but have enough slack to adjust to changing water levels. Floating wetlands can remove significant amounts of pollutants from water, including heavy metals (Fe, Mn, Zn, Cu & Pb), nutrient pollution (N&P), Biological Oxygen Demand (BOD), chemicals (PFAS) and bacteria (*E. coli*). Floating wetlands are up to 200 times more efficient than conventional constructed wetlands, and do not suffer the die-off problems and nutrient release that free floating aquatic plants or conventional wetlands experience. For these reasons, floating wetlands are often the best management approach for open water bodies including lakes, ponds, aquaculture systems, wastewater lagoons and even estuaries with marine waters.

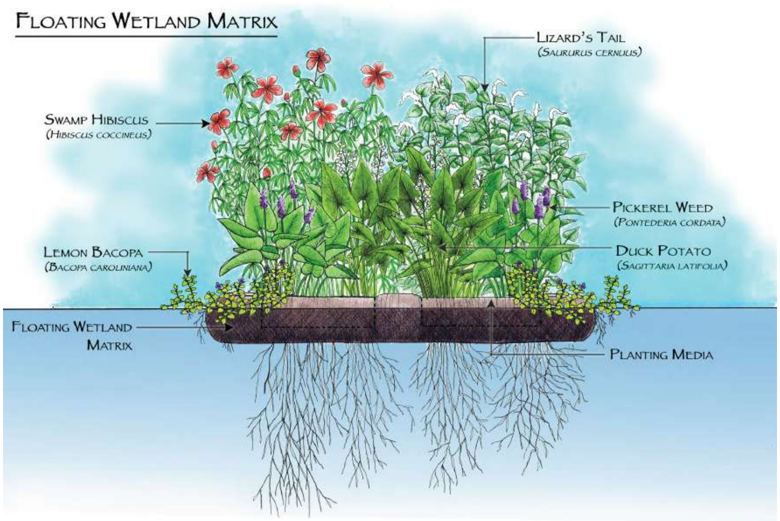



**Figure 85 Schematic drawing of the Floating Wetland Matrix (Escamilla et al., 2019)**

The floating wetlands provide fish habitat in the root zone, protection from predatory water birds, spawning protection for frogs and eels, and nesting sites for endangered water birds. The islands prevent building up of nutrients, with plant roots taking up excess nitrogen and phosphorus, assisting with denitrification underneath the raft. Floating wetlands and islands are multi-functional design elements that stack uses vertically and horizontally, preventing and eliminating algal blooms and fish kills. If farms dedicated just 1% of their land to water quality improvement ponds with floating wetlands, at the landscape point where nutrient laden farm runoff leaves the property, modelling demonstrates its possible to eliminate algal blooms and associated fish kills, preventing inshore marine dead zones.

In general, floating wetlands are in the literature referred to as a beneficial low-cost technology for the improvement of water quality and provision of ESS (Olguín et al., 2017). The concept of artificial islands has already been explored in the German-Polish lagoon, the Szczecin Lagoon, through initiatives like the European LiveLagoons project. Similar efforts have been undertaken in locations such as Gintaro and Juodkrante in the Curonian Lagoon, Lithuania, and Wolin National Park (LiveLagoons, 2021). Even though there is still uncertainty about the optimal use of nutrient removal, the innovation can be a possible contribution to the reduction of nutrient removal of the Vistula Lagoon.

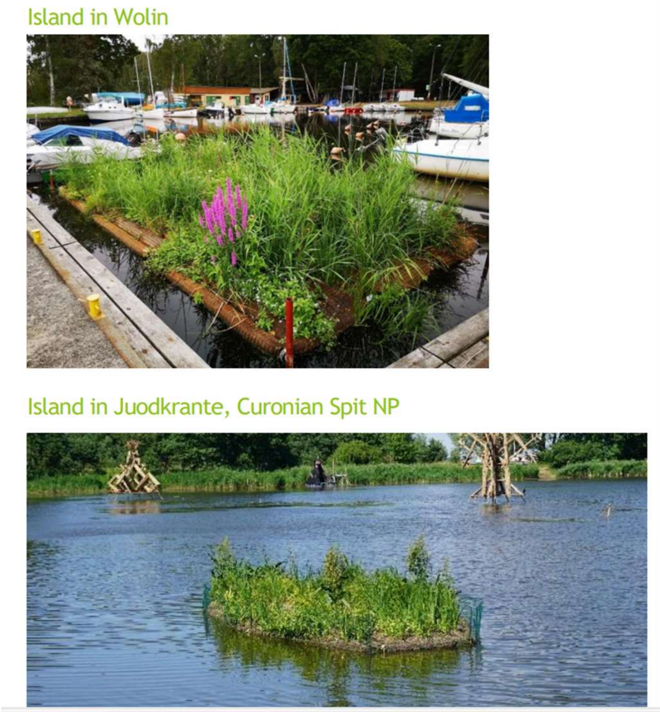



**Figure 86 Photo of Artificial Floating Islands (AFI) in Wolin (top image) and Juodkrante, Curonian Spit (bottom image) (Source: LiveLagoons project report)**

### 14.3.3. Stakeholder overview

The overview of stakeholders is represented in Table 72. The potential identified initiator of the project is The Maritime Office in Gdynia who has full jurisdiction of the Vistula Lagoon area. The beneficiaries of artificial floating islands are local fishermen, and tourism sector. Over the long term an improvement in the water quality would drive tourism and general economic development in the region. The initial funder/financier would be the Maritime Office in Gdynia.

**Table 72 Overview of stakeholders categorized according to legal status and actor category**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| **1** | The Maritime Office in Gdynia | Governmental institute responsible for infrastructure, ports and maritime safety along the Polish Coast | Government | National |
| **2** | the Institute of Hydro-Engineering, Polish Academy of Sciences | Research institute focused on maritime and inland hydraulics and soil mechanics | Public | National |
| **3** | The Polish Society for the | Organization aiming to preserve bird wildlife in Poland | Private | National |

| | | | |
|---|---|---|---|
| | Protection of Birds (OTOP | | |
| **4** | Fishermen associations | Private | Regional |
| **5** | Local office of tourism | Public | Regional |

The Maritime Office in Gdynia is a governmental agency exercising full jurisdiction in Polish coastal areas, including Vistula Lagoon. They are the main stakeholder in the area with and institutional powers are necessary for future restoration projects success. The Maritime office has full jurisdiction on water, beach and dune areas. Additionally, they exercise shared jurisdiction with local authorities in the "protection belt" (ca. 2 km into land form the shore). The Maritime office contains a high level of expertise, with a good understanding of local problems and provide a platform for stakeholder consultations, mainly local authorities and main sectors, such as fisheries and tourism. They are required to respect all regulations applying to NATURA 2000 sites and implement them in their actions.

Institute of Hydro-Engineering, Polish Academy of Sciences has been conducting multiple research efforts in the Lagoon over many years. Due to their high knowledge of the area regarding hydrodynamic conditions, local stakeholders and previous trajectories in past EU projects they can have a significant role in constructing, monitoring and creating knowledge on artificial floating islands within the Vistula Lagoon.

Additionally, the local authorities such as Communities of Frombork, Tolkmicko and Kadyny on the southern banks of the Lagoon, the city of Elbląg, the largest city with around 110.000 inhabitants, communities of Kąty Rybackie and Krynica Morska on the Spit are relevant stakeholders for the socio-economic and environmental development of the region.

#### 14.3.4. Business model proposition

This section is an overview of all the BM in terms of value proposition, creation, delivery and capture identified for upscaling restoration ("extension 1").

##### Value proposition

The value of the restoration effort aimed to create value for different stakeholders and beneficiaries is described in this section. The artificial floating islands are mainly aimed at reducing **eutrophication** in Vistula lagoon and provide several co-benefits in the form of ESS. This can provide value towards beneficiaries such as local fisherman, the tourism sector around Vistula Lagoon, improve biodiversity within Vistula lagoon and help aid environmental targets from various public organizations. In order to identify the relevant ESS that are potentially affected by artificial floating islands a literature review of ESS and combined with input from The Institute of Hydro-Engineering, Polish Academy of Sciences was carried out (Chang et al., 2017; LiveLagoons, 2021).

- Water quality improvement: artificial floating islands absorb nutrients from the water causing a reduction of eutrophication and improving water quality.
- Food provisioning: Increase fish population by increasing habitat area and water quality.
- Cultural ESS: The visual appeal and habitats for animals can provide opportunities for eco-tourism, increasing socio-economic development in the area.
- Creating habitat for wildlife and bird, therefore improving biodiversity

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Rivalry in consumption</td></tr>
<tr><td>High</td><td>Low</td></tr>
<tr><td rowspan="2">Excludability</td><td>High</td><td>Private</td><td>Club<br>(3) Outdoor activities/Eco-tourism<br>(4) Intellectual interactions with natural environment</td></tr>
<tr><td>Low</td><td>(1) Fish population<br>CPR</td><td>(2) Water quality improvement<br>(5) Lifecycle maintenance<br>(6) Biodiversity<br>Public</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Descriptions<br>(1) Artificial floating island can provide habitat for local aquatic organisms<br>(2) Removal of nutrients (mainly Nitrogen) and pollutants that improves water quality<br>(3) Using the environment for recreation; Even though floating islands are not accessible the aesthetic value and biodiversity can indirectly contribute to (eco-)tourism such as bird watching and fishing<br>(4) Scientific research/knowledge development on artificial floating islands and ESS<br>(5,6) Artificial floating island can serve as a resting/habitat area for fish, birds, insects and other species</td></tr>
</table>

**Figure 87 Changes in ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification**

Market analysis (demand and supply) and legal requirements

From previous interaction with external stakeholders. The REST-COAST coordinator from the Institute of Hydro-Engineering, Polish Academy of Sciences, had become inspired to explore a business case for artificial floating islands. Potentially using future revenues from a (winter) marina that can be used for the storage of boats. This can be an attractive business opportunity due to the lower costs for potential clients in Poland relative to other countries such as Denmark and Germany. The marina could provide socio-economic development opportunities for the southern region of the Vistula lagoon while simultaneously generating taxes to fund the environmental challenges of the lagoon. This marina would also have synergies with the construction of the crosscut of the barrier that allows for improved vessel transport to the Vistula lagoon. However, establishing a marina holds promise for driving socio-economic development, yet it falls short in addressing fully the pressing environmental concerns of the Vistula Lagoon, particularly its severe eutrophication. An overarching initiative could provide an umbrella for channelling some revenue from the marina to measures to combat eutrophication.

The main sectors of the market demand that will be relevant for generating potential revenues are represented by:

Water tourism was previously explored through the Vistula River Delta Loop (Figure 88). The Loop is designed to develop local ports and marinas, aimed at reinvigorating the local economy in the Lagoon and surrounding areas. Prior research shows a growing potential for water tourism even prior to the opening of the passage from the sea to the lagoon in 2021. The utilization of marinas, measured by the number of yacht-days, the days vessels of tourists spend in marinas, increased from 22% of total capacity in 2014 to 73% in 2015 and further surged to 92% in 2016. The number of tourists served by the association grew from 29 thousand in 2014, through 124.000 in 2015 to 154.000 thousand in 2016. Additionally, the tourism is highly seasonal with almost 98% of the tourists visiting between May and September.


**Figure 88 Vistula river delta loop. Red dots denote wharves that are used for water tourism**

Value creation & delivery

There currently are no specific business, management or operational strategies in place. This is mainly due to the transboundary character of the Vistula lagoon. Political tension has caused low priority for Russia. Therefore, the various issues the lagoon is subject to sustainable management, such as nutrient inputs and navigation permits remain unaddressed. A regional development plan that overarches the Vistula lagoon can provide support for environmental targets and restoration efforts. Even though this will most likely only be a Polish endeavour, which can result in free riding of Russia on Polish restoration activities. Synergies can possibly be found with the European legislation of the Water Framework Directive (WFD) that focused on water quality in rivers, lakers and groundwater. The current cycle of the WFD will end in 2027, it will be highly unlikely that water quality in the Vistula lagoon will be tackled by then. However, establishing a first test with artificial floating islands to implement in the next cycle can contribute to further restoration efforts within the Vistula lagoon.

Implementation arrangements

The artificial islands would have to be installed and managed by a specialized construction company. The water column then has to be monitored for a variety of indicators which can be done by a knowledge partner such as the Institute of Hydro-Engineering, Polish Academy of Sciences.

The transboundary character of the area means the lagoon is subject to multiple issues and problems related to sustainable management, such as nutrient inputs and navigation permits. A regional development plan that overarches the Vistula lagoon can provide support for environmental targets and restoration efforts.

Value capture

The revenue generated by the artificial floating island is expected to be initially low. Additionally, it will take several decades for significant water quality improvement that can provide socio-economic development which generates indirect taxes. The main funders targeted in the restoration efforts are public parties such as the Polish national government and EU funds. This would require a significant stimulus, like enhancement of efforts toward meeting the WFD targets.

Outputs are expected to be too low for private entities to be interested in the return of investment. The main model from the private sector that is applicable are donations to NbS projects by philanthropic organizations. However, private companies might be reluctant to provide funds that simultaneously impact Russian restoration efforts.

The marina can be established through the private sector, possibly with governmental support through public funds. However, after a discussion with the pilot stakeholder it was concluded that the time-horizon and impact of the artificial floating islands are simply too low and the costs too high to couple the funding mechanism to the marine. Even though the marina could still be an opportunity that can provide socio-economic development, there is currently no coupling possible to the restoration efforts.

**Table 73 Feasibility of funding mechanisms**

| Type of funding | Governance level | Feasibility |
|---|---|---|
| Public funds through European, regional and provincial development plants. | Supranational, national | Feasible |
| Public grants on research of the functioning of artificial floating islands should be explored and can provide synergies. | Supranational, national | Feasible |
| Tourism user fees via the creation of winter marina | Regional | (time horizon too long, return on investment too low, unfeasible) |
| Local tourism tax related to Vistula lagoon | Regional | (time horizon too long, return on investment too low, unfeasible) |
| Philanthropy (private foundations) | Supranational, national, regional | Low feasibility due to transboundary area and long-time horizon |

Economic and financial projections

The below references from Artificial Floating Islands are here used to provide for crude assessments of costs related to the treatment of 1 $m^3$ water in eutrophicated water bodies. Costs are mostly associated with the construction, and less so with the operation and maintenance (San Miguel et al., 2023). It is uncertain on what scale the artificial islands will be established. A pilot with several islands to establish and monitor results would be a first step towards upscaling.

**Table 74 Overview of costs of artificial floating islands**

| Indicator | Cost estimate | Description |
|---|---|---|

| | | |
|---|---|---|
| Cost | 60 million m3 per year of wastewater was treated at **US$0,00026/m$^3$.** | A full-scale FTWs in stabilization ponds receiving sewage (60%) and industrial (40%) wastewater from Faisalabad, Pakistan (Afzal et al., 2019). |
| Costs | A cost range between **0,45 and 2,50 € $_{2021}$/m$^3$ of treated water**. | Most are capital costs required to build the infrastructures and, to a much lesser extent, operating costs. |
| | **0,302 €/m$^3$ of treated water or 21,1 €/kg of N fixed**. | |
| Costs | The discounted **expenses** of the floating filter using *Typha domingensis* over the 10-year cycle amounted to **44.083 €** while the revenues derived from the sale of fodder for animal feed amounted to **11.429 €,** resulting in a **NPV of 32.654 €.** | These costs are equally distributed between the construction (48 %) and operation (51 %) stages.<br>Alagón river basin, Central Spain (San Miguel et al., 2023) |
| Replacement Cost | The total net present value savings calculated for implementing the constructed wetland instead of the sequencing batch reactor is $282 million over the project's lifetime. | The case study analyzes a business decision made in 1995, where a constructed wetland was built instead of a wastewater treatment system in Texas, U.S.A (DiMuro et al., 2014). |

The economic and financial projections regarding artificial floating islands remain uncertain. It is unknown how a pilot project with several artificial floating islands will reduce a certain amount of nutrient load. Additionally, the eutrophication within the lake is so severe it would take decades to improve it. Therefore, the revenue also remains highly uncertain, and the streams are negligible in the near future.

A pilot project with estimation of the use of artificial floating islands and their nutrient uptake within Vistula lagoon can inform future cost-benefit analysis. It can show feasibility of this strategy and the funding needs for successful upscaling within Vistula lagoon.

### Financial instruments

Financial instruments, such as concessional loans, green bonds, or public loans are deemed unlikely to be applicable to artificial floating islands. This is mainly due to the low and indirect return of ESS. The resources of funding arrangements will have to be made available from within existing, or earmarked budgets.

### Risk and contingency plan

This section defines risks and mitigation strategies for achieving the NbS upscaling restoration objectives (“extension 1”)

There are several issues/knowledge gaps related to the implementation of artificial floating islands (LiveLagoons, 2021):

The type of vegetation most suitable for a given location,

Actual nutrient removal potential, more research is needed to properly estimate nutrient removal by bacterial communities.

Studies based solely on mechanical biomass removal from a water body are highly inaccurate, since the role of microbial activity within the root systems of plants constituting floating installations is totally ignored.

The main obstacle that remains is the transboundary character of Vistula Lagoon: cleaning the water column in it would require cooperation from Russia which currently puts low priority on this issue. Applying restoration efforts will require more funds from EU/Polish actors who pay for Russian benefits.

One risk is the colonization of the artificial islands by cormorants. This has been seen in other artificial islands, where two emerged recently in the Szczecin Lagoon.

#### 14.3.5. Critical funding and financing challenges

This section illustrates the financial challenges identified for the implementation of the proposed "extension 1" restoration and related business model proposition.

The key contact of REST-COAST expresses major concern that the concept of marinas co-funding floating islands to improve water quality is rather unrealistic. All of them do not have free resources and are economically too volatile to fund such ventures. In all, the entire economy in the Vistula Lagoon area is still performing much worse than the rest of Poland (except for communities on the Spit, but they practically turn their backs on the lagoon making money from beach uses in summer).

Thus, at the moment there are few private business partners that would consider a decent return on their investments in that way. In other words, the Government is expected to unblock economic recovery of southern banks of the Lagoon and the passage through the Spit and the navigational channel to Elbląg port are intended to begin that process. A real breakthrough would have been achieved if the communities on the Spit had discovered business opportunities in the Lagoon. This however is hardly possible because of poor water quality. Therefore, it remains difficult to break the vicious circle that can only be overcome by long-term investments and policies of the national government.

## 14.4. Extension 2: Financial scalability plan


**Fig** 12-8 Vistula Lagoon and its drainage basin (Bielecka & Rózyński, 2014)

### 14.4.1. What upscaling means to the pilot

The artificial island established in REST-coast is mainly a safe haven for birds and therefore the landscape scale can be defined using birds as a central element (as opposed to water and river basins). The artificial island (the starting point) is 180 ha and will attract birds from the whole lagoon area and adjacent areas, which could mean several hundred kms, especially areas that used to be pastures and are now in transformation. This is because several big state-owned farms and some smaller ones went bankrupt and most of the land is not cultivated anymore and there is a succession of vegetation that impacts on the birds where birds that are hatching on grass are disappearing. There are measures being taken to mitigate this trend, in combination with discouraging the settling of cormorants on the island by mowing (by humans) or introducing sheep.

The river basin is not the main scale for the Lagoon, as the Vistula was cut off the river basin by humans at the turn of the 20th century by the Prussian tsar. This was because local people lobbied for 50 years to prevent flooding that occurred in the 19th century. However, a significant influence is coming from the river basin in terms of agricultural malpractices during communist times impacting on the water quality. These nutrients have been diffusing to the Lagoon from the surrounding lands and via the waterways. Since the 70ies there is a visible decay in water quality with too many nutrients. The area is so shallow that it is in a permanent state of eutrophication. Damage is so significant –according to local ecologists it will take centuries before natural processes clear the area.

Upscaling would mean starting the reduction in the eutrophication process and exploring/implementing a strategy to address this issue simultaneously with the low socio-economic development of the Vistula lagoon. Further upscaling / outscaling of the measures could be relevant to the Szczecin Lagoon, also known as the German Oder Lagoon to the west of Vistula Lagoon.

### 14.4.2. Overview of barriers preventing upscaling

Financial priorities in times of war: Human made measures such as artificial islands are needed, but they are expensive, and they take a lot of time, so given the current political situation (the Russian invasion of Ukraine and following war) this is a big challenge.

Lack of long term and collective goals; formulated, agreed and adopted by key actors. There is currently no overarching long term developmental plan for the Vistula lagoon where restoration efforts can fall under.

Lack of harmonization of policies: Countries of the Lagoon (Poland and Russia) exercise their own very different policies and there is little collaboration between them. Upscaling in the Polish part of the Lagoon is perceived as much easier because it is under the legal umbrella with the European union, and Russia has a different legal system. Russia is very centralized where the local authorities cannot take actions on their own. The central government in Moscow must be involved for decisions regarding the Vistula and for them the Lagoon is not a priority. Joint actions and arrangements are difficult. For example, there is no harmonization of fishing on both sides even though both Russia and Poland are part of the HELCOM convention. The Russians also built some artificial islands near Kaliningrad during expansion of their navigational channel but as far as is known, they just dumped the sediment and that's it they don't use it as habitat for birds.

Polish coastal scientists had a good cooperation with Kaliningrad coastal engineers before the invasion of Ukraine. Now it is prohibited for the Polish scientists to talk to their Russian counterparts. The prohibition came from the Polish academy of science which is an umbrella for 74 institutions embracing humanities technical sciences natural sciences. This is preventing further cooperation.

In the Polish part of the lagoon, the lagoon is divided into two Provinces with different socio-economic development and priorities. In the northern Gdańsk Province (Pomorskie Province), attracts millions of tourists annually. People can make a good living out of tourism, with the nicest beaches in Poland that are not threatened by erosion and are wide and clean. However, the people are not interested in the Lagoon. It is also one of the fastest developing regions in Poland due to rapid and comprehensive expansion of the shipping/port sector (at least three large container terminals were built in Gdańsk and Gdynia in last years). The construction of container facilities had a very positive by-product of massive artificial beach nourishments from newly dredged approach channels, which boosted summer beach uses significantly. This is an example of positive feedback between the economy and beach restoration. In particular, previous shortcomings were repaired (protection of dunes by gabions severed the continuity of ESS - now after nourishments new artificial dunes emerged, so that biological continuity was restored). Meanwhile, in the southern poorer Warmińsko-Mazurskie Province the priorities are reducing poverty and creating socio-economic development. It is one of the provinces that suffered most from the transition to a market economy. This region was dominated by state farms and scarce industries or services and this backwardness was particularly exposed when market principles obliterated the state-owned sector.

In the context of Vistula Lagoon, the boundary between Pomorskie and Warmińskie runs along the main channel inside the water body (see the thin dashed and dotted line running along the Lagoon in Figure 88). The major reason for doing the artificial island (starting point) was to reinvigorate the economy and reinvigorate the city of Elblag port to get direct access to the Sea and attract investors. The port will serve smaller ships (a feeder port) transferring the goods to bigger ships and delivering goods to bigger ports going via the Danish straight. The ultimate capacity of the port is to handle 4.5 million tons of goods per year. The Polish government believes that in this way by economic reinvigoration of the southern banks of the lagoon will also generate resources and funds to address environmental issues. However, Gregor who is a water expert, assesses that improving water quality needs the central intervention of the government because eutrophication is so serious that a lot of investments would be needed, for example in artificial islands[8].

[8] A study showed that there would be very little impact from the port activities on the heavy metals in the sediments. The concentrations of hydrocarbons were only in two instances slightly above acceptable level.

#### 14.4.3. Potential institutional and financial arrangements (enablers) for overcoming key barriers (needed at the landscape level for upscaling and at higher policy level (discussion)

**Financial arrangements**

Funding may potentially be available from revenues from the Elblag port activities. Until then, any upscaling activities are depending on grants from the national government or the European union. This includes for example to continue to install and maintain artificial (floating) islands. The transboundary character of the Vistula lagoon and the long return on water quality improvements result in difficult additional funding opportunities.

**Regional framework agreements are essential for restoration efforts**

The issue of reducing fertilizers and hence nutrient input to the Lagoon is very politically charged in Poland. Therefore, this problem cannot solely be solved by Poland, but consensus must be achieved in the region. HELCOM is an important driver of collective action in the Baltic Sea region. For example, their work to drive regional agreement and policy development on fertilizer application and discharge was mentioned as important to provide a management framework. The Polish ministries must comply with general laws passed by EU and the HELCOM convention.

The reducing concentration of nutrients in the Baltic Sea will also contribute to decreasing the problem of vast anoxic zones (with H2S) which is damaging marine life. A long-term environmental objective (50 years) is to obtain a good status of the Baltic Sea. Addressing the water quality of the Baltic Sea will also have a significant impact on Vistula Lagoon. One interviewee said: “Once we solve the Baltic issue, then the lagoon issue will be solved automatically. “However, this is a long process that will take decades. Involving especially the farming sector in Germany Poland and Denmark.

**Collaborative action for long term goals**

The main actor for driving collaborative action for upscaling is identified by the key informant is The Maritime Office, that has the full legal jurisdiction on water, that will have to collaborate closely with key environmental institutions. Specifically, the two provincial inspectorate of environmental protection, in Gdańsk and the Olsztyn - Warmia-Mazury province. They are responsible for monitoring and reporting of many environmental and water quality parameters. Also, the Maritime Office will have access to this data.

Another important actor for collaborative action is the scientific community. One challenge is to set long-term overarching goals. The barriers and solutions are a political issue, where some areas are rapidly developing area like Gdańsk, and other areas are struggling like Warnier-Mazury. Apart from their role as participants in EU projects, Polish scientist institutions and knowledge sector could work towards achieving a vision and provide a framework for elaborating this vision and long-term goals for the Lagoon. These could be scientists from multiple disciplines such as oceanographers, ecologists, also people related to social sciences, that can elaborate on social trends. Demographers, as the area is facing an aging population now. This multidisciplinary issue requires some kind of coordination, but there is no institution that is currently in position to take such a role, which can be seen as a barrier.

Potentially an exchange with other areas such as Eems Dollard could generate inspiration for the Lagoon actors, of how a regional program can mobilize multiple actors for collective action. Timing is important, perhaps when there is some economic revenue from the port trickling in.

# Glossary

This glossary has been originally developed by the Finance team of the MERLIN project and has been updated to align with this REST-COAST deliverable.

| TERM | DEFINITION |
|---|---|
| (Commercial) revenues | Incomes generated by the operation and exploitation of the NbS. e.g. the sale of carbon credits or other commercial products and services. It also includes payments for ecosystem services. |
| Bankable project | A project that convincingly demonstrates to satisfy the needs of investors, including criteria such as cash flow generating activities, sufficient collateral, success probability of the project, proof of concept and proven track record, among other things (WWF 2020). |
| Biodiversity offsetting | Some countries have a legal requirement to offset biodiversity impacts of new developments, whereas in other places this may be recommended and so only undertaken voluntarily. See also ‘habitat banking’. |
| Blended finance | The strategic use of public and philanthropic funds to attract private capital in projects. |
| (Green) Bonds | Bonds are used by large entities (e.g. governments, municipalities, corporates) to generate large sums of funding from many different lenders simultaneously (Fernando et.al 2022). So called green bonds generate funding for “sustainable” activities, while so called climate bonds generate funding for climate change mitigation and adaptation. |
| Capital expenses (CAPEX) | The amount of money that is allocated or spent on one-off and upfront on new assets (investments), such as land property, machinery, buildings, patents, etc. (also see Assset Investment). |
| Carbon offsets | Carbon offsets that are tradable. |
| Carbon credits | Certificates that testify and attribute carbon offsetting to their owners. |
| Carbon offsetting | The activity of compensating (presumably unavoidable) carbon emissions by reducing or avoiding carbon emissions elsewhere, e.g. by sequestrating carbon in moors or planting trees. |
| Cash | Actual spendable money. |
| Cash-flow | The flow of actual spendable money that is transferred into- and out of an enterprise or a project. It measures liquidity, the flow of cash ‘in’ and ‘out’. |
| Collateral | An asset that can be seized from a borrower who fails to repay debt (e.g. a loan) to compensate the lender (EIB 2016). |
| Commodities | Homogenous and standardized products, e.g. raw materials, that are traded at a more or less uniform price on markets (The Economist 2017). |
| Cost-Benefit Analysis (CBA) | An analysis of the social-economic costs and benefits of a particular project or activity to support strategic decision making (Le Coent et.al. 2021). This includes the capital and operational costs of a project as well as whenever |

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| | possible opportunity costs, intangible costs and benefits, risks, and externalities. |
| Crowdfunding | A funding model, in which many private individuals separately donate (often small) amounts of money to a specific cause or to enable a specific activity. Donations are often motivated by small rewards or out of intrinsic values. Crowd-funding is pre-dominantly facilitated by specialized online platforms (Baroni et.al 2019). |
| Corporate Social Responsibility (CSR) | Corporate social responsibility (CSR) is a business model that helps a company be socially accountable to itself, its stakeholders, and the public. |
| Debt | Money owed to another organization (typically a bank) by the recipient of a loan. |
| Debt financing | Allocating financial resources for a specific purpose by seeking lending that must be eventually repaid to the lender. Examples include loans or bonds. Loans are based on an agreement between two parties (a lender and a debtor) and are normally repaid over time in fixed (monthly) instalments that also include an interest. Loans that finance sustainable projects can be called green loans: see separate entries for 'bonds' and 'loans'. Both bonds and loans can be used to finance specific activities or purchases, but bonds involve connecting funding from many entities, usually for large organizations or governmental entities, whereas loans are organized between single lenders and debtors at smaller-scales.<br><br>Bonds are used by large entities (e.g. governments, municipalities, corporates) to generate large sums of funding from many different lenders simultaneously (Fernando et.al 2022). So called green bonds generate funding for "sustainable" activities, while so called climate bonds generate funding for climate change mitigation and adaptation. |
| Diversification | The process of widening the basis of one's dependency to reduce the risk of relying on a single entity, e.g. customers, suppliers, revenue streams, assets, etc. |
| Enabling conditions | The institutional, infrastructural, and policy settings, conditions or circumstances supporting asset investments (e.g. by generating incentives to invest in a particular activity) (Shames et.al 2014). |
| Equity (financing) | Equity is the ownership of assets. In equity finance, an investor inserts cash or capital into a business in return for an ownership share of the business (i.e. buying a part of the business). Equity investors are motivated by financial returns, which they anticipate either in the form of dividends (i.e. a share of the yearly profits) or by re-selling the equity with a surplus after its value has increased (also called capital gains) (EIB 2020). |
| Financier | A person or entity allocating financial resources for a specific purpose by means of lending, investing, or through grants. Commercial financiers expect a profit in the form of capital gains (an increase in the value of their equity share), dividends (a share of profit), or interests (for debt financing). |

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| Financing | Financing is defined as the act of obtaining or furnishing money or capital for a purchase or enterprise. It entails allocating financial resources for a specific purpose. Internal financing involves the allocation of internal financial resources, while external financing involves a contractual relationship with a financier (NAIAD 2021). |
| Financing instrument | An instrument that is used to finance projects or businesses, e.g. loans, grants, etc. (NAIAD 2021). A financing instrument is a contract or agreement that holds a monetary value (CFI, 2022). |
| Funder | A person or entity providing funding for a particular purpose. |
| Funding | The total sum of money available to a specific project. Also, the activity of providing all or parts of that money (Naiad, 2021). |
| Grant | A sum of cash handed out to financially support a particular purpose without expecting re-payment, generally by governments or philanthropic organizations to support the provision of otherwise underprovided non-market goods (Shames et.al 2014). |
| Guarantees | An agreement in which a third party (e.g. the state or the EU) agrees to cover any outstanding debt or financial obligation, if a debtor fails to repay a lender (EIB 2020). |
| Habitat banking | Habitat banking is a centrally coordinated and managed approach to biodiversity offsetting at the local or regional level (often based on public policy and mandate). It allows a trade in habitat or biodiversity 'credits'. See also ‘biodiversity offsetting’. |
| Impact investors | Investors (individuals or organizations) that accept higher risks or lower profits for investing into projects and businesses that create a positive broader social or environmental outcomes (Shames et.al 2014). |
| In-kind contribution | A non-monetary donation, e.g. by providing labour, expertise, machinery or other forms of support for free or below market rates (Connectology 2022). |
| Institutional Investor | Professional investment companies (e.g. banks, pension funds, mutual funds, etc.) that pool funds from clients or members to invest large sums across a variety of different businesses and projects (Shames et.al 2014). |
| Investment | The allocation of capital to mechanisms, inputs, labour and capacity building that aid the process of ecosystem recovery with the expectation of scaling up efforts in terms of number and size of ESR projects, and generating ecosystem service returns.<br><br>The allocation of capital with the aim of producing a return (gain) for the investor. |
| Investment Ready | An enterprise of project that meets requirements and expectations of investors (PWC, 2022) |
| Investment track record | An investor’s track record outlines past accomplishments and performance to establish credibility and indicate success rate to potential project partners (Financial Pipeline 2014). |

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| Lender | Any actor who lends out money, often in return for interest payments by which the re-payment exceeds the initially borrowed amount of money. |
| (Green) Loan | The money provided by a lender to a debtor.<br>Loans are based on an agreement between two parties (a lender and a debtor) and are normally repaid over time in fixed (monthly) instalments that also include an interest. Thus, the total money to be repaid by the debtor usually exceeds the original money received as a loan.<br>Loans that finance sustainable projects that make substantial contribution to an environmental objective can be called green loans (World Bank, 2021). |
| Mainstreaming | Embedding ecosystem restoration action as a norm across society (i.e. going beyond restoration being driven and undertaken solely by the environmental conservation sector with action to restore ecosystems also driven from across economic sectors). |
| Market | A physical or virtual place that facilitates the trade of commodities among multiple sellers and buyers, following the dynamics of supply, demand, and market prices. |
| Nature-based Solutions | According to the IUCN definition, nature-based solutions involve deliberate action 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. In contrast to traditional restoration activities nature-based solutions aim towards economic viability. |
| Natural capital | Stocks of natural assets which include geology, soil, air, water and all living things, interacting together. It is from this natural capital that humans derive a wide range of services, often called ESS, which make human life possible. (World Forum on Natural Capital). |
| Off-the-shelf-instrument (OTSI) | A set of pre-existing devices designed instruments to facilitate access to funding and finance for restoration projects. WP3 will be providing specific and detailed guidance documents tailored at restoration managers. |
| Operational expenses (OPEX) | Re-occurring, regular expenses associated with the day-to-day operations of a particular business, such as expenses for labour, energy, raw materials, management, etc. |
| Payment for ESS (PES) | A transaction in which the beneficiary of an ecosystem service compensates the provider of the ecosystem service. |
| Payments for health outcomes | An example of PES. Transactions where the beneficiaries of the health benefits provided by the natural environment pay for the outcomes (Esmée Fairbairn Foundation 2020). |
| Payments for Natural Flood Management (NFM) outcomes | An example of PES. Transactions where the beneficiaries of NFM benefits provided by the natural environment pay for the outcomes (Esmée Fairbairn Foundation 2020). |

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| Payments for water quality outcomes | An example of PES. Transactions where the beneficiaries of the water quality benefits provided by the natural environment pay for the outcomes (Esmée Fairbairn Foundation 2020). |
| Private investors | "Local farmers and businesses, private sector companies, impact investors and institutional investors such as banks and pension funds. Development Finance Institutions (DFIs) can be categorized between public aid institutions and private investors. Corporate Social Responsibility (CSR) departments of private companies can be involved in ESR projects through integrated landscape management and offset schemes" (Shames et.al 2014). |
| Public investors | "Government institutions whose main aim is to allocate capital to projects with the expectation of financial or other returns in the future. Involves any government or state funds, including aid" (Shames et.al 2014). |
| Restoration | Deliberate action undertaken to deliver biophysical improvements for enhancing ecosystem functions and processes and enhance biodiversity. |
| Restoration manager | A person or small group responsible for coordinating the conceptualisation, prioritization, planning and/or delivery of a restoration project. Their role may involve facilitating or liaising with many other stakeholders and societal groups, some of whom may take the lead in shaping and delivering specific activities and outcomes within a broader restoration project. |
| Upscaling | Implementing restoration measures and NbS on larger scales addressing technological, social, governance and financial processes. This may entail:<br>- The replication of promising restoration measures at many other places<br>- At a catchment scale, smartly positioning individual restoration measures so that they act in a synergistic way<br>- Considering and promoting connectivity between (sub)catchments and natural systems in order to foster the resilience and societal benefits of specific projects. The restoration of large areas (e.g. large wetlands) which can act as hotspots for biodiversity and ESS (ESs) and positively impact the surrounding areas<br>- At a continental , country or regional scale, strategically choosing systems and sites to restore identifying sites for restoration based on their potential to deliver benefits for society and help tackle large-scale societal challenges suitability, the envisaged large-scale effects and on efficiency. |
| Value Chain | The full range of value-adding activities and processes by different economic actors within a sector (e.g. design, extraction of raw materials, transport, storage, processing, export, branding, packaging, wholesale, retail) to produce a final product or service (Feller et.al 2006). |

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# Annex 1: Interview Protocol Venice Lagoon, Sicily Lagoon, and Nahal Dahlia

**Application of the NBS business model canvas to pilot team**

The information to co-develop the business model is based on the application of an adapted version of the NBS business model canvas (Stork et al, 2023; Mayor et al, 2021) through in-dept interviews and consultations handled with all relevant stakeholders of the following pilots: Venice Lagoon, Sicily Lagoon, Nahal Dalia. The interview process was coordinated by a core team of stakeholders, following all three steps of the NBS business model canvas: 1. Value proposition; 2, Value creation and delivery; 3. Value capture. Further elaboration of the produced information is then framed into the business plan for upscaling coastal restoration (extension #1).

**Step 1: Value Proposition**

CAT 1: Problems to be addressed and Value proposition

*Q1.1 – How much concerned are you about the following problems affecting the Pilot?*

*(scale: 1 - very unconcerned; 5 - very concerned)*

| Problem | Pilot team | Stakeholder 1 | Stakeholder 2 |
|---|---|---|---|
| Erosion | | | |
| Subsidence | | | |
| Damage from flooding | | | |
| Loss of sediments | | | |
| Water pollution | | | |
| Loss of habitats | | | |
| Loss of biodiversity | | | |
| Solid waste | | | |
| Other, please specify | | | |

| Problem | Pilot team | Stakeholder 1 | Stakeholder 2 |
|---|---|---|---|
| Erosion | | | |
| Subsidence | | | |
| Damage from flooding | | | |
| Loss of sediments | | | |
| Water pollution | | | |
| Loss of habitats | | | |

| | | | |
|---|---|---|---|
| Loss of biodiversity | | | |
| Solid waste | | | |
| Other, please specify | | | |

*Q1.2 - Which of the following problems can be addressed by NBS restoration in the Pilot? Q1.2 - Which of the following problems can be addressed by NBS restoration in the Pilot?*

*(scale 1- strongly disagree; 5 – strongly agree)*

| Problem | Pilot team | Stakeholder 1 | Stakeholder 2 |
|---|---|---|---|
| Erosion | | | |
| Subsidence | | | |
| Damage from flooding | | | |
| Loss of sediments | | | |
| Water pollution | | | |
| Loss of habitats | | | |
| Loss of biodiversity | | | |
| Solid waste | | | |
| Other, please specify | | | |


| Problem | Pilot team | Stakeholder 1 | Stakeholder 2 |
|---|---|---|---|
| Erosion | | | |
| Subsidence | | | |
| Damage from flooding | | | |
| Loss of sediments | | | |
| Water pollution | | | |
| Loss of habitats | | | |
| Loss of biodiversity | | | |
| Solid waste | | | |
| Other, please specify | | | |

## CAT 2: ESS provided and value proposition

*Q2.1 – How relevant are the following ESS and Biodiversity improved by the restoration for you?*

*(scale: 1 - very unconcerned; 5 - very concerned)*

| Stakeholder name | Biodiversity | Food provisioning | Water Quality Purification | Reduction of coastal erosion risk | Climate change regulation | Reduction of coastal flooding risk |
|---|---|---|---|---|---|---|
| Stakeholder 1 | | | | | | |
| Stakeholder .. | | | | | | |
| Stakeholder n | | | | | | |

| Stakeholder name | Biodiversity | Food provisioning | Water Quality Purification | Reduction of coastal erosion risk | Climate change regulation | Reduction of coastal flooding risk |
|---|---|---|---|---|---|---|
| Stakeholder 1 | | | | | | |
| Stakeholder .. | | | | | | |
| Stakeholder n | | | | | | |

*Q2.2 - Which activities that you perform/offer can rely on your NBS restoration interventions:*

*Provide a short description*

*Q2.3 - For each ESS and BdV improvement express your level of agreement of the following expected benefits.*

| ESS, BdV | ESS output level<br>BdV output level | Benefits (+/-) | | | |
|---|---|---|---|---|---|
| | | Envirnonmental | Economic | Social | Cultural |
| Reduction of coastal flooding risk | describe | describe | describe | describe | describe |

| ESS, BdV | ESS output level<br>BdV output level | Benefits (+/-) | | | |
|---|---|---|---|---|---|
| | | Envirnonmental | Economic | Social | Cultural |
| Reduction of coastal erosion | describe | describe | describe | describe | describe |
| Carbon sequestration | describe | describe | describe | describe | describe |
| Water purification | describe | describe | describe | describe | describe |
| Fish provisioning | describe | describe | describe | describe | describe |
| Biodiversity | describe | describe | describe | describe | describe |

*Q2.4 - How much do you agree on the following restoration objectives in the Pilot case to be included in a Business Plan for upscaling NBS restoration?*

*(scale 1- strongly disagree; 5 – strongly agree)*

*Q2.5 - Which types of economic good or service can be derived from any ESS/BdV improvement?*

*Q2.5 - Which types of economic good or service can be derived from any ESS/BdV improvement?*

*Q2.6.a Which is the primary value of the NBS restoration intervention?*

*Q2.6.b Which is the secondary (co-benefits) value of the NBS restoration intervention?*

**Step 2: Value Creation/Delivery**

CAT 3: Regulation and Governance

*Q3.1 Which is the current regulation in place impacting value creation?*

*Q3.2 Which are the governance models allowing to achieve the implementation of NBS restoration interventions in the pilots?*

*Q3.3 Are governance models supporting procurement arrangements? If yes, how?*

## CAT 4: Key partners/stakeholders (initiators and implementers)

## CAT 4: Key partners/stakeholders (initiators and implementers)

*Q4.1 Who is the initiator responsible for initiating the upscaling restoration interventions?*

*Q4.2 Who are the main implementers/operators responsible for implementing the upscaling restoration interventions, per each NBS intervention?*

*Q4.2 Who are the main implementers/operators responsible for implementing the upscaling restoration interventions, per each NBS intervention?*

*Q4.3 Which type of procurement arrangements are envisaged for implementing the upscaling restoration interventions, per each NBS intervention?*

*Q4.4 What is the management structure (involving initiator and implementers) allowing the implementation and maintenance of upscaling restoration interventions? How is it organized?*

## CAT 5: Key activities per NBS restoration intervention

*Q5.1 For each NBS restoration intervention, which are the main activities required and the approximate duration for each of the following stage: Planning, Implementation, Monitoring*

| Size impacted area | Restoration phases (or activities) with start/end Activities (start/end) | Total duration | Planning (start/end) | Implementation (start/end) | Monitoring (start/end) |
|---|---|---|---|---|---|
| describe | describe | describe | describe | describe | describe |
| | describe | describe | describe | describe | describe |
| | describe | describe | describe | describe | describe |

*Q5.1 For each NBS restoration intervention, which are the main activities required and the approximate duration for each of the following stage: Planning, Implementation, Monitoring*

| Size impacted area | Restoration phases (or activities) with start/end Activities (start/end) | Total duration | Planning (start/end) | Implementation (start/end) | Monitoring (start/end) |
|---|---|---|---|---|---|
| describe | describe | describe | describe | describe | describe |
| | describe | describe | describe | describe | describe |
| | describe | describe | describe | describe | describe |

## CAT 6: Key resources

*Q6.1 Which are the resources needed to implement the upscaling restoration interventions (existing and non-existing at present)?*

## CAT 7: Beneficiaries/Stakeholders and potential customers

*Q7.1 - Who are the direct beneficiaries (i.e. stakeholders by type), i.e. who are affected by the problem that upscaling restoration interventions are addressing?*

*Q7.2 - Who are the other indirect beneficiaries who will benefit from upscaling restoration interventions and the potential customers willing to pay for any benefit/co-benefit (good/services) related to ESS/BdV improvement?*

| Beneficiaries/Stakeholders By type | Direct beneficiaries | Potential customers | What is the potential demand (n. of unit per type) |
|---|---|---|---|
| List and describe | | | |
| List and describe | | | |

## CAT 8: Customer relationship and channels

*Q8.1 - Which is the type of relationship between the customers and the service providers or implementors?*

*Q8.2 - Which are the distribution channels (how do you reach customers and/or beneficiaries and how frequently)?*

**Step 3: Value Capture**

*Q7.1 - Who are the direct beneficiaries (i.e. stakeholders by type), i.e. who are affected by the problem that upscaling restoration interventions are addressing?*

*Q7.2 - Who are the other indirect beneficiaries who will benefit from upscaling restoration interventions and the potential customers willing to pay for any benefit/co-benefit (good/services) related to ESS/BdV improvement?*

| Beneficiaries/Stakeholders<br>By type | Direct beneficiaries | Potential customers | What is the potential demand (n. of unit per type) |
|---|---|---|---|
| List and describe | | | |
| List and describe | | | |

CAT 8: Customer relationship and channels

*Q8.1 - Which is the type of relationship between the customers and the service providers or implementors?*

*Q8.2 - Which are the distribution channels (how do you reach customers and/or beneficiaries and how frequently)?*

**Step 3: Value Capture**

CAT 9: Cost structure

*Q9.1 Which are the lifecycle costs (including capital costs, operation and maintenance costs)?*

*Q9.2 Which are the opportunity costs (including the benefit, profit, or value that would have been generated by implementing other alternatives)?*

*Q9.3 Which are the avoided damage costs (e.g. risk related damages avoided as a result of the NBS based interventions)*

CAT 10: Revenue stream

*Q10.1 Which are the possible income streams generated as a result of ESS/BdV improvements and/or economic activities (products, services) based on ESS/BdV improvements for which each customer segment is willing to pay, and which ones can provide an economic return?*

*Q10.2 Which are the possible indirect income streams?*

## CAT 11: Financial mechanisms

*Q11.1 Which of the innovative financing solutions/mechanisms identified by D3.2 could be applicable to obtain the funds or capital investment required upfront, to be paid back over time?*

*Q11.2 Who are the potential investors/funders?*

- *Central government grants*
- *Third sector (eNGOs) sources*
- *Community sources*
- *Private sector sources*

*Q11.3 Which role can have the potential investors/funders?*

- *Buyers of ecosystem services*
- *Investors of capital*
- *Donors of fund*

*Q11.4 Which is the financial strategy designed to plan, implement and monitor the NBS upscaling restoration interventions?*

## CAT 12: Impact Indicators

*Q12.1 Which are the tangible and measurable impacts achieved through the implementation of the NBS restoration interventions, described by Key Performance Indicators (KPIs), that should be used to track the performance and efficiency of the business strategy?*

- *Impact on produced capital, built environment, wealth*
- *Impact on Natural capital (ESS, biodiversity, land use, $CO_2$ emissions, etc.)*
- *Impact on human capital (employment, wellbeing, knowledge, increase in 4th sector related companies, increase in Copernicus data usage)*

## CAT 13: RISK, DE-RISK

*Q13.1 Which are the main risks to implementation (e.g. elements or factors that could constrain the feasibility or success in the implementation of the NBS restoration interventions) and which mitigation solutions?*

| *Risk type (or activity to which it is correlated)* | *Risk description* | *Likely of occurrence (low, medium, high* | *Potential impact (low, medium, high)* | *Potential solution (n/a, to be described)* |
|---|---|---|---|---|
| | | | | |

## CAT 13: RISK, DE-RISK

*Q13.1 Which are the main risks to implementation (e.g. elements or factors that could constrain the feasibility or success in the implementation of the NBS restoration interventions) and which mitigation solutions?*

| *Risk type (or activity to which it is correlated)* | *Risk description* | *Likely of occurrence (low, medium, high* | *Potential impact (low, medium, high)* | *Potential solution<br>(n/a, to be described)* |
|---|---|---|---|---|
| | | | | |

# Annex 2: Interview Protocol Arcachon, Ebro Delta, Eems Dollard, Foros Bay, Rhone Delta, and Vistula Lagoon

## Current situation (implementation of REST COAST)

1) Could you please confirm that the ***current*** and potential financial arrangements look like the figure below. If different – could you please indicate what is the correct illustration?

[Illustration relevant for the pilot of NbS Business model – from D3.1].

## Next phase (after REST COAST)

In REST COAST WP 3 (3.3.1 and 3.3.2) we are investigating the next phase after REST COAST activities, (i.e. not listed as activities in the proposal/Annex 1).

In our previous meetings you mentioned you were interested in/aim to write a business plan. We would like to explore these plans further and document your approach as much as possible.

**Main questions:**

1. What are your plans to do after the REST COAST activities?

2. When is the deadline/timeline for producing the proposal for new activities? Is this something you can share with us or tell us more about?

3. For the new planned activities - What are the physical and temporal boundaries, and can you describe them? (aim, objectives, vision?)

4. What Ecosystem Services are you planning to provide related to the new business model? (Same as in the drawing above?).

5. What type of **financing arrangements/ instruments** are you planning on using? How would the financial arrangements look like compared to the figure above? What would be different/the same? (funding model and financing instruments to fit the funding model i.e. business models, value capture instruments) that fit to the ESS targeted.)

6. What **provisioning /procurement arrangement** are you planning on using?

**Starting point: Current Business Model**

<u>Coastal restoration activities</u>

What are the current restoration activities?

<u>ESS and Economic good typology</u>

Which are the ESS supported by restoration? How can they be categorised in terms of rivalry of consumption and excludability? (This is filled in beforehand by interviewee and discussed in the interview). Do you agree on the classification of the ESS in terms of private, club public or common good?

| | | Rivalry in consumption<br>High | Low |
|---|---|---|---|
| Excludability | High | Private | Club |
| | Low | | Public |
| | | CPR | |
| Descriptions | | | |

ESS provided and their economic good typology (Provisioning services, Regulating services, Cultural services, Biodiversity benefits). ESS based on CICES classification

Funding: granting

What are the sources for funding (payment) for restoration activities through granting (public or private transfers). See D3.1 for more information regarding these categories.

**Overview of division funding sources of seagrass restoration in Pilot**

| Funder | Activities | Type of funder | Type of funding |
|---|---|---|---|
| | | | |

Funding: value capture

What are the sources for funding (payment) for restoration activities through "value capture" (taxes, tariffs, sale). See D3.1 for more information regarding these categories.

**(Future) potential funding contributions through value capture seagrass restoration in the pilot**

| Category | Funding type | Actor |
|---|---|---|
| Reduction in costs | Tariffs/ fees | |
| Recreation and tourism | Taxes | |

| | |
|---|---|
| Product sales | Sales |
| Climate change mitigation | Carbon credits |

Finance

What are the financing instruments for restoration activities at the starting point (none according to D3.1).

Procurement arrangements

What are the procurement / implementation arrangements? Note that some arrangements go beyond procurement (such as land acquisition) and procurement is less relevant for private initiators.

Critical funding and financing challenges

What financial challenges have emerged in the past (and are still relevant for the future) with regards to the "starting point" restoration. Check categories for financial barriers identified in D3.2.

**Extension 1: Business model proposition and Business plan**

This section is covering questions about the additional restoration that requires new funding and therefore new business models (T3.3.1) and business plans (T3.3.2).

Mission and Objectives of the Restoration Initiator

What is the overall **mission** of the initiator (D3.1) (organisation(s) committed to extending NBS restoration) in the pilot area and extending NBS restoration objectives ("extension 1")?

- What is the restoration area?
- What are the restoration **objectives**: main problems to be solved?
- What are the coastal restoration activities? Give a brief description of planned activities to achieve the objectives.

Stakeholder overview

Who are the stakeholders potentially engaged in upscaling restoration in the pilot ("extension 1")?

(Roles/categories defined in D3.1)

- Initiator (could be different from the initiator of the current version BM)
- Beneficiary
- Funder/Grantor
- Financier…

**Overview of description of stakeholders categorized according to legal status and actor category**

| | Stakeholder | Description | Legal status | Category |
|---|---|---|---|---|
| **1** | | | | |
| **2** | | | | |

**3**
**4**
**5**
**6**
**7**
**8**

Business model proposition

This section presents the business model proposition for upscaling restoration in the pilot.

Value proposition

What values (ESS) are created through the restoration activities?

Which types of environmental, economic, social and cultural **benefits** are provided by each type of NbS restoration intervention? (Which ESS are involved and type of goods?)

**Types of environmental, economic, social and cultural benefits provided by the restoration in the pilot.**

| **ESS, (Ecosystem Service) BdV (Biodiversity)** | **ESS /BdV output level (as example)** | **Benefits** | | | |
|---|---|---|---|---|---|
| | | *Environmental* | *Economic* | *Social* | *Cultural* |
| Sediment control | Cost of hiring dredging companies | | | | |
| Carbon sequestration | CO2 stored/hectare | | | | |
| Flood regulation | Decrease probability of flood | | | | |
| Water Purification | Total Suspended Solids (TSS)/ Nephelometric Turbidity Units (NTU) | | | | |
| Food Provisioning | kg of fish production (due to increased habitat) | | | | |
| (Eco)-Tourism | Number of tourists/Annual tourism revenue within municipality | | | | |
| Biodiversity | Indices of increased BDV, such as the Shannon-Weiner Index/Fish Index (EFI+) | | | | |

Market analysis (demand and supply) and legal requirements

(Customer segment and customer relationships in the BMC.) When relevant, Innovative financial arrangements from D3.2 should be discussed with the interviewees and considered for implementation. See D3.1 for more information regarding these categories.

What are the potential markets due to NBS intervention and who are their main beneficiaries?

Are there markets for paying for these services? What is the maturity of the markets? What are the potential markets due to NBS intervention and who are their main beneficiaries

What are the legal requirements?

Value creation & delivery

What is the type of demand (for ESS) for each stakeholder and how is the value delivered (cost reduction, revenue etc.)?

**Overview of stakeholders, beneficiaries and potential customers**

| Stakeholders | Potential Beneficiaries | Type of demand |
|---|---|---|
| List the main actor/stakeholder involved in the intervention | List the wider beneficiaries | List ESS demanded by the stakeholder/ beneficiary |

Implementation arrangements

Who are potential/targeted implementers (and how can they be characterised) and key resources to realise the NBS. I.e. key resources in the BMC. When relevant, innovative financial arrangements from D3.2 should be discussed with the stakeholders and considered for implementation.

Value capture

What is the direct versus indirect value capture (funding): Who are the potential/targeted grantors (i.e., those granting or donating money for the implementation of an NBS) and beneficiaries (i.e. those directly consuming the ESS)? How will value capture be done (via taxes, sales, tariffs, etc.?)

Economic and financial projections

What are the economic projections of costs & revenue stream from *extension* 1; what is the financial projections. What is the break-even point?

Financial instruments

Who are the potential/targeted financiers. When relevant, Innovative financial arrangements from D3.2 should be discussed in the interview id considered for implementation.

Risk and contingency plan

What are the risks and mitigation strategies for achieving the NBS upscaling restoration objectives (“extension 1”)?

Critical funding and financing challenges

What are the financial challenges identified for the implementation of the proposed “extension 1” restoration and related business model?

**Extension 2: Financial scalability plan**

What does upscaling mean to the pilot?

Describe the scale and scope and elaborate on why and what criteria we use to set the boundaries for landscape level:

- Do you have a geographical map illustrating the complete area relevant for upscaling?
- What are the main activities for upscaling?
- What is the time scale for upscaling?
- What are the main system dynamics in the area?

Overview of barriers preventing upscaling

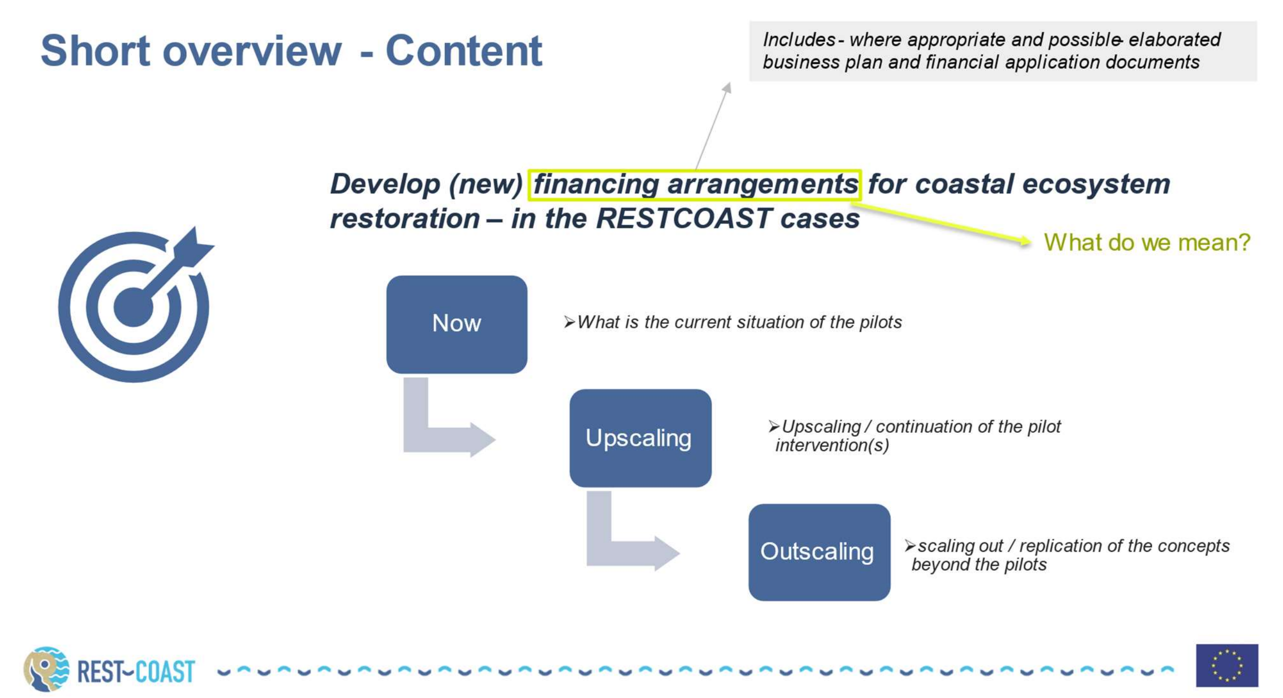
- What are the main barriers to upscale to a larger landscape?

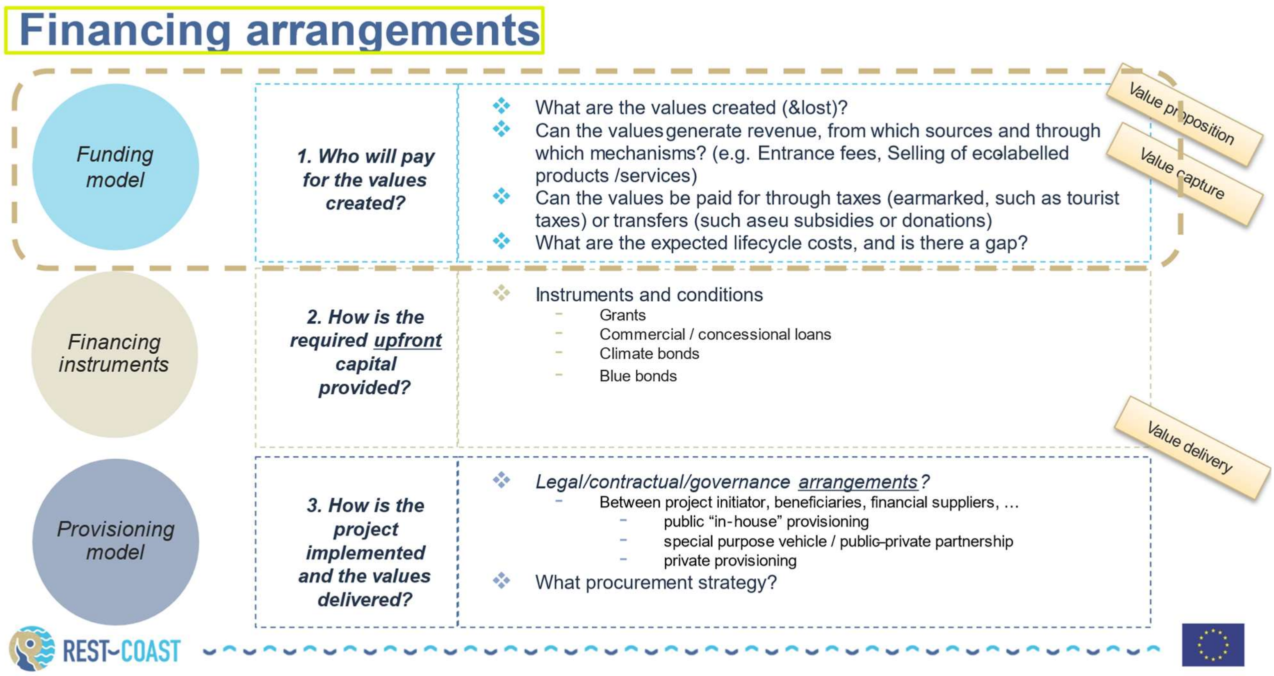
Potential institutional and financial arrangements (enablers) for overcoming key barriers (needed at the landscape level for upscaling and at higher policy level (discussion)

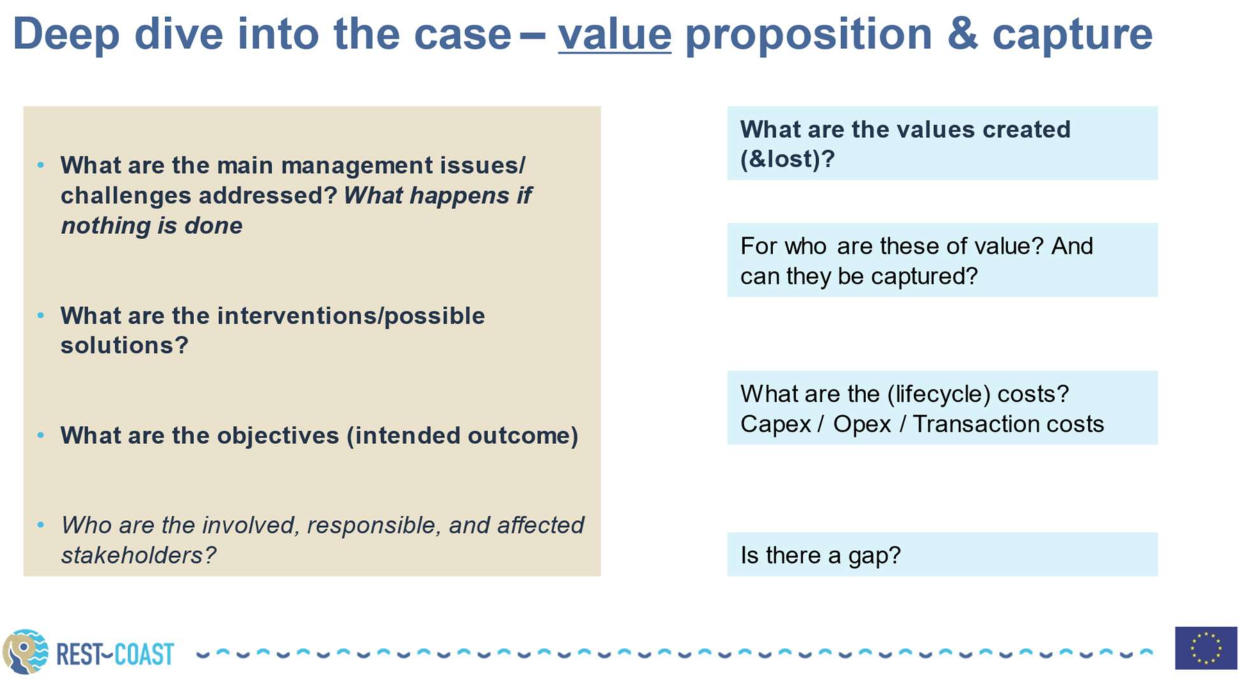
- What are the potential institutional and financial arrangements for overcoming key barriers?
- How do we need to restructure finance for upscaling?
- How do we need to restructure governance for upscaling?
- What are the potential higher-level policies and other enabling instruments for overcoming barriers (e.g. policy integration mechanisms)?

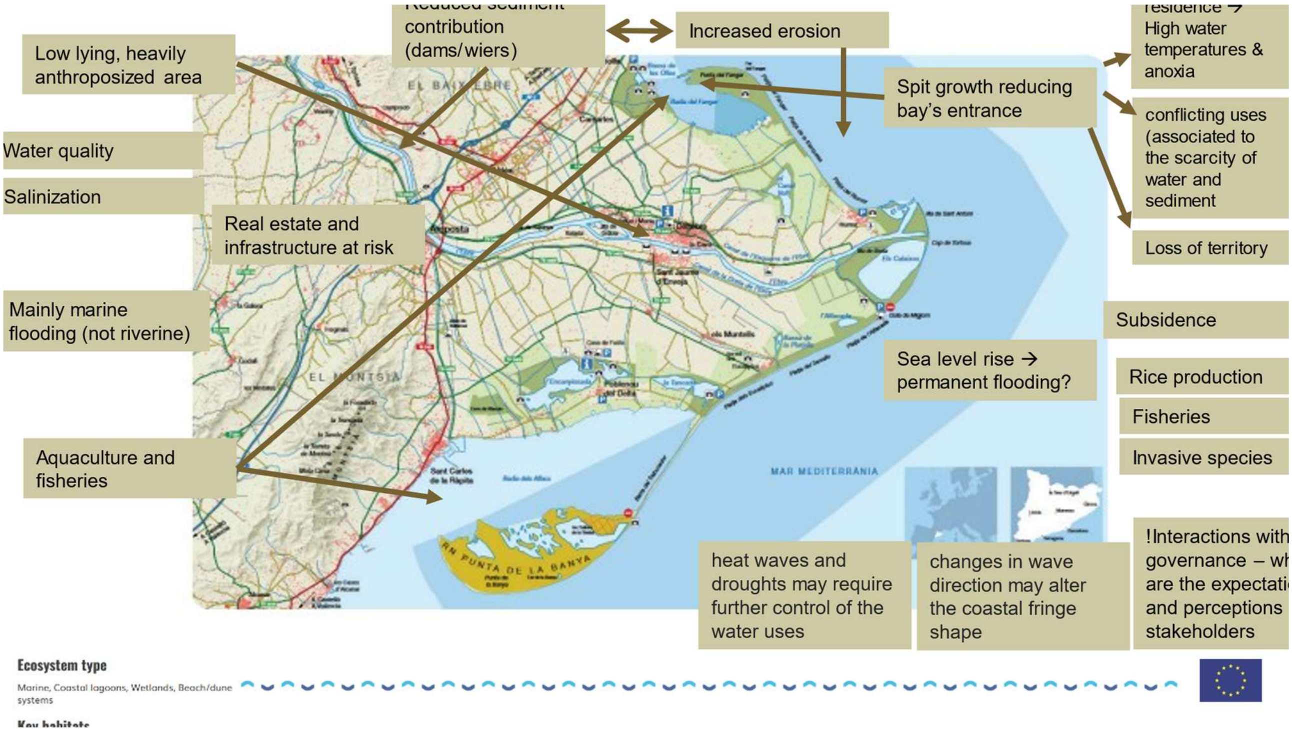
# Annex 3: Example of Process Documentation and Co-Production: Ebro Delta

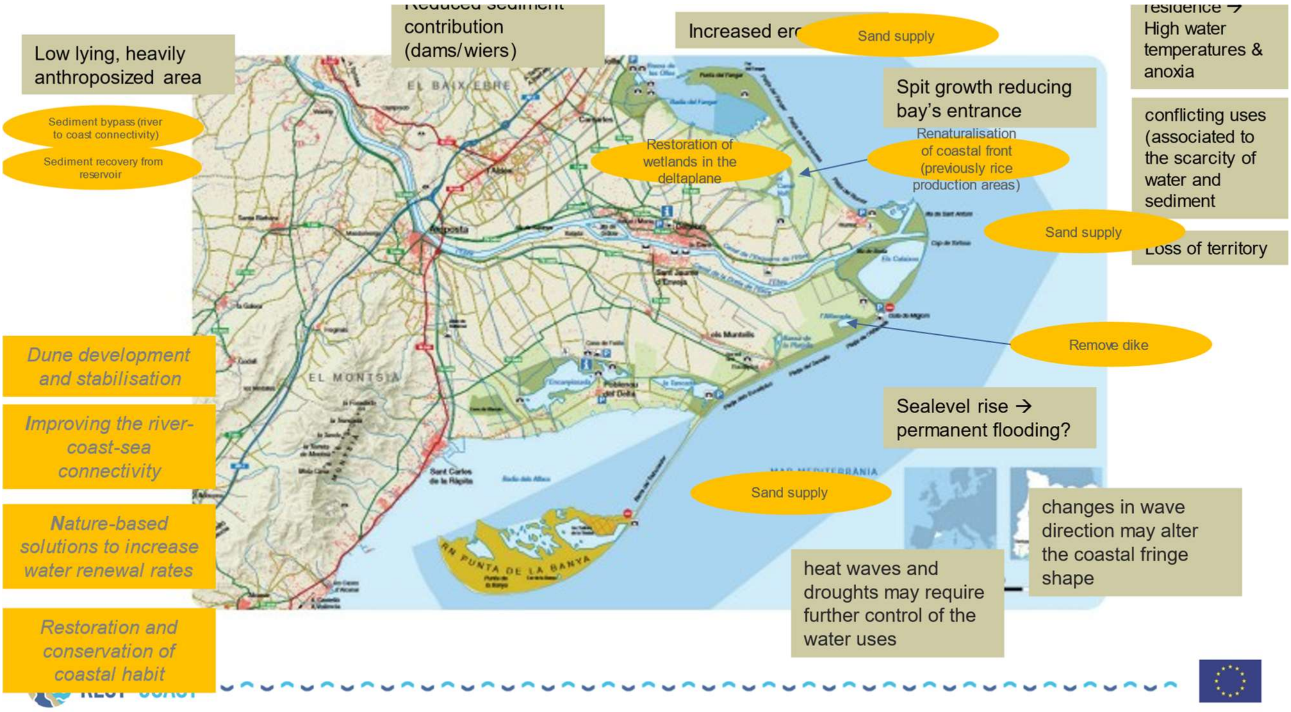
The following presentation is an excerpt from a presentation with the Ebro Delta, illustrating how the information was generated in co-production with pilot coordinators and stakeholders.


Financing arrangements
Funding model
1. Who will pay for the values created?
What are the values created (&lost)?
Can the values generate revenue, from which sources and through which mechanisms? (e.g. Entrance fees, Selling of ecolabelled products /services)
Can the values be paid for through taxes (earmarked, such as tourist taxes) or transfers (such aseu subsidies or donations)
What are the expected lifecycle costs, and is there a gap?
Value proposition
Value capture
Financing instruments
2. How is the required upfront capital provided?
Instruments and conditions
Grants
Commercial / concessional loans
Climate bonds
Blue bonds
Value delivery
Provisioning model
3. How is the project implemented and the values delivered?
Legal/contractual/governance arrangements?
Between project initiator, beneficiaries, financial suppliers, …
public "in-house" provisioning
special purpose vehicle / public-private partnership
private provisioning
What procurement strategy?
REST-COAST


Deep dive into the case – value proposition & capture
What are the main management issues/ challenges addressed? What happens if nothing is done
What are the interventions/possible solutions?
What are the objectives (intended outcome)
Who are the involved, responsible, and affected stakeholders?
What are the values created (&lost)?
For who are these of value? And can they be captured?
What are the (lifecycle) costs? Capex / Opex / Transaction costs
Is there a gap?
REST-COAST


Low lying, heavily anthropozised area
contribution (dams/wiers)
Increased erosion
High water temperatures & anoxia
Water quality
Salinization
Spit growth reducing bay's entrance
conflicting uses (associated to the scarcity of water and sediment
Real estate and infrastructure at risk
Loss of territory
Mainly marine flooding (not riverine)
Subsidence
Sea level rise → permanent flooding?
Rice production
Fisheries
Aquaculture and fisheries
Invasive species
heat waves and droughts may require further control of the water uses
changes in wave direction may alter the coastal fringe shape
!Interactions with governance – wh are the expectati and perceptions stakeholders
EL BAIX EBRE
EL MONTSIÀ
PUNTA DE LA BANYA
MAR MEDITERRÀNIA
Ecosystem type
Marine, Coastal lagoons, Wetlands, Beach/dune systems


contribution (dams/wiers)
Increased er
Sand supply
High water temperatures & anoxia
Low lying, heavily anthropozised area
Spit growth reducing bay's entrance
Sediment bypass (river to coast connectivity)
Sediment recovery from reservoir
Restoration of wetlands in the deltaplane
Renaturalisation of coastal front (previously rice production areas)
conflicting uses (associated to the scarcity of water and sediment
Sand supply
Loss of territory
Remove dike
Dune development and stabilisation
Improving the river-coast-sea connectivity
Sealevel rise → permanent flooding?
Sand supply
Nature-based solutions to increase water renewal rates
changes in wave direction may alter the coastal fringe shape
heat waves and droughts may require further control of the water uses
Restoration and conservation of coastal habit
EL BAIX EBRE
EL MONTSIÀ
PUNTA DE LA BANYA