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DOI
10.1016/j.ecoleng.2025.107706

Publication date
2025

Document Version
Final published version

Published in
Ecological Engineering

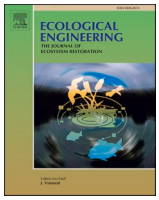
Citation (APA)
Hüsken, L. M., Slinger, J. H., de Rijk, S., Altamirano, M. A., & Vreugdenhil, H. S. I. (2025). Overcoming financial barriers to ecological restoration – The case of the Marker Wadden. *Ecological Engineering*, *219*, Article 107706. https://doi.org/10.1016/j.ecoleng.2025.107706

Ecological Engineering 219 (2025) 107706

Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng



Overcoming financial barriers to ecological restoration – The case of the Marker Wadden

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ARTICLE INFO

Keywords:
Nature-based solutions
Case study research
Public investment planning
Financing gap
Public-private partnership
Financial engineering
Co-funding

ABSTRACT

In this paper, we closely examine the case of the Marker Wadden, a nature restoration project with recreational opportunities in the Dutch lake Markermeer. The Marker Wadden – a mud island concept – has been constructed using locally sourced building materials (sediments from the lake) and is designed to withstand natural dynamics such as storms and waves. Lack of funding and financing has been repeatedly discussed and identified as a key barrier to implementing and upscaling ecological restoration, or Nature-based Solutions (NbS) in general. This highlights the importance of studying a unique case, such as the Marker Wadden, where this well-documented barrier has been overcome. We aim to identify the financial arrangements made and how they came about. We adopt the rounds model (a policy analysis theory), apply evidence triangulation, and employ a theoretical framework that captures an institutional perspective on financial barriers. We find the Marker Wadden project to be an example of public and private co-funding for ecosystem restoration. We further find revenue generation from recreational activities leads to partial cost-recovery, and non-public funding sources are unlocked due to the involvement of an NGO. We also find the pre-investment phase to be instrumental in overcoming financial barriers during later (implementation) phases. We surface the main drivers that led to funding for the Marker Wadden project, reveal opportunities for investment planning for NbS, and expose trade-offs in terms of (democratic) equity, efficiency, and environmental outcomes resulting from the combined public, private, and philanthropic co-funding arrangements used.

1. Introduction

The Marker Wadden is a group of mud islands artificially constructed in the Dutch freshwater lake Markermeer. Initially, a cluster of five islands was built between 2016 and 2021, with a small settlement and numerous recreational facilities (Fig. 1, Fig. 2). By now, there are seven islands, and further expansions are being discussed. Along with the islands came a diverse underwater landscape with varying depths and connections. The project covers an area above and below water of 1300 ha (de Rijk et al., 2022). The design of the islands anticipated making use of locally sourced materials, including fine sediments from the bottom of the lake, both for initial construction as well as for maintenance. A structure of ring dikes was built to contain the sediment and was combined with nearby gullies and trenches to further trap and stabilise sediments from the lake.

Why were these islands, which are commonly referred to as a bird paradise, constructed? A major driving force behind this initiative has been the necessity to improve the ecological functioning of the lake to abide by environmental legislation, which in turn manifested as a precondition for further economic development in the adjacent urban areas. Since 2009, the Markermeer has formed part of the European 'Natura 2000' network and the nature network of the Netherlands. Before that, it was already a designated protection zone under the Birds Directive, and it was an internationally recognised wetland area within the context of the Ramsar Convention of 1971 (Waterhout et al., 2013; Werkmaatschappij Markermeer-IJmeer, 2012). With its average depth of 3.5 m and surface area of around 70,000ha, the lake is one of the largest nature reserves in the Netherlands (Royal HaskoningDHV, 2014).

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https://doi.org/10.1016/j.ecoleng.2025.107706
Received 5 February 2025; Received in revised form 15 May 2025; Accepted 11 June 2025
Available online 20 June 2025

Fig. 1. Aerial photo of the Marker Wadden during construction, October 2017 (Straystone - Peter Leenen, 2017).

Fig. 2. One of the footpaths on the Marker Wadden leading to a bird watching point, amidst the yellow fleawort, May 2020 (Wijnen, 2020).

Historically, the water body used to be a saltwater inlet of the North Sea before the closure dike dammed it off in 1932. A further division of the water body occurred in 1976 when the Houtribdijk was constructed. Originally, the intention of this last closure was land reclamation - creating polders for agricultural purposes - but these plans fell through (see section 3.1 for a description and maps of the historic and contemporary case study area). What remained after the abandonment of the land reclamation plan was a large freshwater lake with a deteriorating ecological quality resulting from the loss of the natural dynamics (as it no longer had an open connection to the sea), the absence of natural shores (due to sediment mining activities and the construction of levees and dams), and the accumulation of sludge at the bottom of the shallow lake, which, when stirred up by winds, leads to high turbidity levels (Kaffener et al., 2019; Noordhuis, 2014; Van Riel et al., 2019). Combinations of these processes limit the growth of algae and benthic fauna, resulting in declining populations of both fish and birds (Noordhuis, 2014). The Marker Wadden was initiated to address the observed and problematic ecological deterioration.

The Marker Wadden can be considered a Nature-based Solution (NbS). NbS are defined as "*actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature*" (Cohen-Shacham et al., 2016). The Marker Wadden is rooted in a "win-win" philosophy for people and nature: to use the sediments that are partly responsible for the ecological deterioration to develop new nature and recreational islands, and with that, contribute to the restoration of the ecological functioning of the lake. NbS are increasingly recognised as a cost-effective strategy to address several critical societal challenges simultaneously, including biodiversity loss, adaptation to climate change, and sea level rise. Despite the great potential, implementation of NbS has not yet found its way into mainstream application (Janssen et al., 2019). Implementing and upscaling NbS faces a myriad of barriers, including the pernicious barrier of a lack of funding and financing (Davies and Lafortezza, 2019; Dorst et al., 2022; Hüsken et al., 2024; Kabisch et al., 2016; Sarabi et al., 2019).

To date, limited empirical evidence is available regarding how ecological restoration projects (a specific strand of NbS (Cohen-Shacham et al. 2016), in particular those of scale, have managed to overcome financial challenges. Although there is increasing scholarly effort dedicated to (full or partial) ecosystem service valuation studies (Beck et al., 2022; Kok et al., 2025; Stouten et al., 2022; Unterberger and Olschewski, 2021) as well as towards novel mechanisms and instruments for sustainable investments in NbS and nature conservation (Berzaghi et al., 2022; van den Burg et al., 2022; Favero and Hinkel, 2024; Ginn, 2005; den Heijer and Coppens, 2023; Hudson et al., 2023; Mullin et al., 2019; Van Raalte and Ranger, 2023; Reguero et al., 2020; Thompson et al., 2023), to the best of our knowledge, there are only a few in-depth studies that empirically examine the financial arrangements of ecological restoration projects in their particular contexts (op de Beeck et al., 2024; Beer, 2022; Richardson and Davidson, 2021). For example, Beer (2022) scrutinizes the case of Chilean Patagonia, where the "dollars for policy" approach (leveraging public conservation outcomes with philanthropy) results in privileging donor power in state environmental decision-making. This work triggers the question whether the conservation ends (long-term financial resources and management of 17 of the 18 national parks in Chilean Patagonia) justify the means (the strings-attached philanthropic capital). By adopting a public financing perspective, op de Beeck et al., 2024 study NbS financing and implementation in four Flemish cities. They find that different strategies are adopted during different lifecycle phases. Further, in particular, internal collaboration is fostered by developing integrated spatial NbS designs during the design phase, leading to multiple benefits and corresponding funding opportunities that can be captured once implemented. Another strategy they find is that during the maintenance phase, partnerships with NbS beneficiaries help to alleviate costs for municipalities. While in the case of Beer (2022) philanthropic capital leveraged public investment, (op de Beeck et al., 2024) find that the interplay between policy and finance acts as an important catalyst for (public) investments in NbS. Studying such cases, where funding and financing barriers have been overcome, leads to insights that can benefit other restoration projects.

Such empirical studies illustrate the existence of a multitude of pathways that can unlock funding and financing for NbS, which are enabled or disabled by contextual institutional conditions. Yet, securing funding and financing remains a pernicious barrier, hindering large-scale implementation of NbS. This argues for the importance of generating a deeper understanding of how financial barriers to NbS can be addressed by empirically studying a unique case, such as this one, where the financial barrier has seemingly been overcome. Therefore, the research question to be answered in this study is: ***What financial arrangements are deployed in the case of the Marker Wadden, and how did these come about?*** In doing so, we contribute to the existing body of knowledge by providing context-sensitive, empirical evidence of the strategies deployed to overcome financial barriers. In doing so, we also contribute to the existing evidence base for NbS and ecological restoration projects.

2. Methods

We examine what financial arrangements (*the substance*) were deployed, and how or why these came about *(the form)* in the case of the

Marker Wadden. In essence, we strive to uncover how the well-documented and seemingly persistent financial barriers to NbS were overcome in this case. Such a question is typically well-suited for a case study approach, which is an empirical method that allows for in-depth investigation of the phenomenon of interest within its real-world context (Yin, 2018). Further arguments for the appropriateness of this research method are the contemporary nature of the case (the construction of the islands happened in the recent past, the maintenance and exploitation phase is occurring in the present, and discussions concerning upscaling of the concept are ongoing), and the lack of control researchers have over the outcome (Yin, 2018). These aspects allow us to study a wide variety of evidence, a unique strength of case study research. This case study research is guided by the theoretical framework developed in Hüsken et al. (2024), adopts the rounds model as a policy analysis theory, and is informed by multiple sources of evidence in a triangulating fashion.

2.1. The case

The Marker Wadden is a unique or unusual case for several reasons. First, it is the first time that land reclamation in the Netherlands has occurred for the benefit of nature rather than for agriculture or urban development. Second, the project was co-funded by public and private stakeholders, and a collaborative partnership was developed between the state and an NGO for the construction work. Furthermore, it has been a substantial capital investment – roughly €80 million - for the purpose of ecological restoration. As such, this makes it a unique case for the Netherlands, but also an interesting case for ecological restoration and NbS in general. Obtaining information from a unique or unusual case can help to develop new concepts, variables, and/or theories that can explain the deviation observed in the case (Flyvbjerg, 2006).

The object of study in this research is the Marker Wadden project. More precisely, it is the so-called *first phase* of the Marker Wadden. This first phase refers not to a particular lifecycle phase, but rather to the first group of islands being built, since the ambition from the outset was to scale up the plans. Our analysis focuses on identifying the financial arrangements made for the lifecycle of the first phase of the Marker Wadden project, including the implementation and operating phases, depicted at the top in Fig. 3. Our object of study (the case) is embedded in a broader policy context, which is relevant to understanding why or how these arrangements came about. This context is studied as the pre-investment phase, sometimes referred to as the "front-end" or "upstream" part of the public investment cycle. As such, we utilise and combine perspectives and terminology from multiple project-level management processes (European Commission: Directorate-General for Research and Innovation et al., 2023; FAO SER and IUCN CEM, 2023; Raymond et al., 2017; Wang and Chen, 2023) and public investment planning processes (McEvoy, 2019; Samset et al., 2016; UNIDO, 2018; van de Ven et al., 2016) depicted at the bottom in Fig. 3. Public investment refers to the spending by the government on the development or creation of long-term, fixed assets, which are frequently implemented as projects. Strategically planning public investments can result in investment projects (such as the Marker Wadden) that are grounded in a long-term development vision, including the monitoring and implementation of this vision (Manescu, 2024a, 2024b).

2.2. Theoretical framework

Different dimensions of financial barriers in NbS projects have been identified: the occurrence of funding gaps, the occurrence of financing gaps, and the cost (structure) of NbS projects (Hüsken et al., 2024). Funding concerns the question of who ultimately pays for the NbS, while financing concerns the question of who provides the upfront resources needed. In general, the lack of funding and finance from public and private parties is a recurrent barrier for many NbS projects (Davies and Lafortezza, 2019; Kabisch et al., 2016; Sarabi et al., 2019). When further unravelling this generic statement, the problem is seen to be more nuanced, with particular types of funding and financing gaps surfacing. For example, project maintenance can be more difficult to fund and finance than the initial construction phase (lifecycle-specific funding

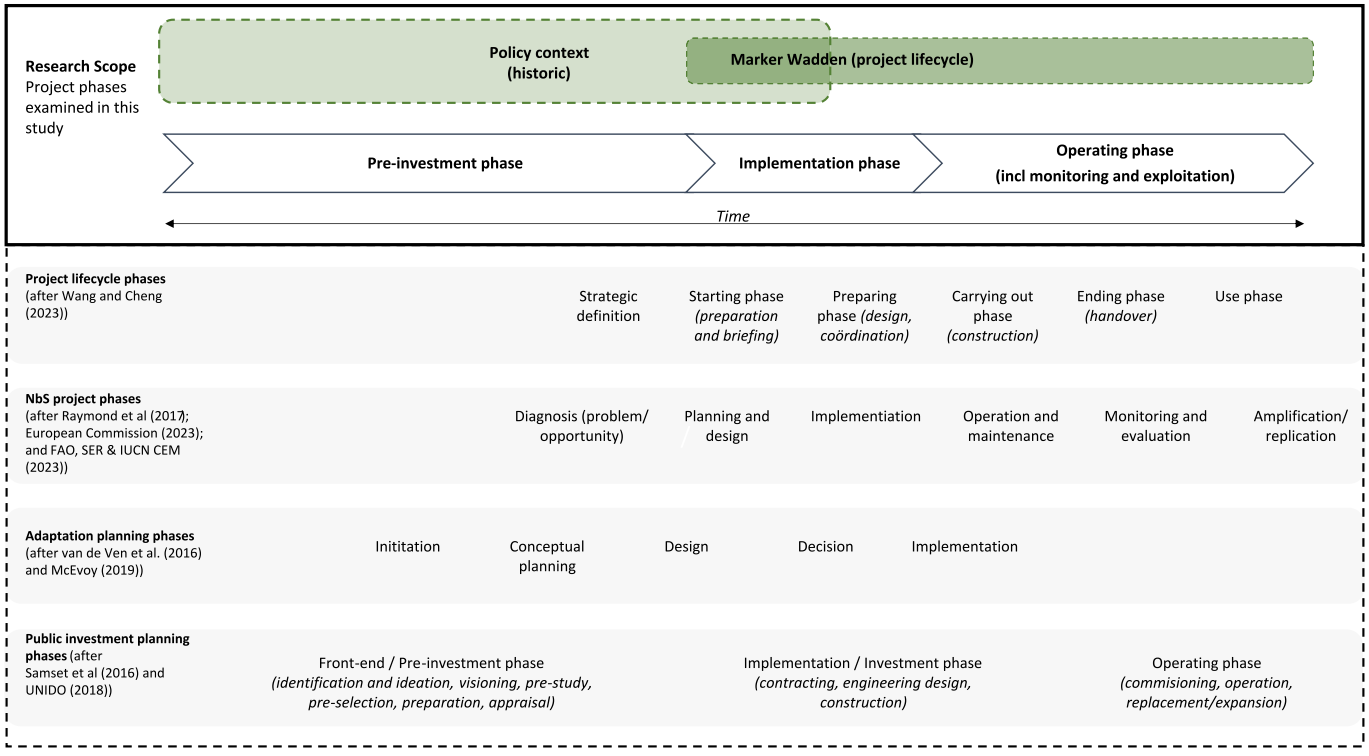

Fig. 3. Conceptualisation of the scope and terminology used in this study (top) compared to different perspectives and terminologies used for project-level management processes and investment planning processes from literature (bottom).

and financing gaps). Activities such as project evaluation, monitoring, capacity building, and certification are also identified as particularly challenging to fund and finance (activity-specific funding and financing gaps). The cost structures of NbS, including the absolute costs, the types of costs, and the uncertainty of costs, constitute the third dimension of financial barriers. Some cost types, such as compensation payments for lost land or income, are more challenging to fund than other cost types. Specific cost items are sometimes too (politically) daunting to even consider proceeding with a project. For instance, costs related to compensation for land or income losses, or the high initial study and preparation costs vis-à-vis the chance of not implementing the project (Bisaro and Hinkel, 2018; Mcquaid et al., 2021; Raska et al., 2022). Furthermore, costs are seen to play a role regardless of cost-effectiveness or cost-benefit ratios. Low-cost interventions, with relatively lower benefits, are seen to be favoured over higher-cost and higher-impact interventions (Macmillan and Duff, 1998; Thomas et al., 2015).

The occurrence of these different dimensions of financial barriers can be explained by a lack of congruence between the characteristics of NbS and the characteristics of our existing institutions. For example, NbS are typically novel approaches with a limited track record, while public and private funders prefer well-established and known solutions. Another example is that the effects of NbS typically occur after a long period, while funders tend to prefer quick results. A third example is that funding justification by public and private actors usually occurs based on an assessment of costs and benefits, whilst NbS are characterised by uncertainty and natural (non-monetary) values with regard to their costs and benefits. In Hüsken et al. (2024), a wide range of such misalignments have been recognised and clustered into 6 main mechanisms, namely, funders' preferences (mechanism 1), revenue generation enablers (mechanism 2), justification requirements (mechanisms 3), funders' regimes (mechanism 4), financiers' preferences (mechanisms 5) and the finance application processes (mechanism 6). These mechanisms are summarized and exemplified in Table 1. We utilise these mechanisms to structure our case study findings and to guide the enquiry into how (the strategies deployed) to overcome financial barriers for NbS. We focus on the first four mechanisms since the core of financial challenges for NbS relates to funding rather than financing (Hüsken et al., 2024). Further, we distinguish between public funding (defined here as funding coming from public actors, including governments and government-affiliated entities) and private funding (defined here as funding coming from any actor that does not fall in the category of public) (den Heijer and Coppens, 2023; Hüsken et al., 2024).

Table 1
Summary of six institutional mechanisms that lead to NbS funding and financing gaps (after Hüsken et al. (2024)).

Institutional mechanism	Description
(1) Funders' preferences	Multiple NbS characteristics (e.g., long timescales, uncertain and dynamic behaviour, high costs, novel concept) are misaligned with the preferences that public and/or private funders have (e.g., short-term results, certain outcomes, low cost, well established) leading to a lack of funding for NbS.
(2) Revenue generation enablers	The characteristics of NbS benefits (e.g. public goods, multiple and dispersed beneficiaries, uncertain benefits, absence of markets) are not congruent with the conditions needed for revenue generation (e.g. excludability and rivalry, few and concentrated beneficiaries, certain benefits, stable markets) negatively affecting the potential of NbS to bridge funding gaps through increased revenue generation.
(3) Justification requirements	The characteristics of NbS (e.g. uncertain and natural values, long project duration, ecological scales, multiple benefits) make investments in them difficult for public and private funders to justify (e.g. comparable costs and benefits required, short-term mandates, restricted to administrative boundaries and singular objectives) leading to a lack of funding for NbS.
(4) Funders' regimes	NbS with their particular characteristics (e.g. transdisciplinary collaboration, natural asset, requires reflexivity and adaptability) are not accommodated for in the different regimes, or processes that public and private funders have (traditional form of administration, grey-infra asset management systems, predefined problems and targets) leading to a lack of funding for NbS.
(5) Financiers' preferences	Multiple NbS characteristics (e.g., high risk - low (monetary) return, dynamic performance, long timescales, natural assets) are misaligned with the preferences that public and/or private financiers have (e.g. low risk – high return, stable revenue generation, quick returns, clear value of underlying asset) leading to a lack of finance for NbS.
(6) Finance application process	Multiple characteristics of NbS projects (such as small investment size, innovative, mostly ecological and engineering expertise present) are not aligned with the features and requirements of the finance application process (e.g. large investment sizes required, not accommodating for risky innovations, financial expertise required) leading to a lack of finance for NbS.

2.3. Decision making in rounds

We adopt the rounds model, a policy analysis theory, in collecting and analysing data to examine how the financial arrangements between public and private parties came about. This is particularly useful to examine the pre-investment phase (see section 2.1). There is a long history of policy research into the when, where, how, and whether sufficient (political) support is present to achieve a (new) policy decision (Hoogerwerf, 1998; Kingdon, 1984; Sabatier, 1988; Teisman, 1995). The policy decision in question here is the decision to build, i.e., invest in, the Marker Wadden. This model assumes a process of decision making in so-called rounds, where each round represents a step towards addressing the issue in question (Enserink et al. 2022; Teisman, 2000). We opt for the rounds model since successive, sequential, decision-making activities, as well as concurrent, parallel, decision-making activities, are conceived as influential to decision-making (Teisman, 2000), especially given the multiple public and private actors involved. When using the rounds model, reconstructing a timeline of events and decisions within different collaborative processes is recommended (Koppenjan, 2024). We adopt this recommendation and construct a timeline mapping out key decisions (often captured in administrative agreements), sequential policy programs resulting from and leading to those decisions, concurrent contextual events, as well as other relevant milestones, deliverables, and activities. We follow in the footsteps of other scholars applying the rounds model in case-study research (Antwi et al., 2023; Veenma et al., 2023).

2.4. Evidence triangulation

This case study is based on desk and field-based research conducted primarily between January 2020 and June 2021, but extending until December 2024. Data sources include 21 semi-structured interviews with government, private, and philanthropic actors (results published in grey literature), observations and feedback from 10 academic, government, and philanthropic events, 6 interdisciplinary research excursions, supplemented by extensive document analysis of relevant grey literature as well as published academic literature. This includes policy, programme, and project reports; administrative agreements; project documents such as contracts and emails; news stories; and agents' and NGO' webpages. See Supplementary 1 for a detailed overview of the data sources and Supplementary 2 for the topics that guided the interviews, as well as other stakeholder interactions for data collection from workshops, academic events, and fieldtrips. Interview transcripts are not publicly available, and anonymous quotes are used in the presentation of the results. This is done to ensure respondents' privacy and safety as well as to encourage honest and open responses. This is particularly relevant given the contemporary nature of the case and the ongoing

Fig. 4. Historical map illustrating the design that formed the basis of the closure of the Zuiderzee and the land reclamation plans (Lely, 1891). The shaded zones mark the polders that are to be reclaimed. Those shaded areas that are circled have actually been reclaimed. One polder has not been reclaimed, resulting in the Markermeer lake. The triangle marks the location of Amsterdam.

upscaling discussions.

These data sources were triangulated to establish the validity of the case study results. For instance, the evidence from the interviews was cross-checked with project documentation. For the historical context, policy documents were consulted and cross-checked with observations from the interviews and available email correspondence. Findings from news articles were cross-checked with observations from interviews, other published academic literature on the case, and insights from academic and government events.

2.5. Presentation of results

The findings are presented in three parts. The first part (section 3.1) concerns the historical policy context, which can be characterized as the pre-investment phase. This is presented in narrative form, with descriptions of the key decisions and events (rounds) that led to the investment decision to construct the Marker Wadden. A detailed visual timeline of events can be found in Supplementary 3. Secondly, we present the facts and figures of the Marker Wadden, in particular what the project costs are, who paid, and how that was arranged (section 3.2). Finally, we present an overview of the main strategies that have been deployed in the case of the Marker Wadden (section 3.3), through which many of the typical misalignments between the institutional characteristics and NbS characteristics have been overcome.

Fig. 5. Satellite image (Google Maps 4-12-2024). The arrow points to the location of the Marker Wadden in the Markermeer Lake. The triangle marks the location of Amsterdam. The circled areas are the three polders (out of the four polders that were originally planned) that have been reclaimed.

3. Results

3.1. An opportunity arises during the pre-investment phase

For decades, the Markermeer lake was reserved for land reclamation from the Zuiderzee (Fig. 4). During this time, ecological management of the area was limited and approached pragmatically (Werkmaatschappij Markermeer-Ijmeer, 2011). In 2006, the land reclamation plans were waived, a decision that was formalised in the national spatial policy (Nota Ruimte - in Dutch) (Minister van Volkshuisvesting Ruimtelijke Ordening en Milieubeheer et al., 2006). This led to the preservation of a large body of open water (Fig. 5). However, the intervention to close off the lake had never been designed for this purpose. As such, the characteristics of the water body, such as the steep dikes and the shallowness of the lake, led to a deterioration of the ecological system. This deterioration is often referred to as the Autonomous Negative Trend (ANT). At the same time, in the adjacent metropolitan area of Amsterdam, plans for further economic growth, urbanisation, and improved accessibility were developed. These plans would all further negatively impact the ecological quality of the lake in addition to the already existing ANT. The lake has a protected status. It was appointed as a Special Protection Zone under the European Birds Directives in 1994 and 2000, parts of the area have been appointed as Special Areas of Conservation under the European Habitat Directives, and since 2009, the whole area has been formally indicated as a Natura 2000 area. Given this protected status

and with growing environmental concerns from both public and civic organisations, the pressure to take action to improve the ecological status was growing.

In anticipation of the decision to abandon the land reclamation plans and in response to the advancement of the housing development plans in Amsterdam and Almere, seven civic and public organisations[1] collaboratively developed a vision for the region named the *Future Vision Markermeer-IJmeer*[2] (ANWB et al., 2005; Waterhout et al., 2013; Werkmaatschappij Markermeer-IJmeer, 2012). Opposition to previous housing plans (IJburg 1) based on environmental concerns was not fruitful, which could explain the coordinated efforts this time around. In the *Future Vision IJmeer,* the parties emphasise the need to invest in the so-called "blue-green quality" of the area. In fact, they frame this investment as a precondition to halt the ATN and to be able to accommodate further economic development. This idea formed the foundation for the later introduced *Future Proof Ecological System* (FPES), which has been a primary objective in the policies of the years ahead.

The national government acknowledged the environmental task that was argued for in the *Future Vision IJmeer* and requested the regional and local stakeholders and interest groups to further co-develop a long-term vision for the Markermeer-IJmeer area, including the need for new infrastructure development. This request was formalised in the NorthWing letter, a letter to Parliament (Peijs and Dekker, 2006). Following this, a collaborative partnership was established. The national government became one of the collaborating parties, and the three provinces were appointed to play a coordinating role (Samenwerkingsverband Markermeer-Ijmeer, 2008). Funding was provided by the cabinet for research (including a pilot project) to look into the opportunities for ecological improvement of the lake. This research was embedded in a larger programme, namely the Programmatic Approach NorthWing. The research and collaborative efforts resulted in the *Development perspective and action agenda* in 2008, followed by the *Future prospect of Markermeer-IJmeer* in 2009. The former report was an intermediate step, or progress report, leading up to the latter. The vision describes how the lake area can develop into a lively and diverse natural area that has sufficient resilience to support other developments such as climate change, urbanisation, economic growth, and recreational demand (Samenwerkingsverband Markermeer-Ijmeer, 2008; Samenwerkingsverband Toekomstagenda Markermeer-IJmeer, 2009). In this vision, the concept of the FPES was explicitly introduced.

The FPES can be described as an "ecological surplus" rooted in the N2000 framework, although also accommodating for other environmental legislation such as the Water Framework Directives (Fig. 6). Four ecological pillars were identified for interventions, which would lead to the realisation of the FPES. These entail the realisation of i) clear waters along the shorelines, ii) a gradient in turbidity and the presence of both clear and turbid waters, iii) land-water transitions of relevant size, and iv) improved ecological connectivity. The FPES would be a more efficient strategy to accommodate for the desired future economic and urban developments than to deal with the situation where each economic expansion or urban development project would need individual compensation measures, as highlighted in the following interview quote.

> *"A few provinces are frontrunners in their thinking about how compensation regulation is applied and how they could increase environmental gains. They are starting to create 'nature compensation pools' where different compulsory compensations are bundled to form a larger project. This is a novel way to realise nature compensation." (Anonymous informant #1).*

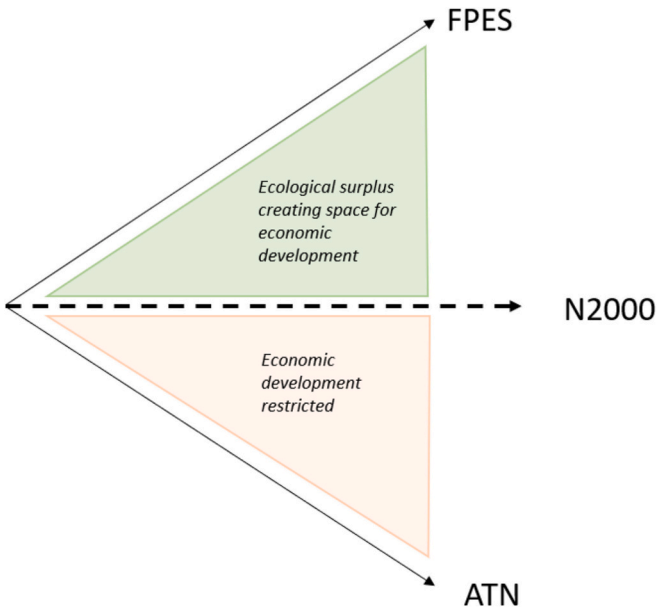

Fig. 6. Conceptualization of the (economic) development space generated over time by achieving a Future Proof Ecological System (FPES) in comparison to the situation of the Autonomous Negative Trend (ATN) and the situation of compliance to N2000 obligations– adapted from (Samenwerkingsverband Markermeer-Ijmeer, 2008). If N2000 objectives are not met, economic development space is restricted. If more is done than the 'minimum' to reach N2000 objectives, economic development space is created.

There are multiple arguments (Samenwerkingsverband Markermeer-Ijmeer, 2008) that explain the (cost-)efficiency of the FPES approach, namely:

- The projected ecological dividends are expected to be higher due to a more systemic, larger-scale, fit-for-purpose approach rather than fragmented, small-scale (less appropriate) compensation measures;
- The expected costs would be lower (economies of scale and benefits of timing);
- Administrative and political complexity associated with individual measures would be reduced, increasing the probability of successful and quicker implementation.

In 2009, the RAAM (Rijksbesluiten Amsterdam Almere Markermeer) letter, having the status of government policy, formalises the different spatial plans and commits to the desired *"triple scale jump"* which indeed includes i) housing development (60,000 houses to be built in Almere) ii) improved connectivity between Amsterdam and Almere, and iii) improved nature through establishing the FPES. The required investment for these joint ambitions was estimated to be €5–8 billion, of which €1 billion would be for the FPES. As the expected investment costs were significant, cost reductions and optimisation for all components of the plan were to be explored, which was part of the follow-up policy programme RRAAM (Rijks-regioprogramma Amsterdam Almere Markermeer) (Werkmaatschappij Markermeer-Ijmeer, 2011). In the same year, the European Commission expressed their general support for the nature-inclusive planning process conceptualised by the FPES, although conditional upon integral argumentation, complete implementation, continuous monitoring, and compliance with procedural requirements (Samenwerkingsverband Toekomstagenda Markermeer-IJmeer, 2009).

A separate working group was set up to optimise the plans. The working group contained representatives from the Ministry of

[1] The Royal Dutch Touring Club (ANWB), Society for Preservation of Nature Monuments in the Netherlands, the State Forestry Department (Staatsbosbeheer), the Municipality of Almere, the Municipality of Amsterdam, the Province of Flevoland, the Province Noord-Holland

[2] The Markermeer-IJmeer concerns a lake of some 30 by 25 km in the centre of the Netherlands. In spite of its name which seems to indicate that we are dealing with two lakes, the Markermeer and IJmeer in reality form one water system, with no clear border between the two lakes.

Infrastructure and Water and the Ministry of Economic Affairs, Agriculture, and Innovation, the Province of Flevoland and the Province of North-Holland. This working group was tasked to formulate a portfolio of measures and corresponding investment strategy to realise the FPES and to optimise these measures with regards to other spatial interventions foreseen in the "triple scale jump" (Werkmaatschappij Markermeer-Ijmeer, 2011). Their approach was centred around i) ecology, ii) economy and utility and iii) finance, iv) legal strategy and v) communication and stakeholder strategy. Furthermore the work was grounded in scientific research established by the ongoing and novel policy research programmes. The result from this round was that a cost-reduction of 42 % seemed feasible based on ecological optimisation, resulting in an expected total investment need of €630–880 million euros to achieve the FPES (Werkmaatschappij Markermeer-IJmeer, 2012). Over an implementation period of 40 years, this would imply an investment of €15–22 million per year.

During this period, in 2011 the Dutch National Topsector approach was introduced in response to the ongoing financial crisis. The ambition of this policy programme was to stimulate the knowledge economy of the Netherlands by improving innovations. The water sector was one of the 9 top sectors. Based on the preliminary results of the ecological optimisation and aligned with the Topsector approach, the national government requested a market consultation in 2012, to make use of the innovative capacity and experience of the market (depicted at the top left in Fig. 7). The central question in this consultation was to design a FPES and to provide a corresponding cost estimate. Thirty-five different players provided input through collaboration in different consortia. At the same time, yet separate from the formal market consultation process, the Society for Preservation of Nature Monuments in the Netherlands (henceforth NM) submitted their plan for the Marker Wadden, along with an initial financial contribution (€15 million) for the realisation of their plan. All plans, including NM's proposal, were evaluated resulting in three promising alternatives to the initial plan, which deemed feasible to realise with even lower public investment needs than initially anticipated.

In 2013, a new milestone, namely the RRAAM administrative agreement, was reached based on the years of collaboration between national and regional governments and the results and insights from the RRAAM programme. This agreement implied a formal commitment from the regional government, in addition to the commitment made in 2009 by the national Government. In the RRAAM administrative agreement, the ambitions regarding the "*triple scale jump*" are formalised. The Marer Wadden plan is included and, as such, became one of the first steps to achieve the FPES. Following, the project objectives entail:

- **Realise a bird paradise,** with wetland characteristics and deep and shallow waters, protected through a resilient outer rim whilst allowing for natural (erosion) processes, and, safely accessible for recreational experience.
- **Improve the water system** through immobilizing and catching sediments as much as possible through sinks and gullies, using the locally sourced sediment as building material for the project, creating a lee zone, and diversifying the underwater landscape to accommodate for a diverse range of (fish-friendly) habitats
- **Develop knowledge for upscaling**, regarding efficient and innovative construction techniques, and the monitoring of turbidity and sediment (settlement) dynamics in proximity to the construction site.
- **Minimise costs for future maintenance** through enabling easy access to sand supply and constructing a self-maintaining system.

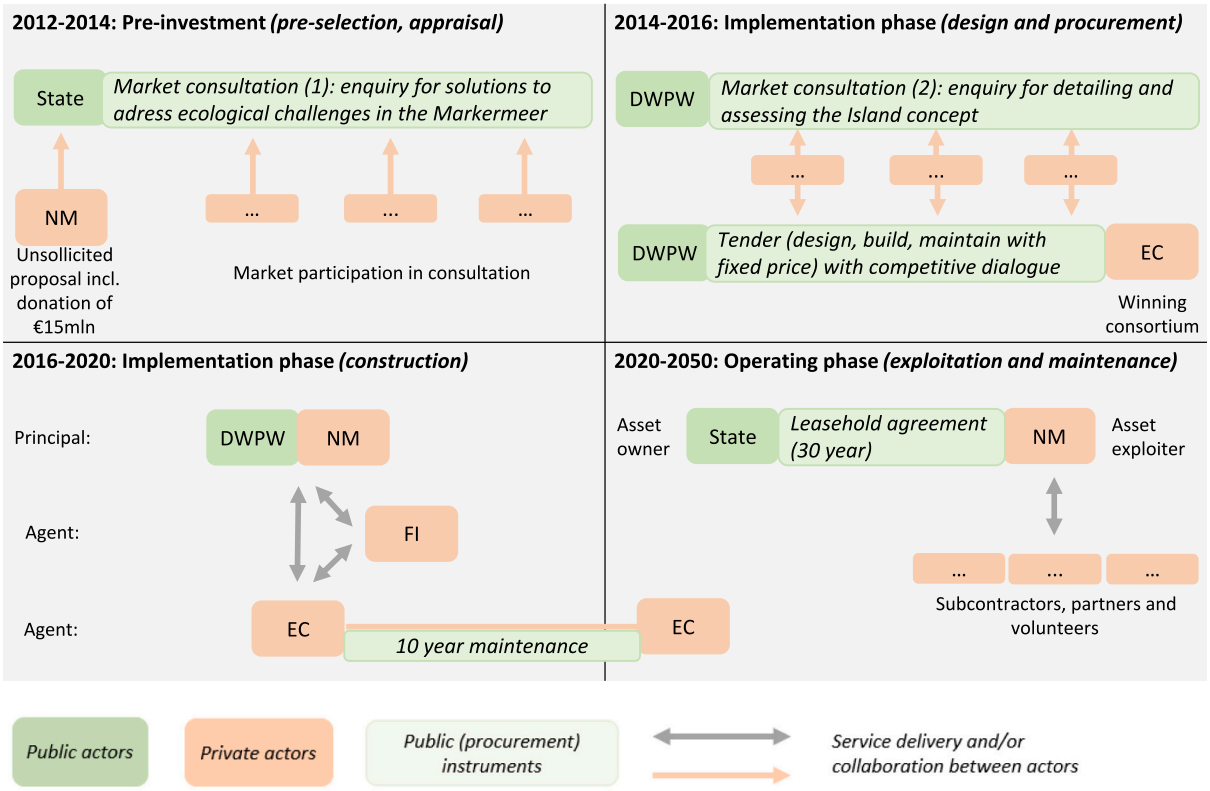

Fig. 7. Visualisation of the actors involved and the procurement and implementation arrangements throughout different project phases. This visual does not include the research and monitoring component of the project, as this was established separately and with different actors.

The collaboration agreement between NM, the Ministry of Infrastructure and Water, and the Province of Flevoland, for the implementation of the Marker Wadden project, was established in 2014. A detailed timeline of the policy context leading up to the Marker Wadden can be found in Supplementary 2.

3.2. The facts and figures behind the Marker Wadden: how much did it cost, who paid for what, and how was it arranged?

Financial engineering refers to the structuring in the most efficient way of the financial terms of a project, including, for example, the blending of multiple sources of funding, establishing repayment structures, and risk management. In the case of the Marker Wadden, financial engineering occurred separately for different phases and activities (project components), rather than in an integrated manner. Three main project components have been identified, namely i) the project construction (i.e., the actual realisation of the islands), ii) the research and monitoring during the construction phase, and iii) the exploitation of the islands (Table 2). Each component is elaborated below, with an emphasis on the project construction.

Two types of maintenance can be distinguished in this project. The first is the maintenance of the structural integrity of the created islands. It includes, for example, the repair of structures or sediment nourishments after storm events. This type of maintenance is captured under component i) Project construction, and it is referred to as the maintenance of the infrastructural integrity. The second type of maintenance is related to the exploitation and concerns ecological management and the maintenance of recreational facilities. It includes, for example, the removal of alien or undesirable species, the maintenance of footpaths, and the maintenance of the energy provisioning infrastructure. This type of maintenance is captured under component iii) Island exploitation.

3.2.1. Island construction

The Department of Waterways and Public Works (henceforth DWPW), which is the executive agency of the Ministry of Infrastructure and Water Management, arranged a market consultation to further detail and test the island concept that was proposed by NM which formed the basis for the collaborative agreement in 2014 (presented under 3.1). This was followed by a public tender procedure with competitive dialogue (depicted at the top right in Fig. 7). The feasibility of the design, build, and maintain for 10 years contract, which means that the responsibility and corresponding financial risk for this duration lies with the contracted agent, was tested and discussed as part of the competitive dialogue in which three proposals reached the final stage. The price, the scenic quality, the size (being the most important criteria), the innovative approach in dealing with turbidity issues, and the project risk profile were the key selection criteria.

During construction, the role of the commissioner, or the 'principal' in the principal-agent relation, was taken up jointly by NM and DWPD, who established an implementation team in which roles were distributed according to each organisation's strengths (depicted at the bottom left in Fig. 7). For example, since DWPW is experienced with large infrastructural projects, they delivered a contract and technical manager to the implementation team, whilst NM provided the needed expertise in terms of communication and stakeholder engagement. Further, a financial intermediary was contracted to secure and manage the funds. This request came from NM for two reasons, namely, to avoid a potential situation where financial commitment would be reversed due to a change in the political arena and to ensure that payments could be made on time, especially given the different financial and reporting systems of the two organisations.

The project kicked off after securing an initial €50 million (Table 3). NM received a donation of €15mln from the Dream Fund, which is a fund from the National Postcode Lottery. This amount was earmarked to be used for the realisation of this specific project and needed to be spent within (approximately) a year. Further, it was conditional upon NM receiving the property rights over the lands created. In practice, NM did not receive the property rights, but they did negotiate the right to exploit the islands for 30 years. Besides this donation, public co-funding came from the national level and regional level, as well as a contribution from NM's own resources. It was anticipated that the remaining €28,5 million would be acquired shortly after the start. There were two important reasons for this. Firstly, funding from European subsidies was foreseen, but time was needed to secure this. Secondly, funding from the private sector was anticipated, yet time and evidence were needed to secure this. As such, project construction started with a funding gap of €28,5 million, an agreement deviating from regular procedures. The initiator, NM, was responsible for acquiring the remaining part of the needed budget and was supported by the financial intermediary. Although it sounded promising, both leads fell through, and the required additional funding was, for a large part, covered by the same (public) parties that had already committed and contributed (Fig. 8). A second donation of €7 million came from the both the Dream Fund and NM, also contributing to bridging the remaining funding gap. After the initial construction was complete in 2020, around €300.000 remained for maintaining the infrastructural integrity for 10 years. Whether this amount is sufficient remains to be seen in the years ahead. Once constructed, the newly created islands become the property of the state of the Netherlands. Consequently, the state carries the longer-term responsibility for the islands. No evidence was found that upon the policy decision to implement the Marker Wadden project, a financial plan or cost estimates existed for the long-term maintenance activities (after 2030), nor for the

Table 2
Summary of the three project components of the Marker Wadden for which financial engineering occurred separately.

Project component:	Implementation phase - *Project construction*	Implementation & operating phase - *Research and monitoring*	Operating phase - *Island exploitation*
Costs	€78,5 million	€ 5 million	Approx. €1 million per year and at least € 500.000 initial one-time payment
Period	2016–2020 (Construction) 2020–2030 (Maintenance)	2018–2022	2020–2050
Includes	• The final design and construction of the project • The maintenance to secure the infrastructural integrity for 10 years (2020−2030) • Subcontracting a financial intermediary (2016–2020)	• Research programme meant to acquire, document, and disseminate knowledge from the construction of the project	• Payment for the leasehold agreement • Ecological and recreation-related maintenance) activities • Construction of recreational infrastructure
Funding model	Public (national, regional, local level) and private co-funding; Earmarked donation	Public (national level) and private co-funding; In-kind contributions	Public (supra-national, regional, local) and private co-funding with partial revenue-based cost-recovery; In-kind contributions; Volunteerism; Earmarked donation
Procurement and implementation arrangements	Project principal as a public-private partnership; Market consultations; Tender with competitive dialogue; fixed price DBM contract; Financial intermediary	Public-private research collaboration	Leasehold agreement and subcontracting

Table 3
Overview of initial funding contributions at the project start, and the additional payments made to bridge the funding gap for the construction of the Marker Wadden.

Funder			Initial contribution (€ million)	Additional contribution (€ million)	Total contribution (€ million)
Public	National	Ministry of Infrastructure and Water	15	3	18
Public	National	Ministry of Economic Affairs	15	4	19
Public	Regional	Province of Flevoland	3,5	3	6,5
Public	Regional	Province of Noord-Holland	–	4	4
Public	Local	Municipality of Lelystad	–	0,5	0,5
Private	n.a.	Society for Preservation of Nature Monuments in the Netherlands (NM)	1,5	7	8,5
Private	n.a.	"The Dream Fund" from the National Postcode Lottery (via NM)	15	7	22
Total (€ million)			50	28,5	78,5

long-term monitoring and research activities.

3.2.2. Research and monitoring

Initially, the Marker Wadden project was budgeted and launched without an integral research and monitoring plan concerning the construction and performance of the intervention. This occurred despite the essential role for monitoring and evaluation in the chosen programmatic approach, where the Marker Wadden project is a first stepping stone towards broader ecological improvements. The following quotation highlights this tension:

> "*The ministries gave money to NM, but they didn't request that they at least establish a research and monitoring programme. This was a pleasant situation for NM to be in. Further, the chosen contract format was not suitable to procure knowledge (development).*" (Anonymous informant #2).

The realisation of the islands was the primary task and main objective of the two organisations in charge of the implementation (DWPW and NM), rendering research and monitoring of lower importance. Furthermore, the initial budget of €15 million that was made available via NM from the national lottery was conditional upon quick spending (approximately within 1 year after granting). As such, speedy progress was required, hindering the early engagement of a broader range of stakeholders, including research institutes.

Initiated by a coalition of research institutes, a research and knowledge programme was established, taking effect about 1,5 years after the start of the construction works. The costs associated with this knowledge programme are estimated at €5 million, covering monitoring and research for 4 years. Funding for the research programme came from the Ministry of Infrastructure and Water, DWPW, Ecoshape foundation (a network organisation operating in the field of Building with Nature), and Deltares (a not-for-profit knowledge Institute operating in the field of water and subsurface). Further, NM committed to in-kind contributions, including making available (research) facilities on the islands, transportation of researchers to and from the islands, and conducting specific monitoring activities. More than 15 organisations were involved in conducting the research, amongst which were universities, engineering and consultancy firms, and the representative association for recreational fishing. The programme's main objectives were to acquire as much knowledge as possible about the functioning of the project and to disseminate the acquired knowledge to contribute to additional societal value by showcasing the project as a means to spotlight the Netherlands' ecological, hydraulic engineering, and water governance capacities.

3.2.3. Exploitation

Having been granted the exploitation rights (for which NM pays a leasehold fee of €3.300 per year, which is equivalent to €1 per hectare per year), NM commenced the construction of additional facilities (to enable recreational and maintenance activities). These facilities include a small settlement of holiday houses, a pavilion to receive visitors, volunteers, and researchers (including an information room, sanitary facilities, a gift shop, and catering facilities), research facilities, and storage space for equipment. Funding was received through a subsidy (€250.000 from the EU Leader+ programme) with co-funding from the municipality of Lelystad (€50.000) and the province of Flevoland (€200.000) to establish a community of volunteers and for the construction of several facilities. A specific fund, which is dedicated to achieving societal impact through supporting large and long-term initiatives in four specific areas (amongst which the environment), contributed with a donation earmarked for the establishment of the research facilities on the island. Further, particular businesses contributed through the delivery of expertise and services concerning the building materials, furnishing, visitors' booking system, and internet connectivity (depicted at the bottom right in Fig. 7).

Through the arrival of visitors (both day trips and overnight stays in the harbour and holiday homes), NM can generate revenues. These revenues contribute to (partial) cost recovery of the maintenance activities. Such maintenance costs include the coverage of salaries, machinery, and other equipment, and in some cases, also the subcontracting of other parties. These costs are kept relatively low due to the involvement of a significant number of volunteers. Both income and expenses levelled to approximately €1 million during the first two years. As such, these revenues generated contribute to partial cost-recovery, but do not cover the full costs for exploitation and management, research, and monitoring (let alone the full lifecycle cost, including also construction, research, and monitoring).

3.3. A synthesis of strategies deployed in the Marker Wadden case

The historical policy context and the financial arrangements have been identified and discussed in sections 3.1 and 3.2. Here we use and expand on these results. Twelve key strategies are identified that have enabled the Marker Wadden project to overcome financial barriers typical to NbS, which are known to manifest due to the misalignment of institutional characteristics and NbS project characteristics (Hüsken et al. 2024). Table 4 displays these findings. From the twelve strategies that are identified, five occurred during the pre-investment phase, two occurred during the project preparation in the implementation phase, three occurred during construction in the implementation phase, and two occurred during the operating phase. As such, we see that nearly half of the identified strategies that enabled overcoming financial barriers occur years before the actual project implementation kicks off.

We further find that at least two of the four mechanisms are addressed by each strategy. This indicates that a single strategy plays a role in overcoming multiple types of financial barriers. For instance, strategy 9 (Financial intermediary) plays a role in each of the four mechanisms. Firstly, it reduces the risk that one (or more) funders will revoke their funding commitments on which other funders are counting (Mechanism 1: Funders' preferences). Secondly, it offers a stable and reliable platform that enables transactions to occur amongst and between the parties involved (Mechanism 2: revenue generation enablers).

Table 4
Key strategies deployed in the Marker Wadden (MW) project that served to overcome financial barriers, explained in terms of institutional mechanisms (Hüsken et al., 2024). * = the original term used in the case study itself that authors adopt as a label for the strategy. Other strategy labels are assigned by the authors. Each colour represents a different project phase.

Project phase	Strategy	Description	Institutional mechanisms addressed by the strategy			
			(1) Funders' preferences	(2) Revenue generation enablers	(3) Funding Justification	(4) Funders' Regimes
Pre-investment phase	(1) Future Proof Ecological System (FPES)*: a broad scope	The MW is embedded in the FPES, the overarching conceptual environmental objective, where a resilient ecosystem creates an ecological surplus which in turn accommodates for future economic expansion that would otherwise be constrained by environmental legislation and be tackled on an individual (compensation) basis. The FPES concept was legally reviewed with a positive result.	*More attractive cost-benefit ratio from efficiency gains, higher ecological yields, and lower transaction costs; Larger span of beneficiaries; Accommodates for uncertainty*	*"Expanding the pie" opens doors to more/other funders; Local nature of public goods reduced by systemic scale; Avoiding restrictions on economic expansion is a (more) tangible benefit*	*FPES encompasses multiple legal environmental obligations; Shift from solely environmental objective to an economic incentive (consequence of inaction is not desirable)*	*Commitment towards FPES formalized in (collaborative) administrative agreements; Predefined high-level end (objective), but means (interventions) still up for discussion*
	(2) Phased approach & project-level acquisition	Working towards the FPES (a long-term objective) is organized in phases. Different steps can be taken over time, including research, piloting, implementation and monitoring of interventions.	*Shorter-term results and achievements; Accommodates for uncertainty and knowledge development; Reduced initial investment need*	*Allows for (multiple) funding contributions over time; Monitoring of and validating (uncertain) benefits over time*	*Justification for phases and interventions required (which have clearer and smaller scopes than the long-term overall objective (FPES))*	*Space for reflexivity and adaptivity; Transparent and manageable "chunks"*
	(3) Trans-disciplinary approach for optimising interventions	Science-based interventions for ecological restoration (FPES) were re-assessed from three perspectives in search of cost reductions and feasibility improvements: i) ecological optimization, ii) spatial optimization, and iii) market innovation and implementation knowledge. This resulted in an ex-ante cost-reduction of > 42%.	*Lower investment costs than anticipated; Market willingness and feasibility tested, reducing the risk of not being implemented*	*Alignment of spatial plans and detection of win-win strategies leading to avoided costs, in particular related to ground/soil/ sand flows;*	-	*Via a formal procurement route, private sector engagement and knowledge were obtained (market consultation), avoiding unnecessary complex partnerships at this stage*
	(4) Intervention proposal accompanied by private seed funding	NGO submits idea for intervention (MW), backed by an earmarked initial financial contribution to be used for the realization of their submitted plan. This seed funding is conditional upon long-term property or exploitation rights over the islands	*Lower public funding contributions, Combining different (certain) funding types, Risk sharing*	*Project buy-in (money for exploitation rights); Long-term leasehold fees*	*Exploitation is not part of public mandates/ responsibilities; More project objectives resulting from funder requirements, but accompanied with financial resources*	*An unsolicited proposal could be merged with the market consultation process and evaluated transparently via a formal procurement route*
	(5) Multi-criteria analysis for evaluation of alternatives (MCA)	A pros and cons multi-criteria analysis was used to compare and evaluate alternatives (amongst which the Marker Wadden) including: (long-term) costs, ecological completeness, legal risk, degree of (public) support, proven techniques, recreational opportunities, private financial contributions, synergies with other projects and foregone opportunities (opportunity costs)	*Provides (comparable) indications for expected costs and outcomes; Criteria reflect funders' preferences, opportunity costs*	-	*Criteria reflect funders' justification requirements (such as the degree to which legal environmental obligations are satisfied by the alternatives) and preferences; MCA is in itself a means to justify expenditures*	*Procedure deviates from regular large infrastructure project evaluations, but serves as an alternative, more flexible method, including a diverse set of criteria*
Implementation phase (project preparation)	(6) Extensive use of strategic public procurement tools for detailing and purchasing the project	A market consultation followed by a public tender with competitive dialogue to further detail the island concept and to test the appropriate contract form and market readiness. Key selection criteria were price, scenic quality, size (being the most important criteria), innovative approach in dealing with turbidity issues, and the project risk profile. The contract form was Design – Build – Maintain with a fixed price agreement	*Increase certainty on expected outcomes and offers insight into project risks; Reduces risk of project abandonment; Novelty/innovation as an objective; Cost certainty resulting from fixed price*	*Innovative character attractive to market parties (reputational gains for international NbS market) increases competitiveness and willingness to take (costly) risks*	*Validated with the market and technological readiness assessed; Clarity in distribution of responsibility and costs; "If we build it, they will come" justified the construction of the project as a result*	*Fixed price accommodates for NbS dynamics via constructive collaboration between principal and agent to absorb or adjust to deviations from the plan within budget constraint; No guidelines, but a high level of engineering consensus*
	(7) Fragmented financial engineering	Activities and lifecycle phases (including construction, research, monitoring, and exploitation) are organized and funded separately rather than via a holistic, single, lifetime approach.	*Shorter term orientation; Funding for specific (local) outcomes according to interests; Fewer objectives; Costs spread over time; smaller scale; Simpler arrangements*	*Allows for (multiple rounds of) funding contributions over time*	*Fewer objectives and smaller scopes (space and time), more aligned with existing jurisdictional boundaries and responsibilities*	*Simpler arrangements, less complex partnerships; Separate accounting systems*
Implementation phase (construction)	(8) Project kick-off with funding gap	Project construction started with a funding gap (36%), anticipated to be secured in the near future.	-	*More time available to secure funding and for evidence collection; reduced abandonment risk*	-	*Administrative collaborative agreement allows this deviation from standard policy*
	(9) Financial Intermediary	A financial intermediary was sub-contracted by the commissioner (principal) to secure funds and manage payments throughout the construction phase.	*Reduces the risk of reverting financial commitment (changing political arena)*	*Stable (trustworthy) platform for managing funds*	*Entity (legally) equipped to receive funds*	*Entity (legally) equipped to receive funds; Bridges different financial and reporting systems*
	(10) Public-private partnership *	The role of the commissioner (principal) was taken up jointly by private and public organisation, shaped by establishing an implementation team.	*Means of control; reduce project risks (organizations' strengths utilized)*	-	*Means of control; Platform for dealing with technical and ecological deviations (uncertainty)*	*Early identification of procedural differences and a platform for pragmatic problem solving*
Operating phase (exploitation and maintenance)	(11) Leasehold agreement for private exploitation	The created islands are property of the state, but the NGO negotiated the right (and responsibility) to exploit and maintain the islands	*Transfer of public responsibility (and associated costs) to a private party*	*Recreation on the islands is a club good rather than a public good; it unlocks other revenue generation mechanisms (e.g., tourist fees) for partial cost-recovery; access to other (funding) contributions*	*Responsibilities defined and distributed according to objectives; Benefits aligned with existing jurisdictional boundaries and responsibilities*	*Agreements regarding distinguished responsibilities avoids misaligned regimes*
	(12) Volunteer-ism	NM makes use of a community of volunteers for exploitation activities such as the provision of guided tours, maintenance activities, and the sales of food and beverages in the visitors' center.	*Lowers costs; More community engagement widens the range of beneficiaries and (generic) public support*	*Reputational gains and membership diversity (NM faces an ageing membership base)*	-	-

Thirdly, it is an entity that is legally equipped to receive the funding. A direct transfer of millions of euros from the national government to NM would be much harder to justify, if at all legally mandated (Mechanism 3: Funding justification and Mechanism 4: Funders' regimes). Finally, making use of a financial intermediary bridges the different organisations' accounting and financial systems, ensuring timely and appropriate transactions (Mechanism 4: Funders' regimes). The relevance of this strategy is highlighted in the following quote:

> *"One of the bottlenecks within many governmental organisations is the slow settlement of financial transactions. At least, that is the experience of third parties. There were concerns that this would also be the case for the Marker Wadden project. Therefore, it was decided by the DPWP and NM jointly, to contract an external fund manager. This would provide a legal basis for transactions whilst maintaining the ability of the project team to act incisively." (Anonymous informant #3).*

The adopted strategies have resulted in a situation in which the characteristics of the Marker Wadden project have been sufficiently aligned with the institutional characteristics. Regarding the first mechanism (Funder's preferences), funders tend to prefer short-term results. The time before specific outcomes are expected and intermediary results are delivered is reduced via strategies 2 and 7. Funders also prefer certainty and predictability. The uncertainty and dynamics in the performance of the project have been reduced in multiple ways, and the remaining dynamics are accommodated for to a certain extent (strategies 1, 2, 3, 6, and 7). Further, in particular, public funders prefer investments that benefit the majority. Via strategies 1, 6, 11, and 12, the number of beneficiaries has expanded, whilst the costs have been reduced or spread over time via strategies 1, 2, 4, 11, and 12, lowering the required initial investment costs. Although the intervention is novel and does not benefit from a well-established track record, sufficient confidence in the intervention was present amongst funders, resulting from strategies 2, 3, 5, and 6.

Regarding the second mechanism, the potential to generate revenues, different strategies contribute to this in numerous ways. Firstly, by broadening the overarching objective to achieve a "future-proof ecological system" (Strategy 1) with its ecological and economic scale, the door to a broad(er) range of interested parties and stakeholders is opened. It also helps in achieving scale benefits through aligning different spatial plans, through which cost reductions can be achieved. Further, there are multiple moments in time in which revenues can be collected from funders, resulting from several strategies (strategies 1, 2, 4, 6, 7, 8, and 11), leading to multiple opportunities for revenue generation. Particular benefits that have further led to revenue generation for the project are the terms and conditions (exploitation rights) under which the donation was made available to be utilised by the project (strategies 4 and 11) and the recreational opportunities provided by the marker wadden being exploited as a club good (strategy 11) rather than it being a public good with the corresponding free-riding challenges. The leasehold agreement with NM made it possible to use revenues generated from recreational activities for partial cost-recovery and also opened doors to other public and private contributors.

Considering the third mechanism (Funding justification), environmental legislation (such as N2000 and European directives) formed an important legal basis upon which financial contributions were justified. However, economic objectives (strategy 1), cost minimisation (strategies 3, 4, 5, 11, and 12), market readiness (strategy 3 and 6) and clearly defined and transparent financial contributions (strategies 2,3, 7, and 11) have also played an essential role for the justification of funding for the Marker Wadden. The multi-criteria analysis (strategy 5) has served as a justification instrument. Lastly, regarding the fourth mechanism (Funders' regimes), many difficulties could be overcome by making use of available instruments such as administrative collaboration agreements and public procurement tools (strategies 1, 3, 8, and 10). Overall, several strategies (2, 3, 6, 7, 10, and 11) contributed to structuring both the FPES as well as the Marker Wadden into manageable "chunks", requiring limited merging of organisational regimes.

4. Discussion

In general, the results of this study present the financial arrangements made in the Marker Wadden project and how they came about. More specifically, this in-depth case study reveals how multiple strategies at different points in time were deployed to prevent financial barriers from occurring and persisting, with a particular focus on the pre-investment phase in public investment planning, the key drivers and incentives that led to sufficient funding, and sheds light on some of the implications resulting from the adopted public-private funding model. These specific points are discussed in the sections below. We also reflect on the generalisability of these case study results.

4.1. The importance of the pre-investment phase

Twelve key strategies were identified, which have been instrumental in securing sufficient funding for the implementation of the Marker Wadden project. Nearly half of these strategies occurred years before the actual start of the construction of the islands, during the pre-investment phase (2006-2012). These are: the setting of a broad, system-level scope (the FPES); a phased approach; using transdisciplinary expertise in setting targets and design optimisation; a private (unsolicited) proposal accompanied by private seed funding; and a multi-criteria analysis for project appraisal. These strategies contributed to the policy decision to implement the Marker Wadden and the corresponding allocation of project funding.

The following two considerations merit particular attention. First, the implementation of these strategies goes well beyond project-level (implementor) capacity and mandates, yet appears essential in avoiding project-level funding barriers. In this case study, an opportunity to initiate the concept of the Marker Wadden arose and was captured via an unsolicited proposal. Although it worked out in this case, in accommodating for more and larger NbS projects in the future, a well-structured investment planning process seems necessary. Scharpf offers a clarifying perspective for this: a project such as the Marker Wadden and the FPES in which it is embedded can be seen as "the system to be managed" that lies within a broader set of institutional rules, interaction processes, and arrangements, which can be seen as "the managing system" (F. W. Scharpf, 1997). The managing system provides the conditions to accommodate for (or prevent) NbS, with their particular characteristics. The pre-investment phase strategies identified in this case study offer insights into how such a managing system can be designed or adapted. Second, in our study, we unravel how each of these strategies, which are not commonly linked to matters of funding and financing, contributes to overcoming funding barriers. Other studies tend to look back over a relatively shorter period (op de Beeck et al., 2024; Beer, 2022; Richardson and Davidson 2021). As such, the current findings present novel insights relevant for overcoming financial barriers for ecosystem restoration and NbS in general.

4.2. Opportunities for public investment planning

We adopted the rounds model for decision making, offering a perspective on the dynamic and non-linear process that led to the policy decision to build and fund the Marker Wadden project (Enserink et al., 2022). On its own, this result illustrates the absence of a rational, linear, protocol- or rule-based decision-making process that a public investment planning process typically intends to deliver (B. Manescu, 2024a). Although we did not set out to compare different public (infrastructure and environment) investment planning processes, a topic worth pursuing in further research, our results do surface deviations from typical procedures for large investments. Examples that illustrate this are the adoption of a multi-criteria analysis for project appraisal (rather than a societal cost-benefit analysis and environmental impact assessment), the

bundling of compulsory compensation efforts (rather than project-level compensation), and kicking off the project with a funding gap (rather than full cost-coverage upfront). Our analysis suggests that deviations from standard procedures were purposefully taken to accommodate for this irregular project, or that standard procedures are non-existent (i.e., there is not a clear environmental investment planning process) for large-scale ecosystem restoration projects in the Netherlands.

Amongst others, NbS can be characterized as being embedded in or driven by local (community) values, and that their time span (or life-cycle) is long, both in terms of impacts as well as the duration of required project management (Cohen-Shacham et al. 2016; FAO SER and IUCN CEM, 2023). This first characteristic is expected to result in NbS initiatives (when they fall within the boundaries of government activities and responsibilities) entering the public decision-making arena via community-led (bottom-up) routes or, as in the case of the Marker Wadden, via an unsolicited proposal. A protocol for dealing with unsolicited proposals has not been established in the Netherlands, but it is common practice in other countries (Abdel Aziz and Nabavi, 2011; Bullock and Chêne, 2019; Takano, 2021). Further, the second characteristic of NbS is expected to lead to projects that require long-term maintenance efforts and corresponding funding. In the Marker Wadden case, no evidence was found that a long-term financial strategy to cover future maintenance costs existed, nor was evidence found that long-term funding requirements for maintenance, monitoring, and research played a role in the policy decision. Concerning investments in the domains of transport and water infrastructure, there is an implicit assumption in the Netherlands that the long-term costs will be covered by the DWPW, being the responsible executive agency (Lodder, 2024). Addressing these gaps in the decision-making processes seems essential to manage and balance risks and opportunities, and to safeguard public interest and transparency in decision-making, and is particularly relevant to accommodate for the scaling of NbS with their particular characteristics.

Lastly, in our case study, we assessed four out of the six institutional mechanisms identified in Hüsken et al. (2024). The two mechanisms associated with project financing were not considered here; only the funding barriers were explored. In the case of the Marker Wadden, there was no financing need. The revenues (funding) were made available at the start of the project, thus, no loan or other instrument was needed because the required upfront capital was available. In particular, given the ambitions to scale up the concept, exploring the suitability of outcome-based or performance-based payments (see, for example Granado-Díaz et al., 2024; White and Hanley, 2016) rather than upfront lump-sum payments in combination with concessional or public finance instruments is recommended (Van Raalte and Ranger, 2023).

4.3. Key drivers for funding ecosystem restoration

In our analysis of financial arrangements for the case of the Marker Wadden, we identify different incentives, or drivers, which have led to the funding and implementation of this project. Firstly, the environmental regulations in place (Natura2000, Water Framework Directive, and Bird and Habitat Directives) required restorative action to be taken, and placed legal responsibility to do so with public authorities at the national and regional level. Furthermore, inaction would have led to an undesirable scenario in which (planned) economic development in the area would have been restricted. These two aspects have been the primary drivers for public funding. Other drivers, which have played an important role, were the expected (export) value from the knowledge and skills to be acquired during implementation (national level), and the improved tourism and recreational opportunities resulting from the project (regional and local level). Although innovative projects are often seen as risky, and as such suffer from funding gaps (McQuaid, 2019; Toxopeus and Polzin, 2021) the contrary is seen in this case, where the innovative character was one of the driving forces that led to funding. Similarly, this case has also shown that private co-funding for public goods (which is a relatively novel arrangement) was not seen as a barrier, but was rather evaluated as a positive characteristic.

NM, the initiator of this project, is typically concerned with the purchase and management of landscapes or areas with high natural and cultural value to enhance and preserve these values. In this case, they deviated from their 'business as usual' by entering into a partnership with public authorities to create/ build a new landscape. An important driver for them to do so was their ageing and declining membership base. Through an innovative and exciting project, they hoped to gain reputational value and attract new and younger members. The dream fund from the postcode lottery supports charity organisations (such as NM) to realise "*brave and groundbreaking*" initiatives. Further, although not a direct funder, the contracted engineering consortium was keen to be able to showcase their expertise regarding building with fine sediments and to develop new (practical) knowledge and experience regarding the matter. Given these drivers for both public and private funding, we point towards the limited utilization of delivered ecosystem services (for example, water purification, wave attenuation, food provisioning, and sediment as a provisioning material) to unlock funding (Hudson et al., 2023; Van Raalte and Ranger, 2023). Similarly, employing (innovative) financial mechanisms such as regulatory compliance or voluntary markets (e.g., Biodiversity Net Gain in the UK, and Carbon Credits) can further unlock private funding and alleviate pressure on and reliance upon public budgets (Ginn, 2005; UK Government, 2024).

4.4. Strings-attached philanthropic donation

Although it has not been the primary focus of this study (rather, it was approached as one of the pieces of the financial puzzle as a whole), the implications of the private seed funding, in the form of a strings-attached philanthropic donation, are multiple. The initial donation of €15 million from the National Postcode Lottery would be made available for the Marker Wadden project only via the involvement of NM, if it were spent within a year, and if NM would come to hold the property rights over the islands. Similar to other scholars' findings, this donation can be characterized as a "deal with an all-or-nothing offer" that maximizes the donor's leverage (Beer, 2022; Linden et al., 2012). Evidence was found that these conditions had their effects on coalition building (via the prescribed involvement of NM and the lack of time) and led to unequal opportunities for exploitation (other interested parties could qualify for exploitation if accompanied by a financial "buy-in" of a similar size)(Grotenbreg and Altamirano, 2019). Yet, it also functioned as a kick-start to finally start the restoration activities after years of research and planning.

Further, although we do not claim a direct causality, the fact that the project started with a funding gap (36 % of the required budget had not been secured at the start of the project), which is a peculiar deviation from standard procedures in large infrastructure projects, can be linked back to the time conditionality of this initial donation. Opportunistic behaviour, combined with a rapid project start with a funding gap, has led to a lock-in situation where, in the end, the distribution of funding between public and private stakeholders deviated considerably from what was expected at the project start (Fig. 8). Another deviation from regular procedures was found, namely, one of the evaluation criteria on which different interventions were compared was the availability of private funding contributions. The submitted plan for the Marker Wadden was the only plan that scored positively on this criterion. The above aspects signal the influence of donors, or private capital, in public environmental decision-making. As such, and in line with other studies (Beer, 2022; Grotenbreg and Altamirano, 2019; Thompson et al., 2023), this case study exposes the existence of trade-offs in terms of (democratic) equity, efficiency, and (environmental) outcomes that are strongly connected to the financial arrangements. Especially in a context where both science and practice are increasingly looking to "scale-up the flow of private finance" in biodiversity and ecosystem conservation,

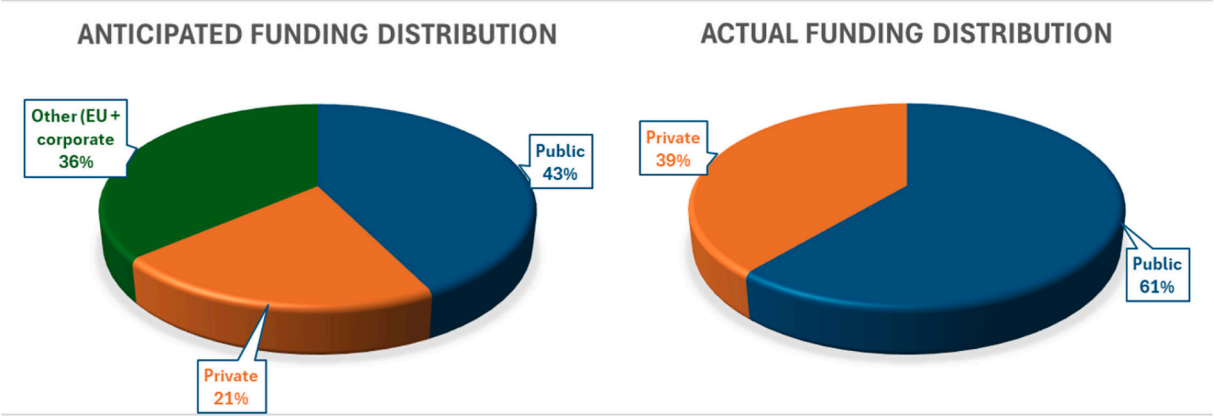

Fig. 8. Anticipated (upon project kick-off) and actual distribution of funding between public and private actors.

such trade-offs warrant further study.

4.5. Generalizing from single case studies

Single case study approaches tend to be criticised for their limited generalisability beyond the case in question (Evers and Wu, 2006; Flyvbjerg, 2006; Yin, 2018). Such criticism would then also apply to our results. However, this claim has been falsified as it was argued that more generic inferences can indeed be made from single cases under specific conditions. We point towards two such conditions, namely the strategic selection of the case study and the role of empirical knowledge and theories that are used to understand the cases (Evers and Wu, 2006; Flyvbjerg, 2006). The observations identified in this single case study, being one that was selected as a deviating case (see also section 2.1), can, as such, represent principles valid in other contexts. Regarding the latter condition, our phenomenon of interest is the financial arrangements in this case, and how these came about. Specifically, our inquiry concerning the "*how these came about*" has been guided by a framework based on an extensive body of empirical and theoretical knowledge (Hüsken et al. 2024). As such, our case study presents generalisable results regarding the type (not the specifics) of arrangements made as well as the strategies that were deployed which led to the enabling conditions for these arrangements to exist.

Given the numerous publications on persistent financial barriers in the contexts of biodiversity, NbS, and ecological restoration (Dorst et al., 2022; Kabisch et al., 2016; Sarabi et al., 2019), and the relative novelty of the research field, our findings can be relevant to other researchers and practitioners working on the matter. Further (case study) research is recommended for increased generalisability and validation of conceptualisations and theories that emerge in this field. In particular, the notion of designing the playing field (creating the enabling conditions) to allow finance to flow into ecological restoration projects seems a promising avenue through which the funding and financing gaps for ecosystem restoration can be addressed. In that regard, the framework of institutional mechanisms developed in Hüsken et al. (2024) has served as a useful analytical tool in this work, an approach that could guide further research.

5. Conclusions

The research question central to this in-depth case study of the Marker Wadden – a mud island concept for ecological restoration - is what financial arrangements have been deployed and how these came about. Given the well-documented financial barriers to ecosystem restoration and NbS in general, the second part of the question is of particular importance. We conduct case study research, in which we make use of policy analysis techniques, evidence triangulation, and a theoretical framework that captures a systemic perspective on financial barriers, one where financial barriers are the result of misalignments between the typical characteristics that NbS have and the characteristics of our institutional system (Hüsken et al. 2024).

We find that three project components of the implementation and operating phases of the Marker Wadden were funded and organized individually. These are the project construction (cost: €78,5 million, funding model: public and private co-funding including an earmarked philanthropic donation), the research and monitoring (cost: € 5 million, funding model: public and private co-funding including in-kind contributions), and the island exploitation and maintenance (cost: approx. €1 million per year with at least at least € 0.5 million initial one-time payment, funding model: public and private co-funding with partial cost-recovery from recreational revenues, in-kind contributions, volunteerism, and philanthropic donation).

We identify twelve key strategies that have played a key role in unlocking and securing funding for the Marker Wadden. These strategies occur during different project lifecycle phases. Nearly half of these strategies took place during the pre-investment phase, which started more than 10 years before the project kicked off. The strategies adopted in this phase were instrumental in avoiding project-level funding barriers, yet went well beyond project-level (implementor) capacity and mandates. The main drivers that led to funding of the Marker Wadden project were environmental legislation (combined with corresponding future restrictions on economic development), increased recreational opportunities, knowledge development regarding building with fine sediment, and reputational gains. Additionally, we discuss opportunities to improve the public investment planning process. Lastly, several trade-offs in terms of (democratic) equity, efficiency, and environmental outcomes associated with the use of private funding and philanthropic donations in the domain of public environmental management were identified. These findings are particularly relevant, as private financing is often proposed as a solution to the biodiversity and NbS funding and financing gaps.

CRediT authorship contribution statement

Lieke M. Hüsken: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Jill H. Slinger:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Conceptualization. **Sacha de Rijk:** Validation, Funding acquisition, Data curation. **Mónica A. Altamirano:** Funding acquisition, Conceptualization. **Heleen S.I. Vreugdenhil:** Validation, Supervision, Project administration, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

L. Hüsken and H. Vreugdenhil report financial support was provided by European Research Executive Agency - Innovation Action number 101037097. M. Altamirano reports financial support was provided by Horizon Europe Research and Innovation Programme - NetworkNaturePLUS 101082213. L. Hüsken, J. Slinger, H. Vreugdenhil and M. Altamirano report financial support was provided by Multi-Actor Systems Research Programme of the Delft University of Technology. L. Hüsken, S. de Rijk and H. Vreugdenhil report financial support was provided by Stichting Deltares. L. Hüsken, M. Altamirano, and S. de Rijk report financial support was provided by the Governance Research Theme of the Knowledge and Innovation program of the Marker Wadden (KIMA).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecoleng.2025.107706.

Data availability

Data will be made available on request.

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