Ponderful

PONDS FOR CLIMATE

Deliverable D1.6

Overcoming barriers to pondscape NBS
A synthesis and final PONDERFUL Framework

Pond Ecosystems for Resilient Future Landscapes in a Changing Climate

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Executive Summary

Pondscapes are important Nature-Based Solutions for climate mitigation and adaptation, as well as in biodiversity conservation, but they are neglected in water- and nature-related national and EU policies and strategies. There is also limited knowledge on the relationships between pondscapes' biodiversity and delivery of Nature's Contributions to People (NCP). The mission of the PONDERFUL project is to increase the understanding of the role of pondscapes in providing NCPs/ES and to promote greater implementation of pondscapes as NBS in order to mitigate or adapt to the current trends of environmental deterioration. PONDERFUL will quantify the relations between biodiversity, ecosystem state, NCP and climate change (CC), develop scenarios for climate mitigation and adaptation using pondscapes, and test the implemented pondscape-based solutions using DEMOnstration sites (DEMO-sites) co-developed with stakeholders. Ultimately, PONDERFUL will develop practical tools for creating and managing pondscape Nature-Based Solutions.

Work Package (WP) 1 of the PONDERFUL project develops a multidimensional framework that supports the effective, efficient, and equitable implementation of pondscapes as NBS for CC mitigation and adaptation, biodiversity conservation, and other NCP. The ultimate aim of WP 1 is to support development of guidance and practical implementation of NBS pondscapes. WP1 activities primarily focus on the project's DEMO-sites, and involve the gathering and integrating social, policy, economic and financing data. By assessing the social, economic, policy and financing aspects of pondscapes, the work within WP1 provides results to support broader application of pondscapes NBS, thereby contributing to the overall objective of PONDERFUL.

The aim of Deliverable 1.6 is to present an updated and refined Framework with overarching guidance for the stakeholder engagement, and social, policy, economic and financing work in DEMO-sites, i.e. the activities coordinated by WP1. Deliverable 1.6 builds on Deliverable 1.1 (Evaluation and implementation framework protocol for policy, socio-economic and financial analysis of pond nature-based solutions) and refines it based on the experiences gained during the PONDERFUL work in the DEMO-sites.

Deliverable 1.1 framed the WP1 work in relation to key theoretical concepts necessary to understand the WP 1 activities in PONDERFUL. It was divided into two sections: one explaining WHY we were carrying out our work in WP1, motivating our work by explaining the current socio-economic and policy challenges and barriers to pondscape implementation; and one explaining How WP1 work was to be organised to make sure it is efficient, low-cost for DEMO-site partners.

Deliverable 1.6 includes summary of tasks 1.3-1.6 of WP1 (details are provided in separate Deliverables 1.2-1.5) and refined PONDERFUL framework based on what we have learned from WP1 work about the key barriers and opportunities in implementing ponds, as well as methodological considerations.

1 Introduction

1.1 The PONDERFUL project, ponds and pondscapes

We are currently facing many global challenges, key ones being biodiversity decline and climate change, both having important consequences for humans (Cardinale et al., 2012; IPBES, 2019). Biodiversity decline, driven by population growth, land use change, habitat fragmentation and climate change, continues, even if numerous policies, initiatives and projects have been implemented during the last decades to counteract this trend (IPBES, 2019). This is worrying, because functioning ecosystems based on rich biodiversity are a prerequisite for human survival and well-being (Daily, 1997; Harrison et al., 2014), as biodiversity contributes to the delivery of numerous ES or NCP. Climate change aggravates biodiversity decline, as it puts pressure on ecosystems through increases in extreme weather events, desertification of some areas, as well as changes in average temperatures and precipitation. It also leads to an increase in new pests and invasive species and novel contexts of community interactions. This forces species to adapt or migrate, which not all are equally capable of (Merilä and Hendry, 2014). All of these factors, in turn, have impacts on human well-being, e.g. in terms of food security, heat stress, zoonotic diseases, or potential conflicts. At the same time, more resilient ecosystems, i.e. ecosystems that can withstand different disturbances, have the potential to mitigate the effects of climate change and to help us adapt to its consequences (Loreau et al., 2003; Yachi and Loreau, 1999).

In relation to the above, pondscapes are crucial. They provide important habitats for rich biodiversity, which is a prerequisite for delivery of many ES/NCP. While individual ponds may seem not that important when compared to larger water bodies, such as lakes or rivers, collectively they represent 30-50 % of the global freshwater area (Williams et al. 2004; Downing et al., 2006; EPCN, 2008; Biggs et al., 2017).

Because of their role in supporting biodiversity and delivering crucial ES/NCPs to people, ponds can help with climate change adaptation and mitigation. Using ponds is thus, as opposed to the use of grey infrastructure, a way of using nature to deliver diverse solutions to environmental problems, i.e. Nature-based Solutions (NBS). More information about ponds as NBS and types of pond/pondscape NBS can be found in PONDERFUL Deliverables D4.1, D4.1, D4.3 and D4.6, leaflets (Oertli

et al., 2024), and publications (Bartrons et al., 2024; Biggs et al., 2024; Cuenca-Cambronero et al., 2023).

In spite of their great ecological importance, ponds are largely neglected in water and nature-related national and EU policies and strategies (Biggs et al., 2017). This is problematic, as ponds are exposed to the same threats as larger bodies of water (e.g. land and water use, pollution, invasive species) and may be particularly vulnerable to climate change, being less buffered to temperature extremes and changes in hydrology (Biggs et al., 2017; Gozlan et al., 2019). That impacts both their number and state (e.g. changes in hydro-period, water level, salinization and eutrophication) (Gozlan et al., 2019). It is important to investigate the relationships between pondscapes' biodiversity and ES/NCP delivery, particularly as the supply of these services are likely to dramatically change with the ecological status of ponds and ongoing climate change.

The PONDERFUL project focuses on the role of ponds and pondscapes in the delivery of different Nature's Contributions to People (NCPs). Pondscapes can refer to specific sets of ponds in the landscape, or any area of interest – either defined by ecology (catchment area, floodplain, valley, etc.) or by societal or political borders (urban pondscape, provincial or national borders). Particular attention is paid to pondscapes as NBS and in particular their role in climate mitigation and adaptation as well as in biodiversity conservation.

The mission of the PONDERFUL project was to increase the understanding of the role of pondscapes in providing NCPs and to promote greater implementation of pondscapes as NBS in order to mitigate or adapt to the current trends of environmental deterioration.

1.2 PONDERFUL evaluation and implementation framework

Pondscapes constitute socio-ecological systems with relations and feedbacks that operate at multiple spatial scales. Ecological systems are complex and how they behave depends on many interactions between their different components. They are also continuously changing and adapting to changing conditions (Levin et al., 2013). At the same time, ecological systems are strongly interconnected with social, political, and economic systems, as human activities and decisions impact the management and state of ecosystems. Thus, many different stakeholders are engaged in decision-making regarding ecosystems and impact ecosystems in various ways. This is of course also the case for pondscapes and thus to implement them on a larger scale and manage them in a way that promotes their benefits requires broad engagement of different actors. These actors operate at multiple spatial and governance scales and represent different sectors and areas of interest. They could be authorities and decision makers at levels from local to international (e.g. EU), NGOs, representatives of academia, and private actors as well as land owners and land owner organisations.

As the ecological and social systems of pondscapes are intertwined, to manage and plan for their sustainability it is important to understand the policy context (e.g. existing governance arrangements, policy instruments, possibilities for financing, etc.) they are embedded in and decision making processes that affect pond creation and management. It is also important to understand social perceptions of the (value of) benefits that pondscapes deliver, including gender differences in these perceptions.

In relation to the above, in the WP1 of the project we aimed at understanding how policy, finance, economics, and public perceptions affect ponds, and to identify how these levers can be used to increase the implementation of high-value pondscapes as NBS to many societal challenges. For that we developed a multidimensional evaluation and implementation framework that supports the effective, efficient, and equitable implementation of pondscapes as NBS. Adjusting Angelsen's (2009) definitions to the scope of PONDERFUL, the effectiveness of a pondscape is their ability to supply benefits for mitigation and adaptation to climate change, biodiversity conservation, and other ES/NCPs. Efficiency refers to the costs and value for money of pondscape NBS, allowing to compare them to alternative approaches designed to reach the same objectives. Equity refers to the fair distribution of these costs and benefits. An initial version of the Framework was developed at the beginning of the project (Deliverable 1.1), and it was then refined using lessons learned from the work within WP1, conducted in the project's DEMOnstration sites (DEMO-sites; for a list of DEMO-sites see Deliverable 4.3). Key results of the work are included in this Deliverable.

The PONDERFUL Assessment Framework was developed to offer multidimensional guidance related to four key barriers to effective, efficient, and equitable pond implementation: 1) social acceptability, 2) policy implementability, 3) financing, and 4) economic efficiency (see figure 1 below). Ultimately, PONDERFUL seeks ways to offer robust advice concerning the implementation pondscapes as NBS based on a comprehensive evaluation including all important (but often neglected) criteria.

The overarching aim and specific tasks of WP 1 are captured in figure 1.

The aim of the Framework presented in this Deliverable is to provide overarching guidance for anyone who would like to implement ponds or pondscape NBS. To do so there may be a need to overcome numerous barriers and activate different levers linked to social, policy and economic aspects. Here, it is also important to understand the context of the area and engage with relevant stakeholders. The guidance included in this Deliverable aims at supporting the organisation of the stakeholder engagement, and provides a social, policy, economic, and financing analysis in relation to pondscapes, to inform an improved implementation of ponds and pondscape NBS.

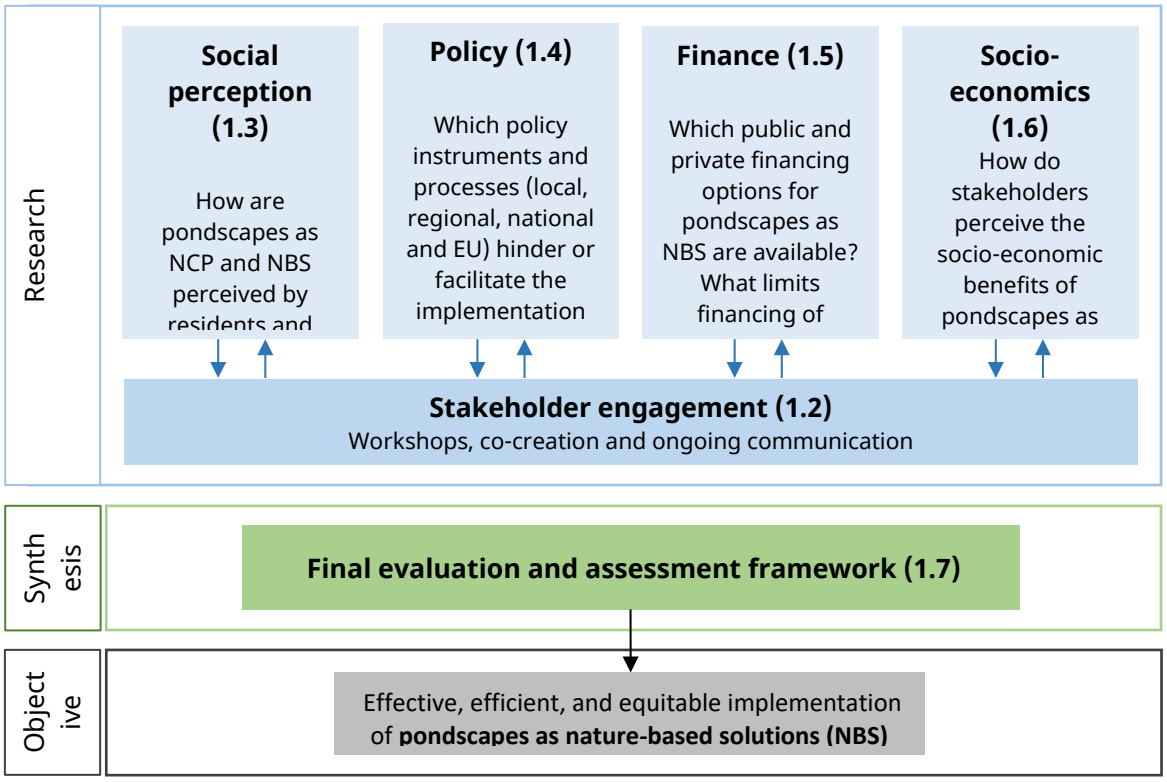

Figure 1. The overarching aim and specific tasks of WP 1.

In this Deliverable we first provide a summary of tasks 1.3-1.6 of WP1 (sections 2.2-2.5) and then present a refined PONDERFUL framework based on what we have learned from the application of the initial framework in the project's DEMO-sites about the key barriers and opportunities in implementing ponds as NBS. The Framework includes lessons learned and recommendations that arose from the work in DEMO-sites in relation to the 1) organisation of stakeholder workshops; 2) methodological aspects of the work, and 3) general implementation of ponds and pondscapes NBS.

2. Challenges and opportunities for pond implementation – key results

As pondscapes are complex socio-ecological systems, the application of ponds as NBS requires that considerations are given to numerous dimensions. First, decisions regarding pondscapes are taken by a wide range of stakeholders who have different levels of interest in ponds and NBS, and different abilities (power) to influence them. Second, stakeholders may perceive and value ponds in different ways and prioritise various ecosystem services they deliver. Third, ponds are being created and managed in a specific policy context that can influence possibilities for their use. For example, options for financing of pondscapes need to be available. Finally, stakeholders can perceive socio-economic benefits from pondscapes differently and different types of pondscapes can provide these particular benefits with different efficiency.

In this section of Deliverable 1.6. we provide a short overview of the key findings of WP1 of PONDERFUL: on social, policy, economic, and financing aspects of implementation of ponds as NBS. Details can be found in respective deliverables (Del. 1.2-1.5). In addition to describing and interpreting the results of our research, we also summarise our methodology, with the aim that this offers guidance to future pond developers.

2.1 Stakeholder engagement (Task 1.2)

2.1.1 Background/Rationale/introduction/RQs

In PONDERFUL we engaged with a wide range of stakeholders (see section on stakeholder mapping in Deliverable 1.1), to gather information relevant for the social, policy and finance aspects of the project, discuss baseline scenarios and co-develop future positive scenarios, co-create resources to be used by practitioners and policy makers, and communicate and disseminate the project's results. This work was important to understand stakeholders' needs and priorities regarding ponds and their ES/NCP as well as the socio-political environment they are part of. Its goal was to enhance the appreciation of ponds and raise awareness about their advantages among stakeholders. Additionally, it sought to equip stakeholders with the necessary knowledge and tools to improve their planning for pond areas in the future.

2.1.2 Methodology

A comprehensive stakeholder mapping was conducted at the beginning of the PONDERFUL project. It was led by WP1 and was done with contributions from all DEMO-sites. The mapping covered main stakeholders in all DEMO-sites, their level of operation, their main roles in relation to pondscapes, their interest in the PONDERFUL project, their power to influence decisions concerning pondscapes, as well as their priorities with regard to different ES/NCPs, as perceived by DEMO-site leaders. The instructions for two steps of stakeholder mapping are included in Milestone 5: PONDERFUL Concept Note.

Three stakeholder workshops were organised in each DEMO-site, to engage with stakeholders, develop a meaningful communication and collaboration process and build trust between stakeholders and researchers within the project, as well as to gather data and information for particular tasks (Table 1). WP1 provided comprehensive guidelines for each workshop organisation, as well as conducted individual meetings and training with each of the DEMO-sites. WP1 researchers also acted as support during all workshops.

Table 1. Content of PONDERFUL Stakeholder workshops

Workshop	**Key focus of the workshop (with relevant Tasks in the brackets)**	**Number of workshops**	**Responsible participants**	**Timing**
First stakeholder workshop	Scoping stakeholders needs; social aspects (1.3); identifying socio-economic and ecological indicators (1.6) and indicators for scenario development (3.3)	8 (each DEMO-site)	Each DEMO-site leader (WP4) organises; WP1 (UU and ISARA) and WP3 (BU) provide guidance	M9-12 (August-November 2021)
	Sustainable financing (scoping, 1.5)	3 (selected DEMO-sites)	WP1 organises (ECOLOGIC) in collaboration with DEMO-site leaders	
Second stakeholder workshop	Policy analysis (1.4) and scenario development (3.3)	8 (each DEMO-site)	Each DEMO-site leader (WP4) organises; WP1 (UU) and 3 (BU) provide guidance	M20-26 (August 2022 to January 2023)
	Sustainable financing (option co-creation, 1.5)	3 (selected DEMO-sites)	WP1 organises (ECOLOGIC) in collaboration with DEMO-site leaders	
Third stakeholder workshop	Discuss preliminary results, incl. scenario maps (3.3) and policy options (1.4). Co-develop information resource set (Technical Handbook with CLIMA-Pond, Guidance Document, decision-making tool) (4.5)	8 (each DEMO-site)	Each DEMO-site leader (WP4) organises; WP1 (UU),3 (BU) and 4 (HES-SO) provide guidance; WP 5 provides communication support	M34-39 (September 2023 to February 2024)

	Sustainable financing (evaluation and results, 1.5)	3 (selected DEMO-sites)	WP1 organises (ECOLOGIC) in collaboration with DEMO-site leaders	

2.1.3 Results and recommendations

Key results of stakeholder mapping are included in Milestone 5: PONDERFUL Concept Note (also included as Annex 2 in Deliverable 1.1: Evaluation and Implementation framework protocol for policy, socio-economic and financial analysis of pond nature-based solutions. Synthesis of minutes and recommendations from the stakeholder workshops are presented in Deliverable 4.4: The minutes of the workshop with the stakeholders. These recommendations are also used in the section 3 of this Deliverable, i.e. the PONDERFUL Framework.

2.2 Social perception of ponds (Task 1.3)

2.2.1 Background/Rationale/introduction/RQs

Our objective was to examine how the local population and professional stakeholders perceive the purpose and the environmental condition of the pondscapes selected in the PONDERFUL project. Knowing the needs of stakeholders and their perception of nature/pondscapes is important to be able to prioritise decisions that impact the different values attributed to pondscapes.

A better knowledge of expectations of these actors may facilitate incentive mechanisms based on their endogenous motivations to preserve, conserve, or improve the conditions of pondscapes. Gathering the opinions and perceptions may thus help to enhance the effectiveness and legitimacy of the restoration or management actions in pondscapes, considering the diversity of viewpoints in order to identify all the stakes and issues. The identification of values of ponds and perceptions provides the basis for prioritising the most important social and environmental stakes with regard to local actors (Lopez-Rodriguez et al., 2015), as perceptions and preferences depend on social and cultural context. All this information is necessary to develop effective policies and implement measures to make pondscapes better for local actors.

At the start of the PONDERFUL project, no information was available about the different DEMO-sites. It was therefore not known how local actors felt in relation to ponds and pondscapes, what they valued about them (Jarvie, 2017), and what benefits and contributions from pondscapes were most important to them. Our study provides an intermediate step toward determining priority of NBS implementation (Dumitru, 2021) and valuing the role of pondscapes for the quality of life. This perception analysis also makes a genuine contribution to WP4 work by

determining quality-of-life indicators. The survey findings provide the foundation for choosing relevant indicators to adapt NBS and pondscape management to the local social context.

2.2.2 Methodology

To do this in-depth social study, we chose a mix of qualitative and quantitative approaches with a view to inventorying the perceptions, the local knowledge, the expectations and the feedback on previous actions, and to establish a typology of social perceptions of pondscapes. Using this typology, we identified the variability of benefits provided by pondscapes and NCPs priorities.

Applying an inter-site analysis method, data was collected from stakeholders (during the workshops and using a questionnaire) and from inhabitants (questionnaire distributed in the pondscapes areas). We analysed data from individual DEMO-sites and carried out a cross-case analysis.

The questionnaires were developed by the WP1 team and made available to stakeholders in each DEMO-site's local language in 2021. No questionnaire was disseminated to stakeholders in the La Pletera pondscape given the on-going research initiative with a LIFE project. The subjects of the questionnaire addressed are the profile of the respondents, the social closeness to the relevant pondscapes, the relation to nature and to the ponds, the perception of pondscapes' changes over time, the general assessment of the ecological status of the pondscape, the NCPs and NBS priorities.

108 completed responses were collected from the different stakeholders. We also collected 703 responses from inhabitants, of which 590 had already visited some of the PONDERFUL pondscapes at some point. The first conclusion that may be drawn from this numerical result is the difficulty to obtain a greater number of responses. There are many reasons for this experience, and some of them are specific to the particular DEMO-site:

- No exclusive legal responsibility (uncertain status of ownership) for the ponds in some countries with challenge of identifying the stakeholders;
- Limited knowledge of the pond landscape of the stakeholders
- Some ponds and pondscapes have small surface areas or are located in geographically remote areas;
- Ponds are sometimes without water (irregular or short hydroperiod).

Besides both questionnaires, our second method for interaction was through stakeholder workshops. The aim was to understand stakeholders' diverse needs, as well as opportunities and threats for improved management. Our intention was to put into perspective the results of the questionnaire and obtain explanations of some perceptions. We conducted different exercises related to the NBS measures, the management of the pondscapes, and the NCPs priorities in the present and the future.

As a result, a continuity in the collection of data between both questionnaires and workshops can be observed. The figure below (Figure 2) summarises the overall logic of the data gathering exercises:

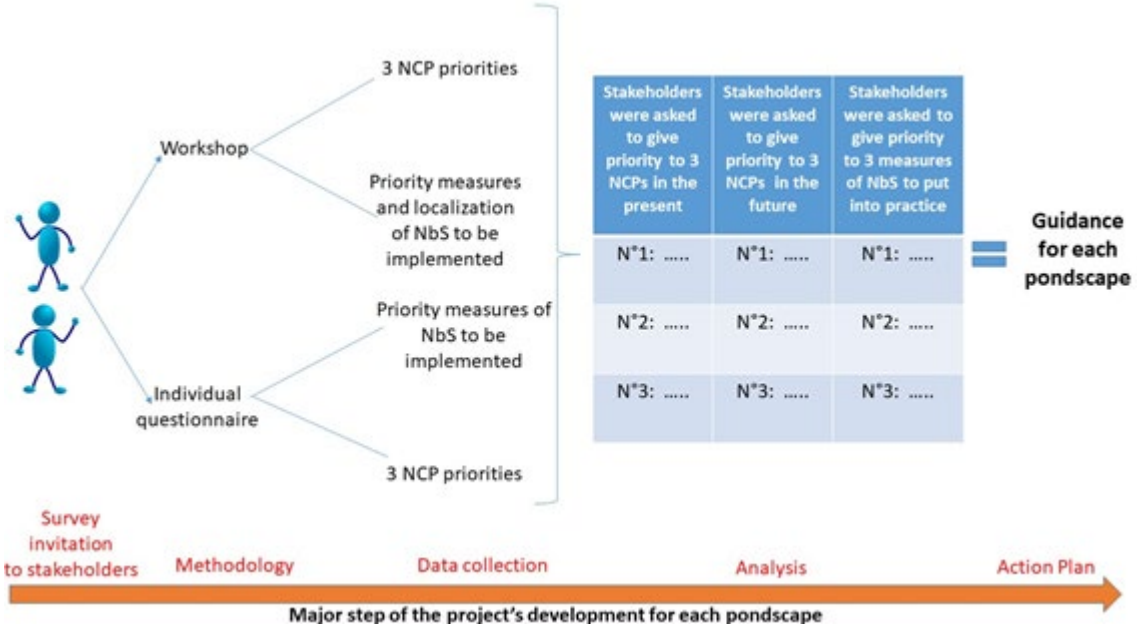

Figure 2. The logic of data gathering on social perceptions of ponds (Task 1.3 of WP1).

2.2.3 Results

All results are available in the Deliverable D1.2. Below we compare specifically the results from the stakeholder with the ones from the general public survey, highlighting similarities and differences.

Perception of change in pond landscapes over the last ten years

First, we present the results linked to the question "Have you observed significant changes in this pondscape during the last ten years?" and we have considered the convergence of responses between stakeholders and inhabitants (Figure 3). The results vary a lot between the pondscapes. The perceptions of very important changes are observed in Germany and Uruguay with more than 66% of positive responses for inhabitants and stakeholders. Several other pondscapes are concerned by the convergence of perception between inhabitants and stakeholders – for example in Rhône Verbois (Switzerland), and in Tommelen (Belgium) but with results around 50% of "Yes". A converging negative response ("no significant change") is also observed in Pinkhill Meadows (England) and Pikhakendonk (Belgium).

For other pondscapes, results are inconclusive, confirming that we have contrasted even contradictory responses between inhabitants and stakeholders. We can only guess why the differences between stakeholders and inhabitants are sometimes so significant, particularly in Fyn (Denmark) and Turkey where stakeholders perceive more change than inhabitants.

Secondly, we compared the results of the most common changes selected by stakeholders and inhabitants (Table 2). As shown in the table, there is an overlap between the perceptions of stakeholders and inhabitants in six pondscapes (Germany, Bois de Jussy, Albera, Dikkuyruk, Imrahor, Gete Vallei, and Tommelen).

When combining all pondscapes, the negative changes highlighted exceed the positive. The most frequently cited negative changes are "more frequent drying of ponds", "lower pond water level", "more rubbish" and "degradation of water quality".

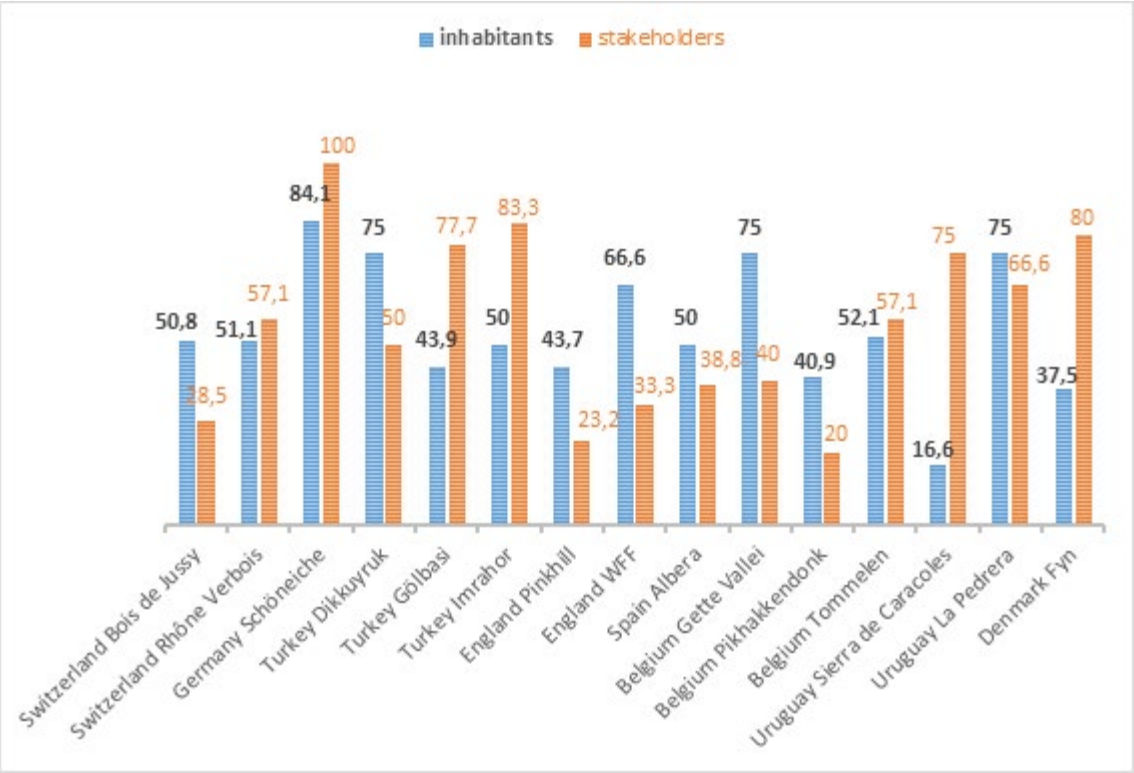

Figure 3. Inhabitants' and stakeholders' perceptions on the occurrence of significant changes to the pondscapes during the last decade (% of respondents who answered positively to the question "Have you observed significant changes in this pondscape during the last ten years? And, if so, which one(s)?"

Table 2. Comparison between inhabitants and stakeholders on changes observed during the last decade

	Main type of changes selected by inhabitants	Main type of changes selected by stakeholders	Level of convergence
Switzerland: *Bois de Jussy*	colonisation of new plant species colonisation of new animal species increase in the number of ponds	colonisation of new animal species increase in the number of ponds	Strong convergence
Switzerland: *Rhône V.*	colonisation of new plant species colonisation of new animal species increase in the number of ponds	/	/
Germany: *Schöneiche*	decrease of pondscape surface area more frequent drying ponds lower pond water level	decrease of pondscape surface area more frequent drying ponds	Strong convergence
Turkey: *Dikkuyruk*	deterioration of water quality lower pond water level	decrease of pondscape surface area deterioration of water quality	Strong convergence

	Main type of changes selected by inhabitants	Main type of changes selected by stakeholders	Level of convergence
Turkey: *Gölbasi*	deterioration of water quality **increase of bad odours** **more rubbish**	decrease of pondscape surface area, **lower pond water level**	No convergence but grim picture in common
Turkey: *Imrahor*	decrease of pondscape surface area deterioration of water quality	decrease of pondscape surface area deterioration of water quality	Strong convergence
England: *Pinkhill M.*	Improvement of water quality **colonisation of new animal species**	**colonisation by new plant species** increase in the number of ponds	No convergence but positive picture in common
England: *Water Fr. Fa.*	colonisation of new plant species colonisation of new animal species	/	/
Spain: *Albera*	lower pond water level more frequent drying of ponds **decrease of pondscape surface area**	lower pond water level, more frequent drying of ponds	Strong convergence
Belgium: *Gete Vallei*	improvement of water quality more frequent drying ponds increase in the number of ponds	deterioration of water quality	Limited convergence
Belgium: *Pikhak.*	higher pond water level more frequent drying ponds	/	/
Belgium: *Tommelen*	more drying frequent pond lower pond water level **colonisation of new plant species**	more drying frequent pond, lower pond water level	Strong convergence
Uruguay: *Sierra de C.*	**colonisation of new plant species**	colonisation of new animal species, increase in the number of ponds	No convergence
Uruguay: *La Pedrera*	colonisation of new plant species colonisation of new animal species increase in the number of ponds	/	/
Denmark: *Lystrup*	**colonisation of new animal species**	/	/
Denmark: *Fyn*	**colonisation of new animal species**	**extinction of local animal species,** decrease of pondscape surface area, **lower pond water level**	No convergence

NCP' assessment

We asked participants to rate the various NCPs in terms of their contribution to the pondscape in question, from 1 to 5 (where 1 means "not important at all" and 5

means “very important at all”), to reveal which ones should be prioritized. We noted that stakeholders have almost always given a higher rating than inhabitants for all NCPs (Figure 4). All pondscapes combined, the comparison between stakeholders and inhabitants show similar results with a clear top-three NCPs: ‘maintenance of habitats/biodiversity’, ‘physical and psychological experiences’ and ‘maintenance of options’ (i.e. potential opportunity offered by nature to ensure resilience in the future).

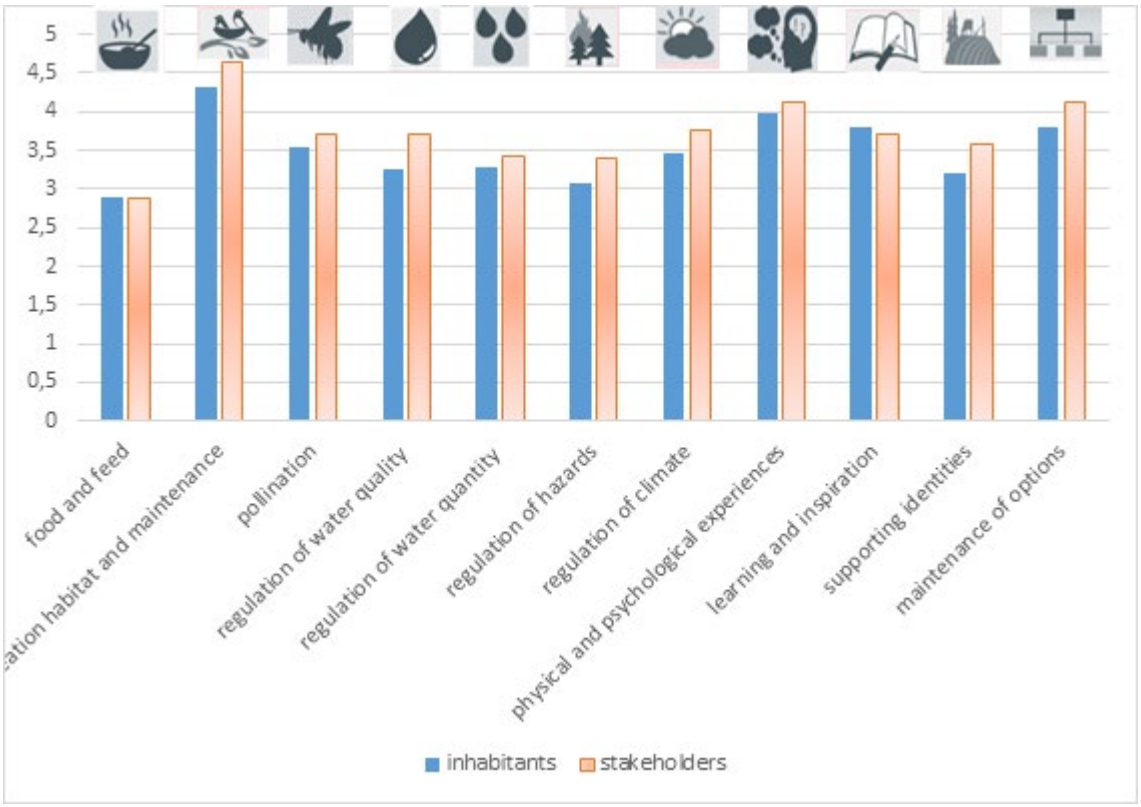

Figure 4. Mean of expected NCPs from all pondscapes combined, as perceived by stakeholders and inhabitants (response to question “What are the contributions provided by this pondscape?”)

The item “maintenance of habitats/biodiversity” received the highest marks by all the stakeholders and the general public, who also expressed that the conservation and protection of threatened species were important.

The NCP “physical and psychological experiences” was the second most cited. This confirms that social, cultural, and recreational activities linked to pondscapes were also perceived as very important by a large majority of participants. By cross-referencing these results with two other survey questions about well-being and activities linked to pondscapes, the respondents wanted to emphasise the wide variety (hiking, wildlife observation, relaxation, cycling, educational purposes, workplace) of activities provided by pondscapes that promote their well-being.

Environmental status of the pondscape

The ratings from the stakeholders and the inhabitants on environmental status of the pondscapes were similar (Figure 5). The variations exceed a threshold of 0.5 points only in Turkey, Pinkhill Meadows (England), Schöneiche (Germany), and in Belgium. The mean of rating was relatively high (3.5/5), but with low scores for German or Turkish pondscapes.

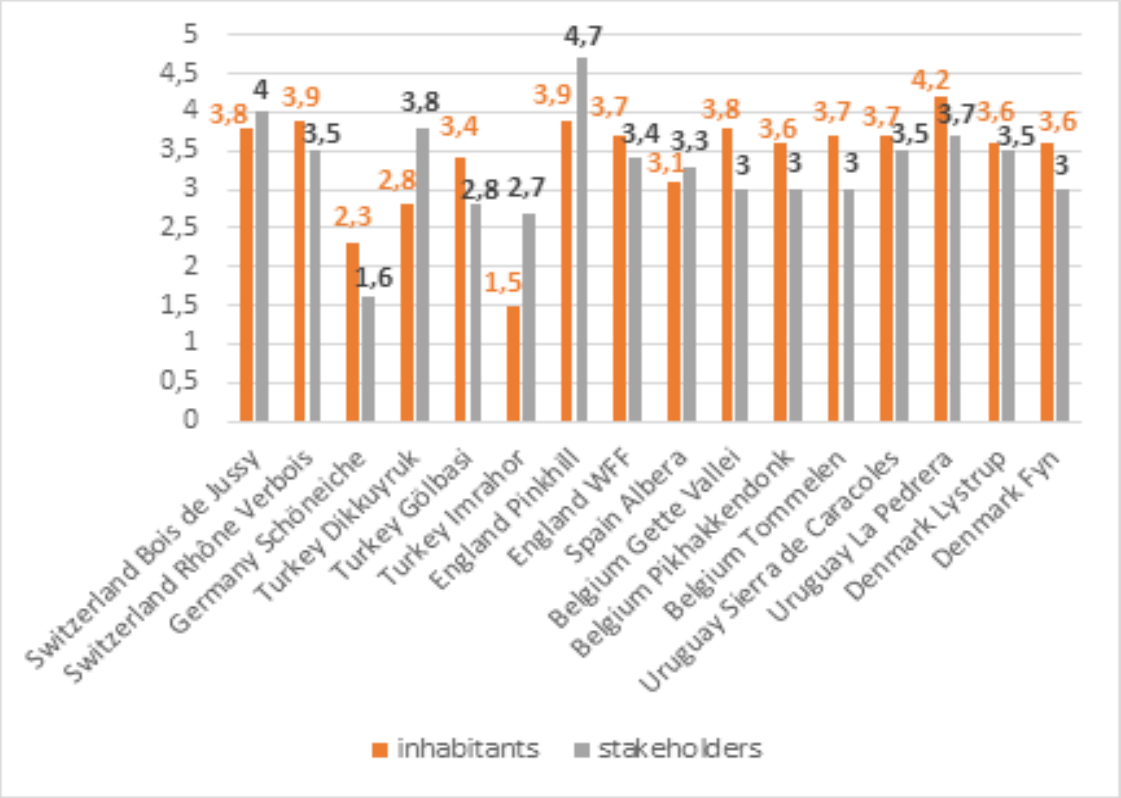

Figure 5. Responses to the question "what is the environmental condition of this pondscape?" on the five-point scale (1 = "very bad", 5 = "very good")

NBS measures

We compared the results from inhabitants and stakeholders regarding the perception of the NBS measures that should be implemented in the future. The perceptions on NBS are quite similar for a large majority of pondscapes. Views of both types of respondents are often aligned. The most appropriate NBS measures selected are "restoration", "supporting connectivity", "maintenance of biodiversity" and "improving the water quality". In facing the challenge of water quantity, respondents from the Belgian, German, Turkish, and Uruguayan DEMO-sites have selected other options as "increasing water volume" and "limitation/abandonment of certain uses" with action both on the supply and demand of water.

2.3 Policy analysis (Task 1.4)

2.3.1 Background/Rationale/introduction/RQs

In recent years there has been an increasing recognition of the importance of small water bodies such as wetlands to fulfil EU environmental policy goals (Biggs et al., 2017; van Rees et al, 2020). Also, a new emphasis has been environmental policy integration, i.e. the incorporation of environmental concerns in policy sectors outside of the environmental policy domain, e.g. agriculture or urban planning. Yet, ponds are said to be largely neglected in EU and lower-level policies (Biggs et al., 2017).

At the same time, supra-national policy frameworks, such as the EU's, are of paramount importance for the regulatory and ideational margins of operation for lower governance levels (Seddon et al., 2021; van der Jagt et al., 2023). Yet, NBS implementation is also highly dependent on the governance context as well as the potential NBS itself (Dorst et al., 2022; Raška et al., 2022; Tozer et al., 2022), which is why it is critical to increase the resolution of research and focus on particular ecosystems as potential NBS.

Thus, in Task 1.4 we explored how EU-level policies and local, regional, and national policies in the DEMO-sites (can) support or hinder the implementation of multifunctional pond and pondscape NBS. Besides focusing on the policies of EU countries, we also analysed policies in four DEMO-sites outside the EU: Switzerland, Turkey, the United Kingdom, and Uruguay. The aim was to provide a broader perspective on ponds and pondscapes NBS, and develop recommendations that can be applied internationally. Based on that analysis, we detected possible policy gaps to be addressed as well as opportunities that can be harnessed to implement pond and pondscape NBS. This involves:

Two key research questions of this task were:

1. What are policy factors (including policy processes and instruments, as well as existing data) at EU level that may hinder or facilitate implementation of pond/pondscape NBS?
2. What are policy factors (including policy instruments) at local, regional and national levels that may hinder or facilitate implementation of pond/pondscape NBS?

2.3.2 Methodology

To answer the above-mentioned research questions, we conducted a qualitative content analysis of EU policies as well as the policies and practices in the respective DEMO-site countries. A detailed elaboration of the methodology would go beyond the scope of this Deliverable, but can be found in Deliverable 1.3. Below we provide a brief overview of the analysis process.

Data Collection

Based on reviewed literature, snowball sampling, and a targeted search, we selected thirty-eight policies (see Deliverable 1.3. for complete list) to assess barriers and enabling factors for implementing pond and pondscape NBS in the EU policy framework. Generally, the most recent binding policy in each relevant policy area was first sought out, as they are assumed to carry the most weight. Where there were no binding policies for a particular policy area or issue or binding policies lacked detail, they were supplemented by relevant non-binding policies.

Meanwhile, to understand the barriers and enabling factors affecting the implementation of ponds and pondscapes as NBS at lower governance levels we also investigated eighteen pondscapes in the eight DEMO-site countries in-depth. Here, data was gathered from policy documents, through correspondence with local experts (e.g., partners of PONDERFUL, environmental lawyers, civil society representatives, local decision-makers), and via stakeholder discussions on workshops. Since, firstly, the selected pondscapes are also impacted by policies at higher governance levels and, secondly, stakeholder workshops held in each country (see below) elicited insights beyond the pondscape-level context, we shed light on both barriers and enabling factors both in the selected pondscapes (i.e. local) and the broader regional/national context in the countries.

Data Analysis

The analysis processes were very similar, albeit not identical (see Figures 6 and 7 for graphical illustrations). The qualitative content analysis enables the in-depth engagement with the nuanced language of policy texts and capturing the complex interactions between policies (Bowen, 2009; Cardno, 2018). Furthermore, it allows for drawing from multiple dissimilar types of data sources (e.g., policy documents, workshop discussions). Also, it is well suited to uncover patterns or common themes across data and cases (Gläser & Laudel, 2013).

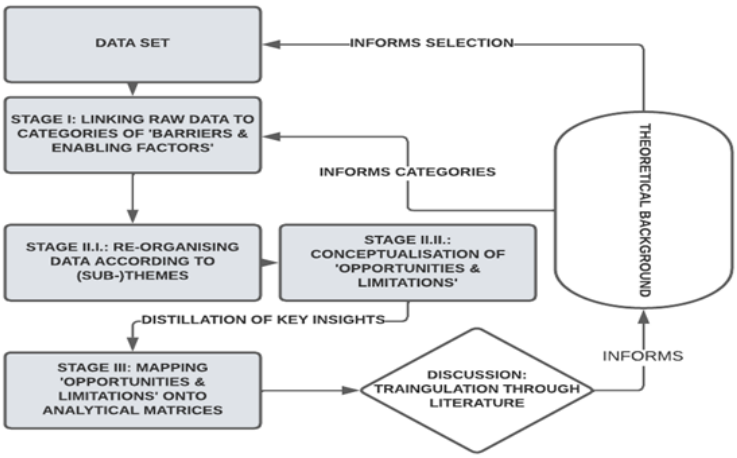

Figure 6. Graphic illustration of analysis process (EU analysis)

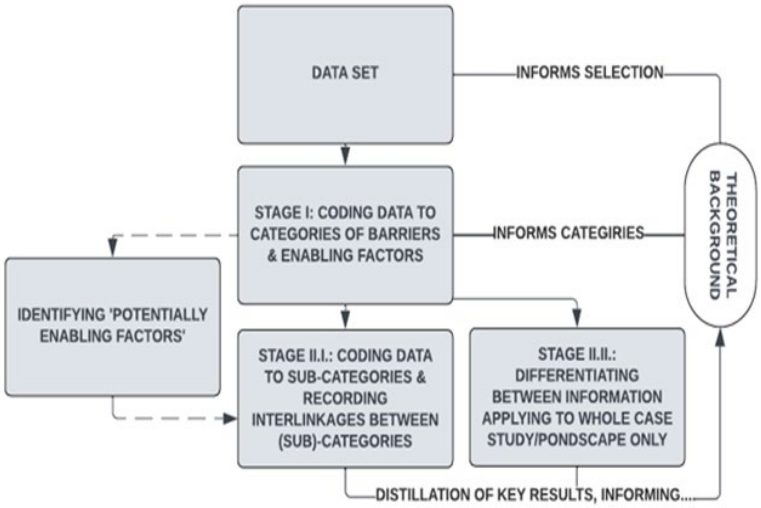

Figure 7. Graphic illustration of analysis process (DEMO-site analysis).

2.3.3 Results

Below we provide a summary of the results of Task 1.4. For a detailed presentation of the results refer to Deliverable 1.3. (Figure 8) shows the key insights of the EU policy analysis. For the DEMO-site analysis, it is substantially more difficult to distil the complex and diverse insights gathered throughout the analysis process. However, the key insights are put into context with the main findings of the EU analysis below.

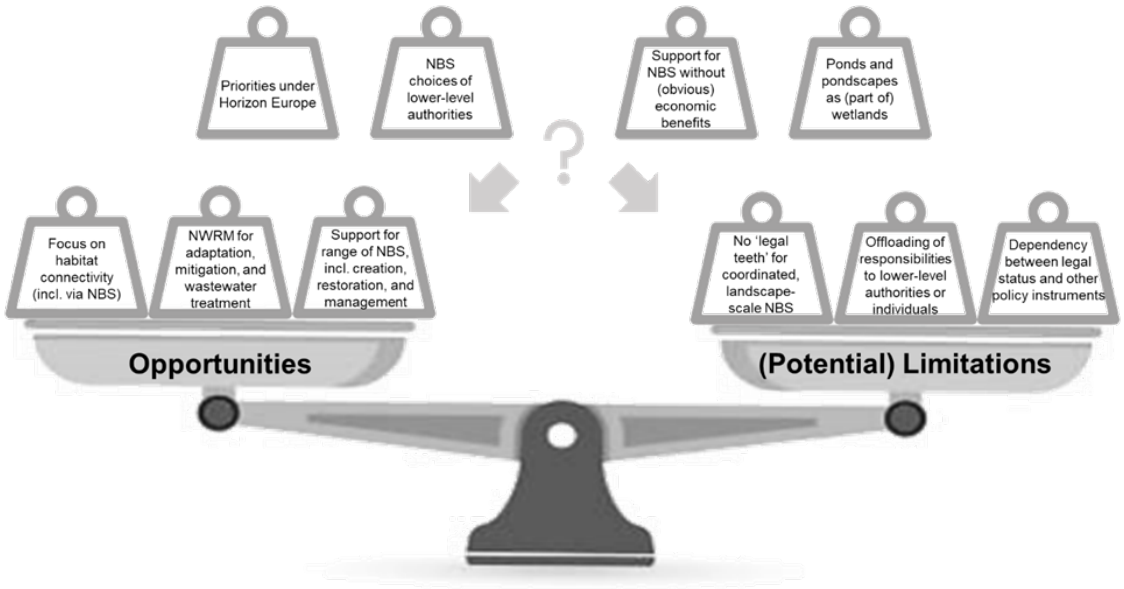

Figure 8. Visual summary of the main opportunities and limitations contained in EU policies, as well as the issues that can 'tip the scales'

Support for NBS, but limitations to implementation persist

In summary, policies in the EU show support for NBS, even though ponds and pondscapes are often not explicitly mentioned. While the policies often emphasise creating and restoring ecosystems, there is also some consideration for managing and protecting them. The EU seems to be shifting toward a comprehensive approach to NBS, promoting habitat connectivity through networks of ecosystems with varying maturity and complexity, supporting it with financial support and guidelines for lower-level authorities. However, ambitions to improve habitat connectivity often lack legal backing. Ultimately, the responsibility to implement NBS lies with local authorities. While some lower-level policies prioritise habitat connectivity, they tend to overlook ponds and pondscapes. In rural areas, individual landowners hold the responsibility, but they are often hesitant to implement pond NBS, especially when it is voluntary. Low payments for environmentally friendly practices and a lack of mechanisms to facilitate coordination among farmers limit opportunities. Private or fragmented land ownership can also complicate the implementation of pondscape-level NBS and monitoring, particularly if landowners are uncooperative.

Path dependency from legal status to implementation opportunities

The analyses highlight a more robust policy framework for implementing NBS in areas with specific legal statuses. In the EU, regulations, financing, planning tools, and monitoring strategies primarily target habitats and species listed in the Annexes of the Birds and Habitats Directives, particularly those designated as Natura 2000 sites. Locally, Natura 2000 status alone often does not lead to direct improvements, but it correlates with better planning, monitoring, and institutional support. On the other hand, for non-protected habitats, regulatory, managerial, and financial tools are less effective. This limits opportunities for NBS in terms of restoration and management, especially for ponds, leaving many areas without regulations or incentives for creating or restoring ponds.

Legal classifications of ecosystems that set quality standards are also crucial. European water quality management, governed by the Water Framework Directive, often excludes ponds due to their smaller size. In some EU Member States, monitoring efforts are also directed toward protected area ponds. However, improvement in monitoring may happen if ponds are reclassified as lakes or wetlands.

Emphasis on NBS for climate change adaptation and mitigation

Policies, including those of the EU, place a significant emphasis on the potential climate change adaptation and mitigation benefits of NBS. However, ponds have not yet gained strong recognition for these purposes. Some policies do support natural water retention measures (NWRM) more broadly, but the application of ponds as NBS appears contingent upon whether they are considered part of wetlands or peatlands. Currently, at the country level ponds are infrequently used as NWRMs due to institutional barriers, uncertainties regarding costs and benefits,

and disputes about who bears the costs when the benefits accrue in a different location than the NBS site.

Local leadership may matter more than support from policies

Ultimately, the success of implementing NBS often hinges more on the choices made by local individuals than written policies. The lack of interest in using ponds and pondscapes for NBS is a significant obstacle, whether it is municipal staff sceptical of NBS or private landowners who view ponds solely as tools for production. Economic arguments often do not sway them; instead, ethical considerations about the inherent value of nature tend to be more influential. While leadership was rarely explicitly mentioned as a barrier or enabling factor in the DEMO-site analysis, addressing existing barriers such as detrimental land uses and improving institutional cooperation often requires strong political leadership. Without it, implementing NBS, especially at the pondscape scale, can be challenging, as barriers like land tenure and landscape fragmentation persist.

2.4 Possibilities for financing (Task 1.5)

2.4.1 Introduction

Insufficient financing has been identified as a significant barrier for NBS uptake (Faivre et al, 2017; Mayor et al., 2021; UNEP, 2022). We define financing as encapsulating all sources of money necessary to cover costs associated with NBS creation, restoration, and/or management. While in 2020 worldwide NBS financing amounted to €145 billion (UNEP, 2022), Deutz et al. (2020) estimate that achieving post-2020 global biodiversity objectives will require annual financing of €635-850 billion. Currently, NBS financing predominantly comes in the form of public funding, with estimates of the proportion of NBS projects financed by public sources ranging from 76-97% (Almassy et al., 2017; EIB, 2023).

The literature identifies many challenges limiting the financing of NBS. Attributes of pond and pondscape NbS make these likely to be especially pressing, though there is limited data on financing of ponds and pondscapes (Cuenca-Cambronero et al., 2023). Pondscapes generate predominantly public goods (e.g. biodiversity enhancement), which are undervalued by markets (Wild et al., 2017). Pondscapes generate multiple benefits that benefit multiple beneficiaries; this scattering of benefits poses coordination problems for NBS financing (Toxopeus & Polzin, 2021). Measuring pondscape benefits is challenging due to their variability and lack of agreed-upon methodologies and data (Cuenca-Cambronero et al., 2023); such knowledge gaps hinder NBS financing, compounded by the difficulty of monetising non-market benefits (McQuaid et al., 2021). Furthermore, pond and pondscape NBS are often small-scale; EIB (2023) identifies the relatively small size of NBS projects as a barrier to efficiently implementing common financing approaches.

There has been a call for a significant increase in private NBS investment to help address current financing gaps limiting widespread implementation of NBS (UNEP,

2023; Deutz et al., 2020; OECD, 2019). Some authors have pointed to novel financing instruments as a potential solution (OECD, 2019; Tobin-de la Punta & Mitchell, 2020). However, authors such as Kedward et al. (2023) have also identified the challenges and risks of relying on private sources and novel financing instruments.

In this section, we report work undertaken for the investigation of financing of NBS in the context of ponds and pondscapes. In addition to a targeted literature review, we evaluate data on cost and benefits gathered from 14 pondscapes coming from the eight DEMO-sites across Europe, Turkey, Uruguay under investigation in the PONDERFUL project. We draw on structured and semi-structured interviews as well as stakeholder workshops to address three questions:

1. What are the budgetary requirements of pondscape NBS implementation?
2. How are ponds and pondscapes currently funded/financed as nature-based solutions?
3. How could innovative financing instruments fund/finance future pond NBS in the future?

2.4.2 Analytical framework

Figure 9 introduces the logical sequence that underpins our analytical framework. The creation, restoration, and management of ponds and pondscapes cost money. In addition, and as with any other type of NBS, ponds and pondscapes deliver public and/or private benefits that, depending on the beneficiary types, unlock different financing needs. Table 3 introduces key terms and methods for assessment employed in this research.

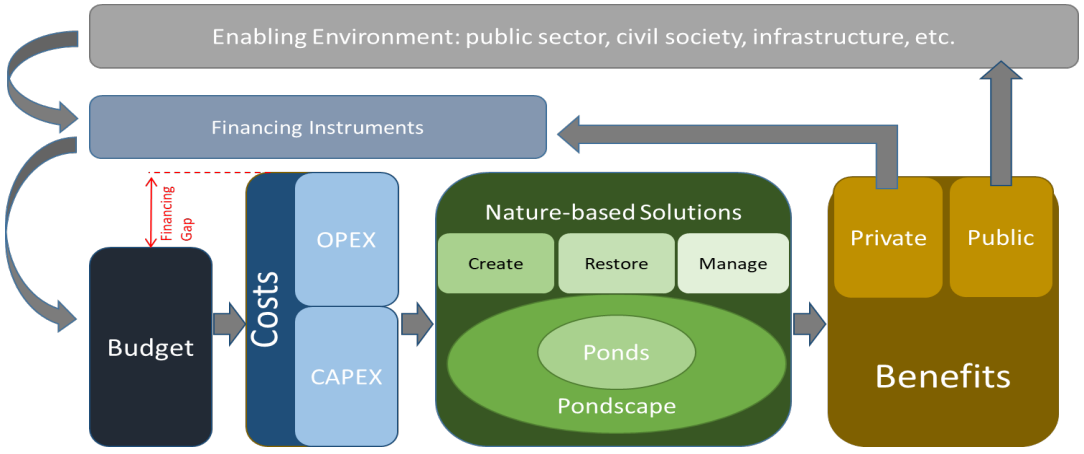

Figure 9. Logical sequence that underpins our analytical framework in Task 1.

Table 3. Key terms and methods for assessment employed in Task 1.5.

Analytical Element	Description	What needs to be assessed	Method of assessment
Nature-based Solutions (NbS)	In this context, NbS consists of ponds and the surrounding pond-scape. NbS activities can either be construction of a new pond(-scape), restoration of an old pond(-scape), maintenance of an existing pond(-scape), or a combination of these. These activities bear financial costs (OPEX, CAPEX) but also result in various benefits (public and private).	Pond/pondscape types of NbS action Costs and benefits Identification of beneficiaries	Literature review; Stakeholder workshops; Financing Workflows
Costs	Costs are either operational expenditures (ongoing) or capital expenditures (one-off). Together these categories form the total costs (or budgetary needs) to enable Nature-based Solutions financially. Costs are covered by the overall budget.	Financial costs typology	Financing Workflows
Budget	The budget is the available capital to cover costs for NbS activities. The budget is the result of using one or several financing instruments. If the budget is less than the total costs (OPEX+CAPEX), the occurring financing gap needs to be closed by raising the budget through financing instruments.	Financial costs inventory	Financing workflow; Stakeholder workshops;
Financing Instrument	Financing instruments are the various means and mechanisms which create the budget for a pond(scape) NbS. Financing instruments can be used by the public (e.g. grants) or by private actors (e.g. income instruments).	Inventory of sustainable financing instruments	Literature review; Stakeholder workshops;
Benefits	Benefits arise from successful NbS action and can be private or public, depending on whether the benefits are excludable or not. Private benefits enable financing instruments, (e.g. the sale of market good and services), while public benefits justify the use of financing instruments by the public (e.g. grants, subsidies).	Identification of societal challenges Benefits assessment	Stakeholder workshops; Financing workflow;
Enabling Environment	The enabling environment encompasses the public sector, the civil society, and public goods such as public infrastructure. Public benefits of NbS can improve the enabling environment, for example by reducing the flood risk of infrastructure or by providing recreational spaces for the civil society. Accordingly, the actors from the public or the civil society make use of financing instruments to enable budgets for NbS action (e.g. grants, donations, etc.).	Identification of beneficiaries	Stakeholder workshops;

2.4.3 Methodology

Literature review

Literature reviews and desk research lead to the development of the inventory on sustainable financing instruments. Findings from this exercise are documented in the Deliverable 1.4 “Synthesis report on sustainable financing of the establishment of ponds and pondscapes”. This report introduces a total of 24 financing instruments for NBS, each matched by at least one concrete example of the financing instrument in action. The Inventory aims to support pondscape

developers understand financing options and identify the finance instruments best suited to their pondscape NBS project.

Case studies

The following pondscapes were included in our analysis: Belgium (Tommelen, Hasselt; Gete Vallei, Tienen; Pikhakendonk (Boortmeerbeek)), Switzerland (Bois de Jussy, Geneva; Rhône de Verbois, Geneva); Denmark (Fyn Islands, Odense); Spain (Albera, Figueres; La Pletera, Torroella de Montgrí (Girona)); Turkey (Imrahor River Valley, Çankaya, Ankara); UK (Water Friendly Farming, Leicester); Uruguay (Sierra de los Caracoles, Maldonado) (for full list of DEMO-sites and their pondscapes see Deliverable D4.3).

Semi-structured interviews (detailed financing workflows)

Purpose: to assess NBS action, costs, benefits, and possible financing instruments, mainly for research question 2.

As a next step, protocols were developed to gather relevant information about the pondscapes. Based on existing good practice approaches and literature, we developed templates to collect information for each pondscape. This exercise included gathering information about societal challenges, benefits, and financial costs[1]. A detailed finance workflow was designed to gather information for the suitable finance plans for the DEMO-sites. The aim was to help DEMO-sites to answer the question: How do I pay for my pondscape NBS? A detailed financing plan workflow was developed. It provides a step-by-step guide to collecting the necessary information to understand and manage the costs associated with implementing and maintaining the NBS, identify commercial and non-commercial funding opportunities, and financing to manage cashflow and cover any financing gap. The detailed finance workflow was tested in 3 pondscapes of the project: Water Friendly Farming (UK), La Pletera (ES) and Turkey. These reports are included in the annexes.

In addition, the finance data gathered for all DEMO-sites can be found here: https://dataportal.ponderful.eu/dataset/b1e8bcf7-3f27-4306-ab7c-9d526a54226d/resource/7890fb8a-6179-4785-86b1-04b368123b2f/download/ponderful-leaflet-cba-data.final01.11.2023.xlsx. This information was used to complete the cost-benefit and financing section of the project leaflets (see Oertli et al., 2024) that can be found here: https://zenodo.org/records/12160725

Structured interviews (simplified financing workflows)

[1] Further information can be found in the WP4 protocol: Milestone MS06 "Protocol for Assessing DEMO-sites"

Purpose: To assess NBS action, costs, and benefits, and financing instruments, mainly for research question 1.

Based on the experience and the findings from the previous research steps, a simplified financing plan workflow was developed to be applied in the remaining pondscapes of the project. This consisted in gathering the minimum level of information that would allow pondscape developers to understand the current situation and draw conclusions about future financing needs of the sites (including pond NbS information, benefits, financial costs, funding, and financing options). See annex xx for the template and completed simple financing plans.

Interviews with pondscape leaders validated the approach and offered access to relevant documentation and insights into existing and future plans for the pondscapes. Simplified financing plans were completed for pondscapes in the project with available data.

Stakeholder workshops

Purpose: to assess benefits and suitability of possible financing instruments for research question 2.

Process: Workshops with pondscape developers and relevant stakeholders in the 3 DEMO-sites mentioned above were used to gather information about current and future financing needs for the site. In addition, reviews on existing literature/reports were undertaken to gather information about the finances of each pondscape.

2.4.4 Results

We identified 22 financing instruments for pond and pondscape NBS, categorising them into eight types: Income Instruments, Contracting Approach, Voluntary Contributions/Donations, Tradable Rights/Permits and Payment for Ecosystem Services, Subsidies, Grants, Debt Instruments, and Equity Finance. These instruments support pondscape implementation by generating revenues, providing private or public funding, avoiding or reducing costs, or through debt/equity finance. The PONDERFUL Sustainable Finance Inventory was published in PONDERFUL D1.4 (McDonald et al., 2023), with a full version of the Sustainable Financing Inventory available online at https://www.ecologic.eu/19473. Different financing instruments have different strengths and weaknesses, making them more or less appropriate for different contexts and actors. The Inventory describes each instrument as well as examples of their practical implementation. The Inventory aims to support pondscape developers to understand financing options and identify the finance instruments best suited to their pondscape NBS project.

Table 4. Ponderful sustainable finance inventory

Main category	Category definitions	Instruments	Examples	Instrument type
1. Income instruments	Instruments for raising revenue that can then be used to finance NbS. Some can be used by landowners (1.1, 1.4, and 1.5); others can only be levied by government-sanctioned associations (1.2 and 1.3) or governments (1.6).	1.1 User fees	Altnabrocky River	Revenue
		1.2 Business improvement districts	Vauxhall Missing Link	Funding: private
		1.3 Betterment levies	Wimbledon and Putney Commons	Funding: public
		1.4 Development rights and leases	SANPark concessions for tourism	Revenue
		1.5 Sale of market goods	Carp Ponds in Bavaria, Germany	Revenue
		1.6 Other revenue raising measures	UK Network Rail Port Townsend water utility fee	Revenue/funding
2.Contracting approach (cost reduction/ restructure)	Legal agreements that reduce or restructure the costs of financing NbS, either by providing assets or use of assets at below market rates (2.1) or by shifting financing of upfront costs in return for ongoing payments (2.2).	2.1 Community asset transfer	Chapman's Pond Community Company	Cost avoidance/ reduction
		2.2 Public private partnership	Valley State Parks Camping Concession	Cost avoidance/ reduction
3. Voluntary contributions/ donations	Voluntary payments made of own free-will, whether a direct beneficiary of the NbS (3.2) or simply to contribute (3.1, 3.3)	3.1 Philanthropic contributions	The Living Danube Partnership	Funding: private
		3.2 Voluntary beneficiary contributions	Wild Haweswater - contribution	Funding: private
		3.3 Crowdfunding	Treflach Wetland UK – crowdfunding	Funding: private
4.Tradable rights/permits and payment for ecosystem services	Financing is raised by selling the 'rights' to ecosystem services generated by the NbS. This payment can be relatively informal (4.1) or through structured markets for climate mitigation (4.2), for offsetting damage to biodiversity elsewhere (4.3), or for reducing water pollutants (4.4).	4.1 Payment for ecosystem services	Vittel (Nestlé Waters) PES	Revenue
		4.2 Transfer-based instruments: voluntary carbon markets	MoorFutures	Revenue
		4.3 Transfer-based instruments: Biodiversity offsets and habitat banking	Eco-Accounts biodiversity offset Great Crested Newts 'District Licensing'	Revenue
		4.4 Transfer-based instruments: Water quality trading systems	Pennsylvania nutrient credit trading	Revenue

Main category	Category definitions	Instruments	Examples	Instrument type
5. Subsidies	Subsidies are a financial contribution from the government to a person, company or organisation to promote socially beneficial outcomes. They can be ongoing payments (or tax breaks) linked to outcome or production (5.1, 5.2)	5.1 Environmental subsidies	Ecofarm Petra Marada – CAP subsidies	Funding: public
		5.2 Tax concessions	Western Australia Conservation Covenant	Funding: public
6. Grants	Direct contribution from government (local, national, or EU) to a recipient in return for undertaking a specific activity. Grants are generally one-off payments (though they may be paid in instalments), and often competitive (6.1).	6.1 Grants	Hunte-Leda-Moorniederung	Funding: public
7. Debt instruments	Transfer of capital in return for a promise to repay that capital over time, generally with interest. This can involve direct lending from a lender to a borrower (7.1) or be mediated through debt markets (7.2).	7.1 Loans and green loans	Linnunsuo – Rewilding Europe Capital loan CWS Revolving Fund – Winona Wetlands	Debt/equity finance
		7.2 Bonds and green bonds	DC Water Environmental Impact Bond The Conservation Fund's Green Bond	Debt/equity finance
8. Equity finance	Financing raised by selling an ownership share of the NbS, potentially with a claim to some of its profits. This can be motivated by a desire to have impact (8.1) or be purely commercial (8.2)	8.1 Impact investing	Sumatra Merang Peatland Restoration Project	Debt/equity finance
		8.2 Commercial investing	Mill Creek Mitigation Bank	Debt/equity finance

One-off costs

The acquired data for one-off costs for each project was categorized into a few categories, presented in Figure 10.

The average allocation for design and planning across the 10 case studies is 17%, with a range from 1% (Water Friendly Farming, Leicester, UK) to 96.8% (Tommelen, Hasselt, BE). For the four case studies which report costs for land acquisition, this cost category marks most overall one-off costs, ranging from 66,3% for Fyn Islands, Odense, DK to 75,7% for Gete Vallei and Pikhakendonk in Belgium. Four case studies

report data for one-off equipment purchases, including Imrahor Valley with 34,9% of the overall one-off budget going to monitoring equipment, and Tommelen, Hasselt, BE at 3.2% and Water Friendly Farming, Leicester, UK at 1.6%. Construction and development is the highest category of one-off costs, with 49% on average, and a range from 3.3% in La Albera, Figueres, ES to 100% in Rhône de Verbois, Geneva, CH. For five case studies, construction and development accounts for more than 60% of their total one-off expenses. The average allocation for other costs is 12%, ranging from 1.8% (Pikhakendonk, BE and Gete Vallei, Tienen, BE) to 84.4% (La Albera, Figueres, ES). This category encompasses miscellaneous costs not covered by the previous categories, with La Albera, Figueres, ES, notable for its high percentage.

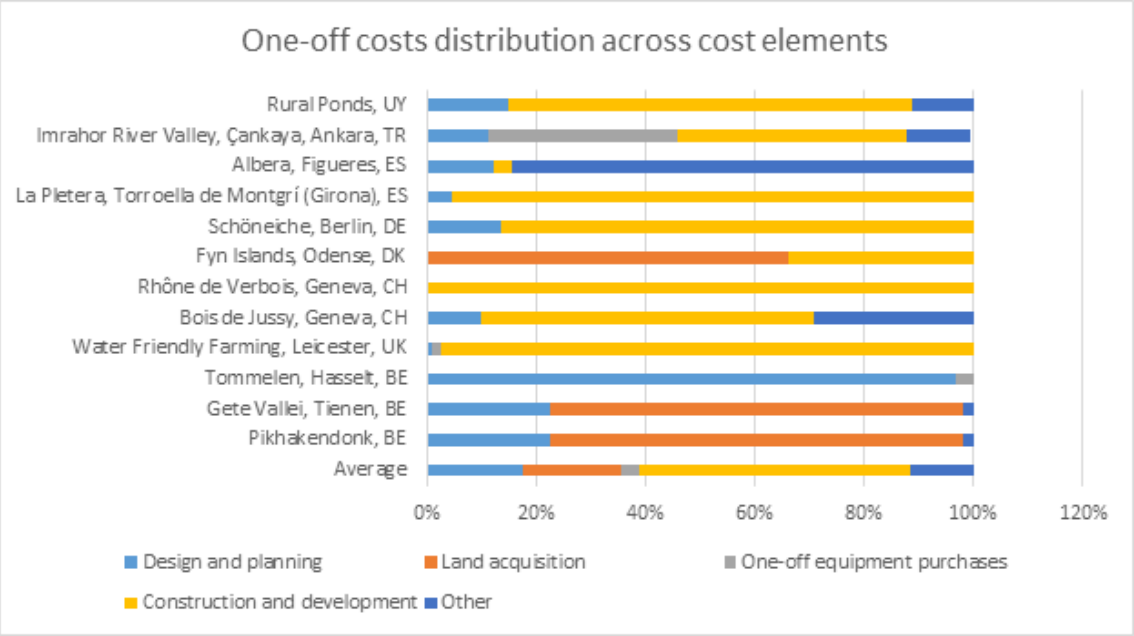

Figure 10. One-off costs for PONDERFUL pondscapes. Results are presented as percentage shares to enable comparison across different size pondscapes.

Ongoing costs

Ongoing costs for each project was categorised into categories presented on Figure 11.

Maintenance and operational costs are the highest ongoing cost for all but case study (Schöneiche, Berlin, DE). This cost category is the only one with data for all case studies. The average proportion is 72%, with a range spanning from a minimum of 8.70% in Schöneiche, Berlin, DE, to a maximum of 100% in Tommelen, Hasselt, BE, and Rural Ponds, UY. Depreciation costs, representing the diminishing value of assets over time, showcase an average for this category is 7%. Notably, Schöneiche, Berlin, DE, records the highest proportion at 73.30%, while a total of seven case studies demonstrates an absence of reported depreciation costs. Monitoring costs, encompassing activities related to assessing project

performance, display a diverse distribution across the case studies. La Pletera, Torroella de Montgrí (Girona), ES reflects the highest proportion at 19.1%, followed by Bois de Jussy, Geneva, CH, at 14.60% and Rhône de Verbois, Geneva, CH at 1%. All other case studies do not report any ongoing costs for monitoring costs. The average percentage for monitoring costs is 3% of overall ongoing costs. Visitor and stakeholder management costs, which pertain to efforts in engaging and accommodating project participants, vary notably among the case studies. Rhône de Verbois, Geneva, CH indicates the highest proportion at 32.4%, followed by Friendly Farming, Leicester, UK, at 17.50%. Fyn Islands, Odense, DK and La Pletera, Torroella de Montgrí (Girona), ES, report moderate levels at 11.8% and 10.7% respectively. Other miscellaneous costs, capturing expenditures not falling into the aforementioned categories, exhibit substantial diversity, ranging from 50% in Imrahor Valley and 48% in Albera, Figueres, ES to 7.6% in Rhône de Verbois, Geneva, CH, and 0% in four case studies. The average percentage for other costs is 13%.

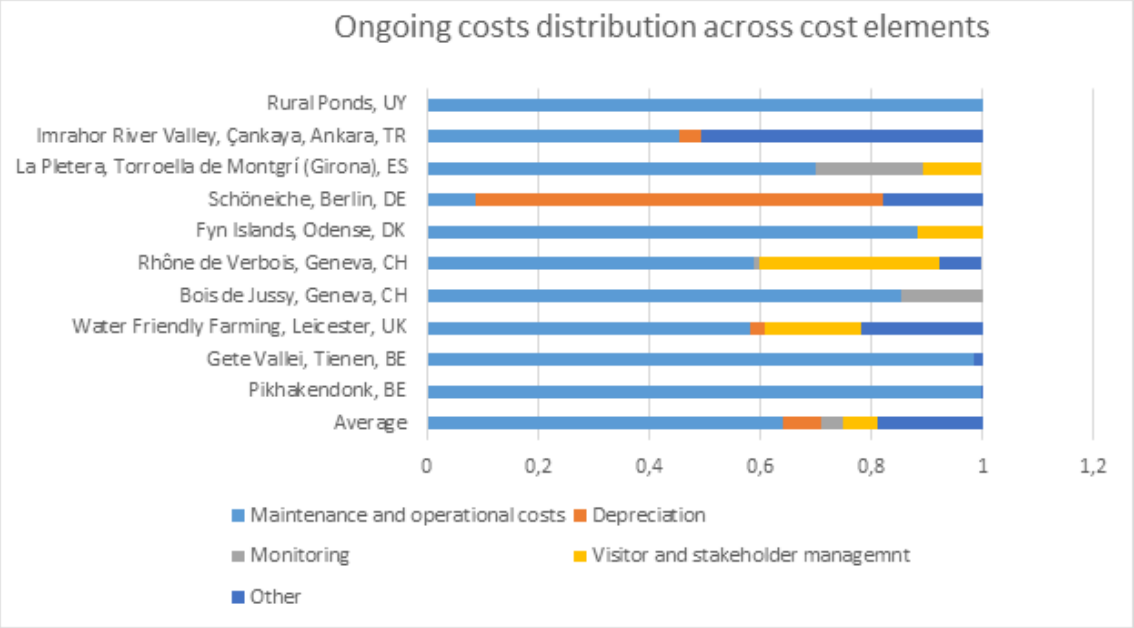

Figure 11. Ongoing costs for PONDERFUL pondscapes. Results are presented as percentage shares to enable comparison across different size pondscapes.

One-off to ongoing costs ratio

The one-off to ongoing costs ratio in project finance is not a standard financial ratio, but it can provide insights into a project's strategic approach to its expenditures. One-off costs are a project's major, long-term expenses, often yielding long-term benefits; ongoing costs are a project's day-to-day expenses, usually yielding benefits to a project within the next 12 months but not extending beyond that. The one-off costs to ongoing costs ratio can indicate how much a project is investing in long-term growth versus maintaining its current operations. A higher ratio might suggest that the project is investing more in long-term assets and growth, while a

lower ratio might indicate a focus on short-term operational efficiency or maintenance.

In the context of project finance, the one-off costs to ongoing costs ratio provides insights into the project's financial structure. For instance, a project with a high one-off cost to ongoing costs ratio might be a capital-intensive project with significant upfront costs but lower ongoing operational costs. Conversely, a project with a low one-off cost to ongoing costs ratio might have lower upfront costs but higher ongoing operational costs.

The average ratio of one-off costs to ongoing costs across all case studies is approximately 13.2, while the median lies at 7.7. The minimum ratio is observed in the case of Pikhakendonk, BE with a value of 2.2 followed by Lystrup, DK (3.28), and Tommelen, BE (5.2). Moderate levels include UY, rural ponds (6,25), CH, Rhone de Verbois (6,9), ES, La Albera (8.5), Imrahor Valley, TR (4.1) and BE, Gete Vallei (9,3). The maximum ratio is found in DK, Fyn, at 38.01. Other high ratios include UK, Water Friendly Farming (25.2), CH, Bois du Jussy (28.54), and DE, Schöneiche (22).

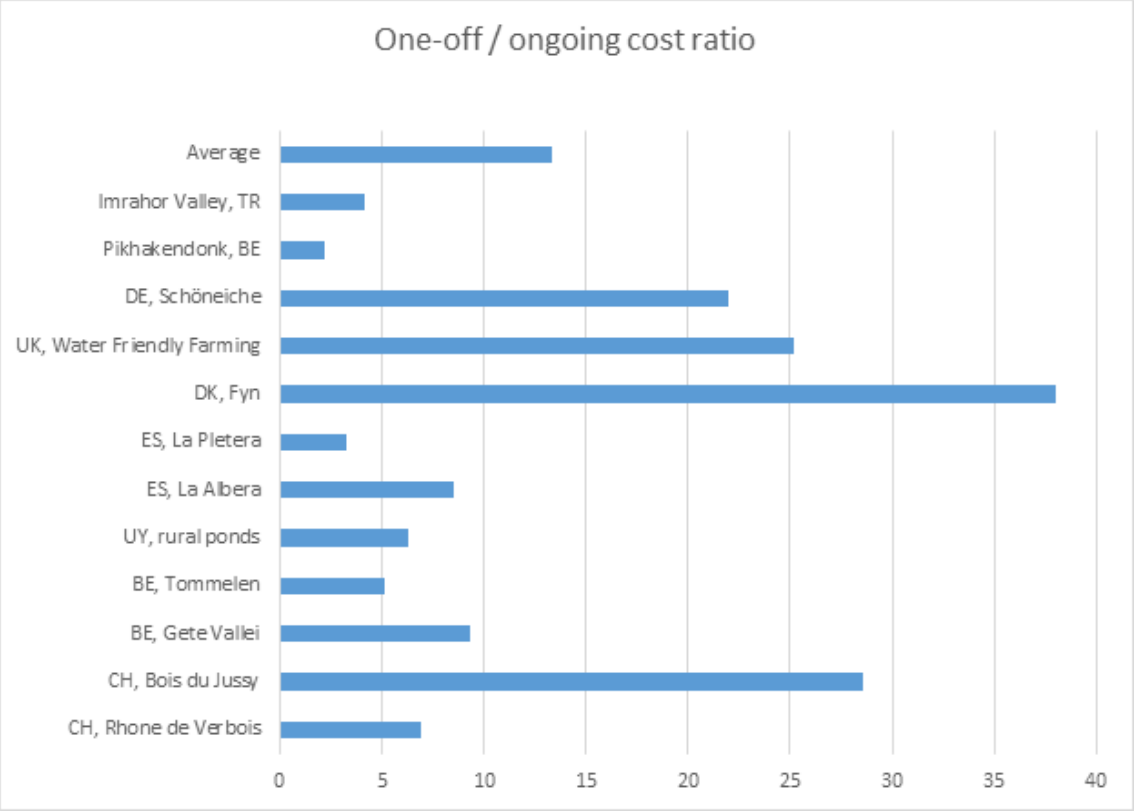

Figure 12. Ratio of one-off to ongoing costs in PONDERFUL pondscapes. High scores indicate that pondscapes report high one-off investment costs and low ongoing costs.

Benefits

DEMO-site leaders indicated the benefits of their pondscapes by assigning importance scores (0: not important; 1: somewhat important to 5: very important) to a set of benefit categories (see on Figure 13).

Habitat provision is the most highly valued benefit category, accumulating 55 points. This suggests a strong consensus among case studies regarding the importance of creating and sustaining habitats through freshwater pond NBS. Conservation value ranks secondwith 35 points, further underscoring the significance placed on preserving and protecting natural ecosystems within these projects. Recreation and well-being, with 32 points, represent another highly valued category, indicating that case studies recognize the importance of providing spaces for leisure and enhancing the well-being of communities. Water quality improvement, flood management, and education and research are moderately valued, with 16, 15, and 23 points, respectively. Groundwater recharge received zero points, indicating a potential lack of emphasis on this particular benefit category among the assessed case studies. The category of Participatory Planning and Governance received only 2 points, just like greenhouse gas sequestration and supporting identities. The benefit category of food and materials received a modest 5 points, indicating a relatively lower emphasis on the direct provision of resources for sustenance or material use compared to other benefits. Finally, perceptions among DEMO-site owners regarding GHGs sequestration benefits are surprisingly low. This seems to suggest that according to the pondscape project leads, GHG sequestration is a contested benefit type. Thus, highlighting that Ponds/pondscapes benefits in terms of justifying their implementation would primarily come from habitat provision, biodiversity and conservation value, and recreation.

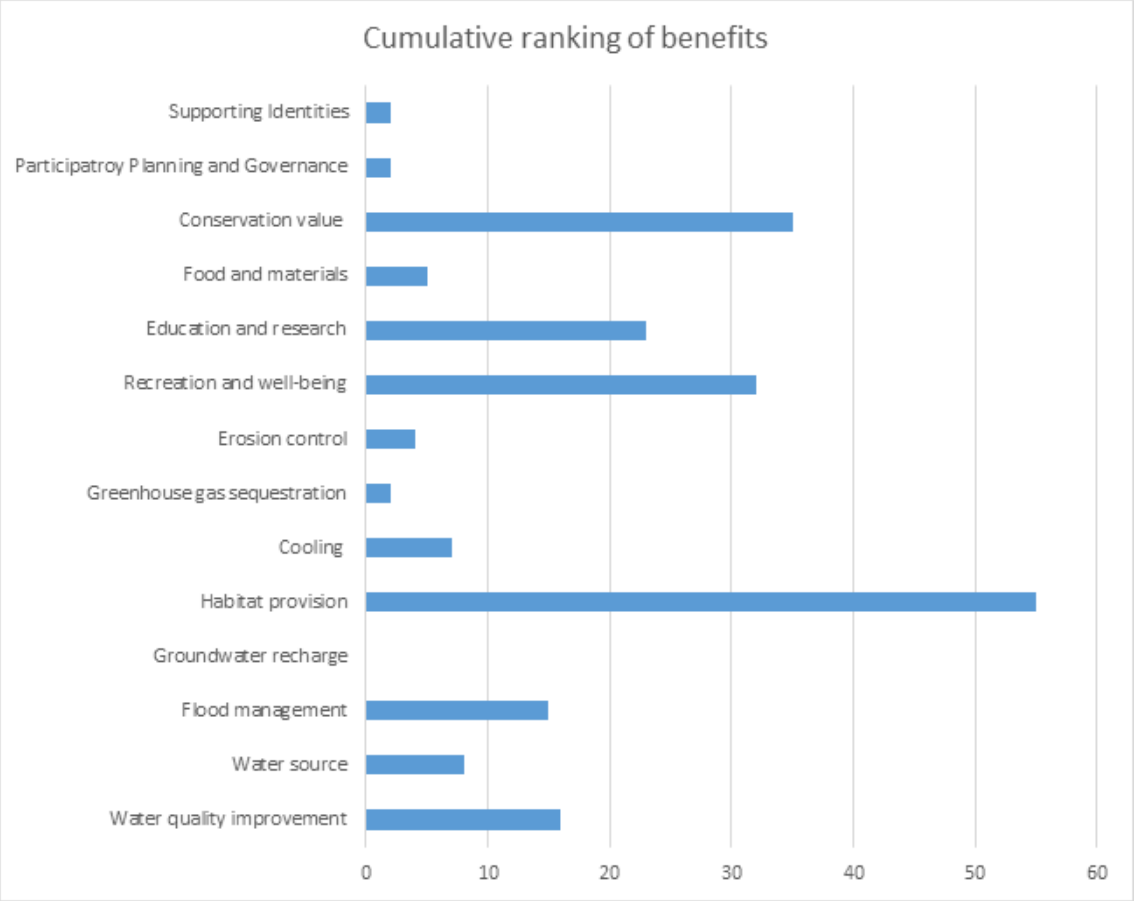

Figure 13. Benefits generated by PONDERFUL pondscapes, as reported by pondscape project leads (total reported scores across all pondscapes)

Financing instruments

User fees received positive responses for future applications and potential, with no instances of past utilization. Sale of market goods and services stands out with counts in all three categories, registering four instances of future application, two instances of potential future applicability, and one historical application. Conversely, business improvement districts, betterment levies, community asset transfer, and public-private partnerships demonstrate limited indications of future feasibility or past usage, with counts of zero or one in all categories.

Philanthropic contributions exhibit notable responses across all categories, with four instances of future application, three instances of potential future applicability, and four historical applications. Grants emerge as a dominant financing instrument, particularly noteworthy for its prevalence in historical applications, where it garnered nine positive responses, indicating its substantial role in funding pond NBS projects in the past.

The data also reveal a mixed pattern for voluntary beneficiary contributions, crowdfunding, and environmental subsidies, with varying counts across the three assessment categories. Notably, grants and philanthropic contributions seem to

play a pivotal role in past financing practices, suggesting a historical reliance on external funding sources. For each financing instrument, Figure 14 presents the sum of pondscape projects that have previously applied the instrument and the sum of projects who identified that such an instrument would be appropriate to apply in the future.

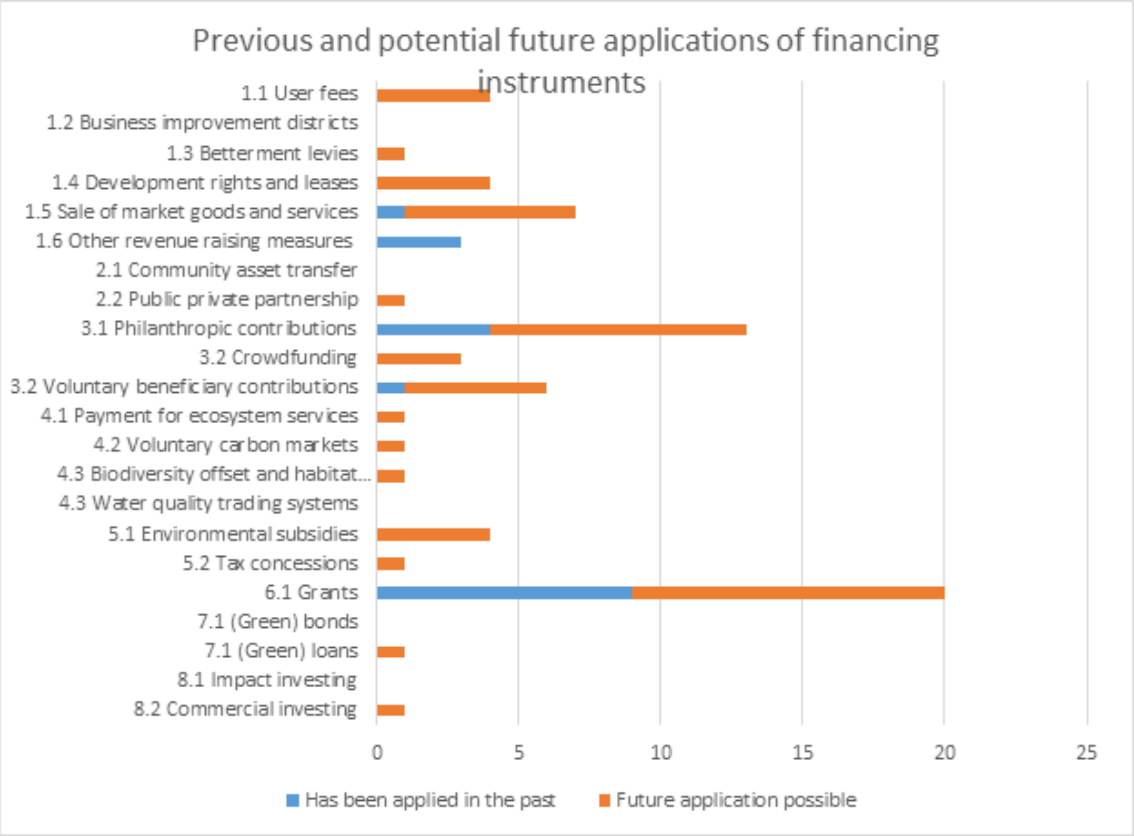

Figure 14. Count of existing and possible future financing instruments, summed across all pondscapes

2.5 Assessing the socio-economic benefits of ponds (Task 1.6)

2.5.1 Background/Rationale/introduction/RQs

The current literature on NBS describes several strategies that can be adopted to provide a variety of ES and NCPs. To support the potential role of ponds and pondscapes as NBS, it is therefore crucial to characterise the quality and quantity of benefits they might deliver, how efficiently they do so, as well as the perception that stakeholders have of such benefits.

To this end, we investigate several pondscapes, from different contexts, in terms of effectiveness and efficiency of socio-economic and environmental benefit delivery. We classify these benefits into criteria according to generally accepted frameworks found in the literature. Next, such criteria are quantified with the data collected at the pondscape level. Several variables describe both environmental and socio-

economic gains, providing a comprehensive picture of the pondscapes' contributions. Moreover, the involvement of experts, stakeholders, and the application of modern data analysis techniques allow for an overall assessment of the pondscapes' delivery capacity.

Lee and Lautenbach (2016) stated that socio-economic and environmental benefits do not always have a synergetic relationship. Because of this trade-off among different types of benefit, stakeholders' preferences should be considered when evaluating the success of implementing pondscapes as NBS. Otherwise, the NBS implementation could produce a mismatch between benefits and stakeholders' needs. Currently, there is no research on pondscapes as NBS involving stakeholders to evaluate benefits of pondscapes for the local area.

The insights on stakeholders' preferences allow for a more coherent assessment of the potential of pondscapes as NBS. Furthermore, any NBS bears some costs, these are the necessary inputs for the realisation, maintenance, and management of the strategy. Viewing these costs as inputs in a production process in a general form, the ES and NCP that NBS provide can be considered the corresponding outputs. After understanding which benefits pondscapes can deliver, and their extent, we provide an additional dimension for their evaluation in the form of efficiency. Efficiency in this case can be seen as the juxtaposition of the amount of inputs (costs) used and the amount of outputs (benefits) obtained. Comparing pondscapes in terms of efficiency, we generate a benchmark of best performing cases. This approach can also be replicated to compare pondscapes with other NBS, to explore our thesis that they can be efficient NBS for climate change mitigation and adaptation.

By carrying out this task, we provide an example of how the socio-economic benefits of ponds and pondscapes can be quantified, how stakeholders perceive the relative importance of environmental, social and economic characteristics of ponds as NBS, and how pondscapes can be ranked in terms of effectiveness as well as efficiency.

2.5.2 Choice of Criteria

To quantify pondscapes' potential to deliver benefits, the available benefit data must be organised in relevant ES and NCP criteria (categories). While the literature does not agree on a unique classification for the ES provided by NBS, our study proposes a solution that combines CICES (Haines-Young & Potschin, 2018), which has clear structures and definitions of provisioning and regulating services, with the classification provided by the handbook to evaluate NBS by the European Commission (2021), which elaborates the indicators and definitions in socio-

economic aspects.[2] The relationship between the MEA, the IPBES assessment framework, CICES and the EU Handbook is illustrated in Figure 15.

From this hierarchy, Vo et al. (2023) generated the classification presented in Figure 16 for the assessment of ponds. In a first step, ponds' contributions are categorised into environmental or socio-economic benefits. Next, these criteria are divided into a first level of twelve sub-criteria; three of which can be further divided in an additional second level of detail. We will limit our analysis to the first sub-criteria-level, since the second sub-criteria level is not complete.

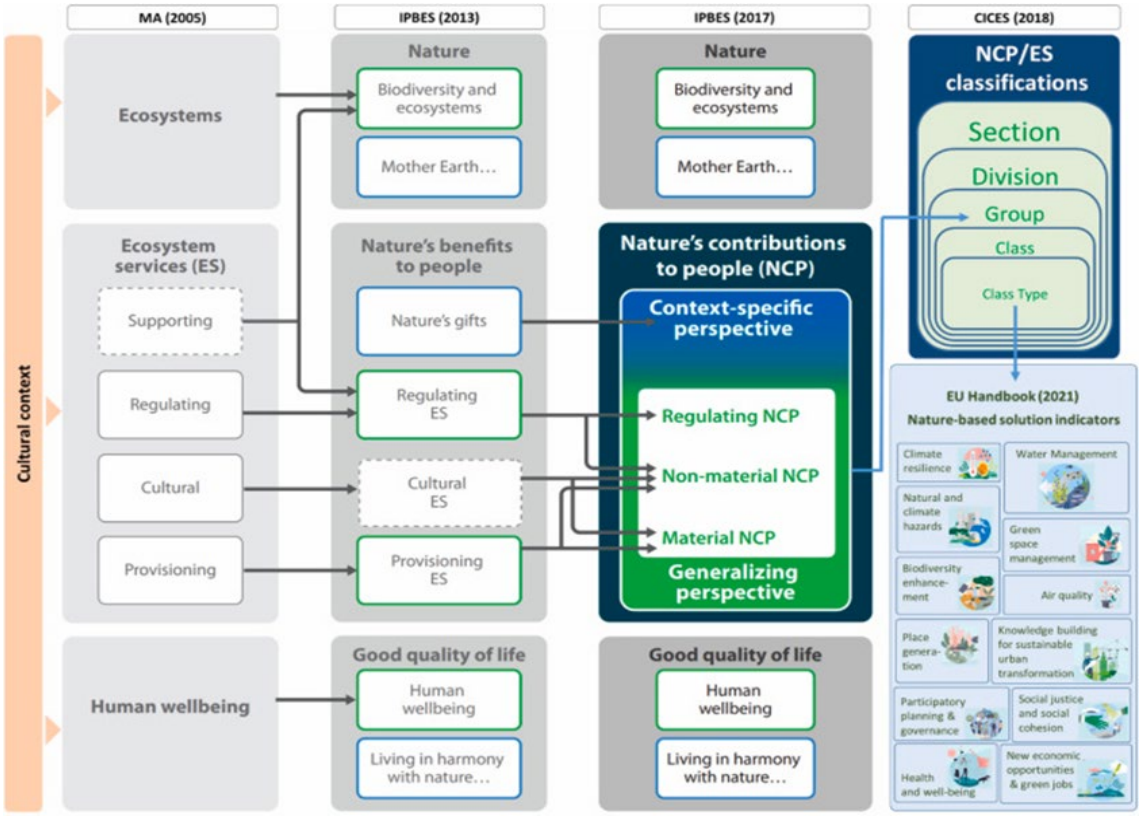

Figure 15. Relationship between MEA and IPBES assessment framework. MA (2005), IPBES adopted from Díaz et al. (2018). Photos of EU Handbook adopted from European Commission (2021). Source: Vo et al. (2023)

[2] A total of 12 sub-criteria are hypothesised. Once the definitive data will be available from the other WPs, we will be able to select which of these sub-criteria will become part of the final analysis

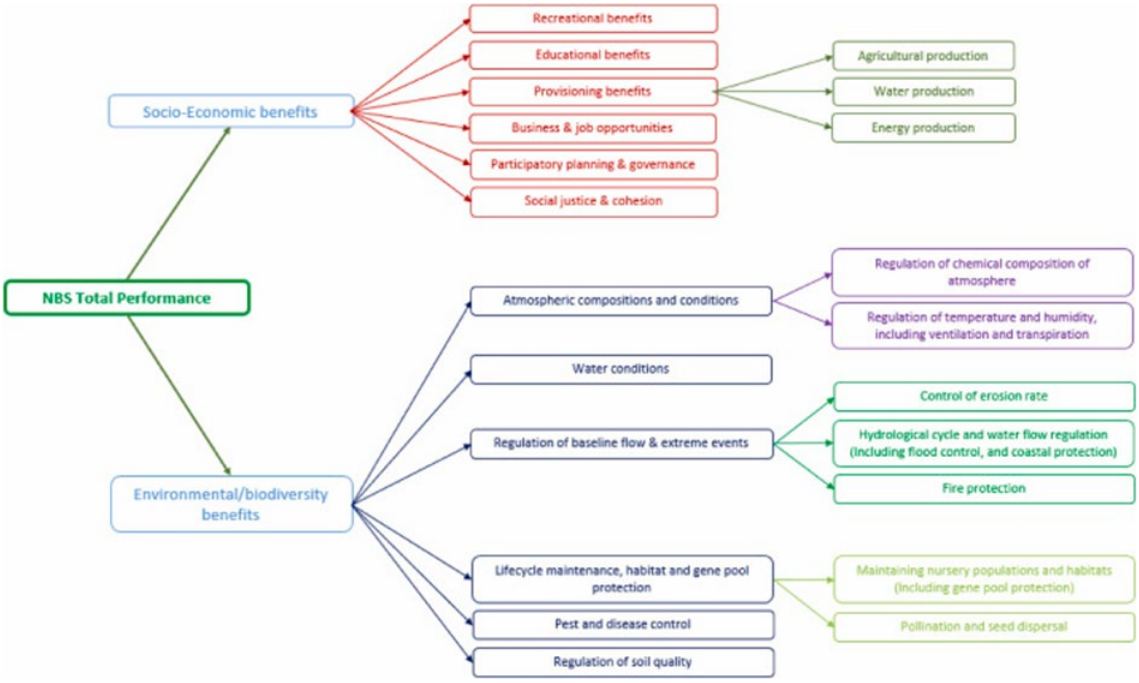

Figure 16. Classification model/hierarchy of this study. Source: Vo et al. (2023)

2.5.2 Methodology

Once matched with the above classification, the data collected within the PONDERFUL project are representative for 6 of the 12 sub-criteria proposed above. Specifically, these are Recreational, Provisioning, Business, Atmospheric, Lifecycle, and Pest contributions. Since multiple indicators are available for some of the sub-criteria, their values must be combined into aggregated scores. However, these indicators are often multidimensional, some quantify undesired outputs, and we have no prior knowledge on their relevance relative to each individual criterion. Therefore, we apply a directional Benefit-of-the-Doubt (BoD) aggregation method and generate a composite index for each sub-criterion (Rogge et al., 2017). These can then be used to compare pondscape performances.

Aggregating benefit data

The BoD method consists in an output-oriented Data Envelopment Analysis (DEA) used to combine multidimensional indicators into an aggregated score, when no prior knowledge on the contributing weights is available. The fundamental assumption is that different units prioritise different aspects (indicators) of the overall performance. Since a unique set of weights could be biased towards the characteristics of a specific unit, DEA endogenously estimates indicators' weights for each observation unit. This is the set of multipliers that maximises the overall performance of such a unit with respect to all others. Consequently, for each unit, higher weights are coupled with their best performing indicators, and lower ones with the least performing.

Effectiveness - Analytical Hierarchy Process

To coherently evaluate the pondscapes' effectiveness of benefit delivery, we need to integrate the stakeholders' preferences for such benefits. We adopt a Multi-criteria decision analysis (MCDA) in the form of a weighted sum. Specifically, we aggregate the previously determined sub-criteria scores according to stakeholder preferences determined through Analytic Hierarchy Process (AHP) (Bozali, 2020; Haile and Suryabhagavan, 2019; Bryan et al., 2011; Macedo et al., 2018). AHP assesses stakeholder preferences by pairwise comparisons of benefit sub-criteria, using a predefined scale from 1 to 9 to derive the importance of one criterion relative to another. Pairwise comparison is useful when the decision weights or utility functions are not known in advance (Ishizaka and Nemery, 2013). AHP can serve as the main research method to derive relative preferences for ES and NCP. Such assessment was originally carried out at the DEMO-site level, across all 12 classification sub-criteria. Therefore, we subsequently limit relative preferences to the 6 contribution sub-criteria represented in our data, and generalise them at the national level.

Efficiency - Data Envelopment Analysis

The evaluation of the pondscapes' efficiency is carried out with Data Envelopment Analysis (DEA). This is a non-parametric method to assess production efficiency, given a certain level inputs, even without prior knowledge on the transformation processes involved. As such, DEA offers the opportunity for an objective evaluation of pondscapes' benefit delivery efficiency. In our case, the Decision Making Units (DMU) under assessments are the social planners that coordinate the pondscapes implementations and management. Specifically, given the fact that decision makers can only control the inputs to a pondscape project (they cannot directly decide on the outputs delivered), input-oriented DEA is applied. Furthermore, we allow for variable-returns-to-scale to make the model less restrictive.

We measure inputs as costs incurred, while outputs are the benefits delivered aggregated at the first-classification level, to avoid the burden of dimensionality. In Cooper et al. (2007), the rule of thumb for setting the number of DMUs is given as #DMU = max(m*s; (m+s) * 3), where m and s are respectively the number of inputs and outputs considered. In our study, we are constrained by the number of available pondscapes for which we have input and output data (40). Consequently, when assessing pondscapes at the sub-criteria level (6 outputs), we can consider a maximum of 6 inputs, while there can be as much as 11 inputs when outputs are at the criteria level (2).

2.5.3 Data collection

The data on stakeholders' preferences were collected during on-site workshops, which brought together a total of 101 stakeholders from all eight project DEMO-sites, between October 2021 and March 2022. Most participants were actively involved in the management decisions regarding the pondscapes. For example, the stakeholders might be, but not limited to, landowners of the ponds, authorities, scientists working with those ponds, or representatives of non-governmental

organisations. A first phase of the workshops dealt with fundamental concepts of the PONDERFUL project, such as the definition of "pondscape", NBS, NCP, ES, and others. Then, the participants' expectations on pondscape development were assessed. Finally, they filled a questionnaire expressing their preferences for specific benefits of pondscapes as NBS, following the AHP methodology. By this time the stakeholders had received the necessary information to understand the topic and to have a coherent opinion on it. As described above, AHP preference data were subsequently adapted to the limited set of contribution sub-criteria represented in our data, and generalised at the national level.

Cost data for pondscape implementation were unfortunately not available within the project. Therefore, we resorted to proxy variables of pondscape characteristics that are linked to their cost of implementation, according to the scientific literature. Some of these proxy inputs are the number of ponds within a pondscape, the total water surface area, their median depth, and others. Benefit delivery was quantified through data collected within WP2 and WP1 of PONDERFUL.

2.5.4 Results

Stakeholder preferences

We have investigated the stakeholders' preferences for environmental and socio-economic benefits across pondscape. The AHP results provide a clear description of these preferences. Particularly, we can see that in all pondscapes environmental benefits are ranked the highest by stakeholders, with the exception of the Uruguayan ones, where provisioning benefits are favoured (Figure 17 and Table 5). Furthermore, some differences in stakeholder preferences exist between groups defined by gender and education (Figure 18).

The stakeholders' preferences closely reflect the purpose and characteristics of the pondscapes and the occupation of stakeholders involved. In the case of the Uruguayan DEMO-site, all the ponds are used for agricultural purposes (e.g., watering cattle) and are located entirely on private properties. Therefore, stakeholders of these ponds include farmers who own the land and technical public servants or policy makers aware of that purpose, thus it is not surprising that the provisioning benefits are most highlighted (Figure 17). In contrast, the European and Turkish DEMO-sites have been dedicated for conservation purposes or connected to various environmental programs, so the environmental services play a more important role in the perception of stakeholders.

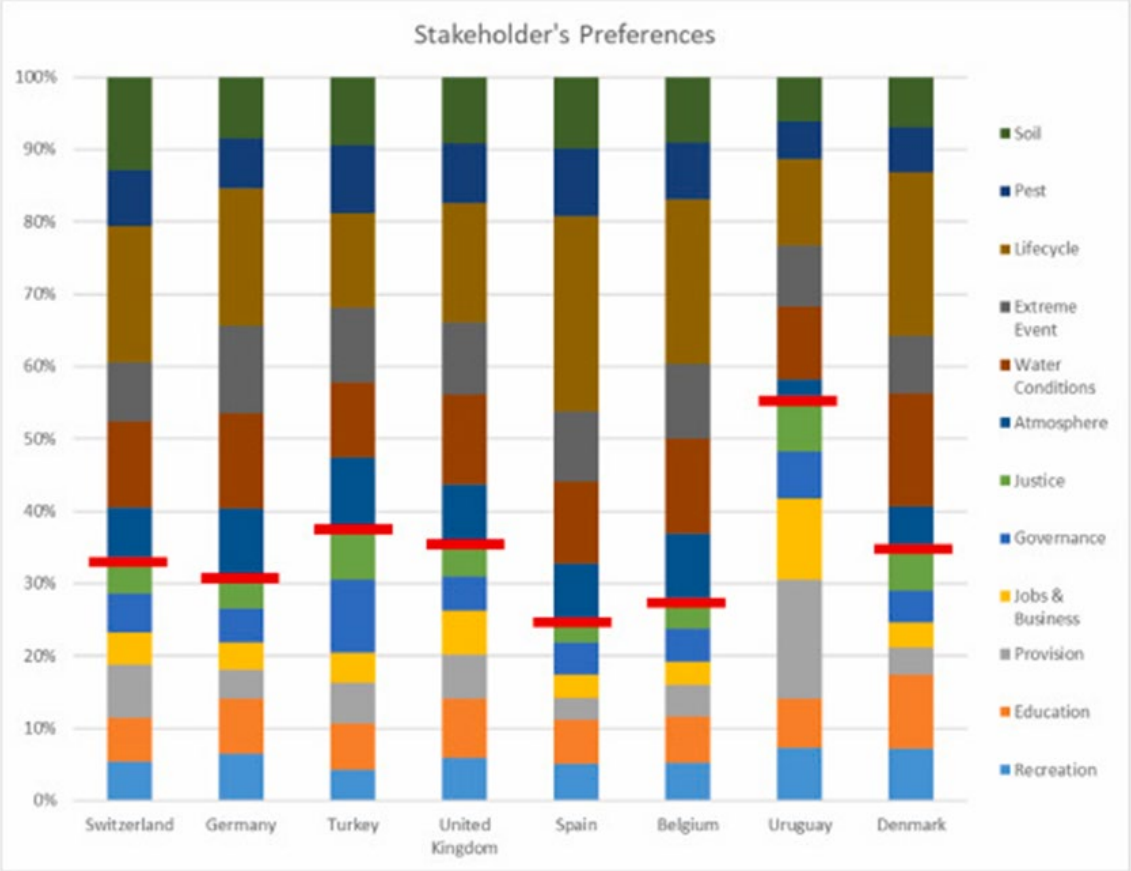

Figure 17. Stakeholder preferences for Socio-economic /below the red line) and Environmental (above the red line) contributions. Source: Vo et al. (2023)

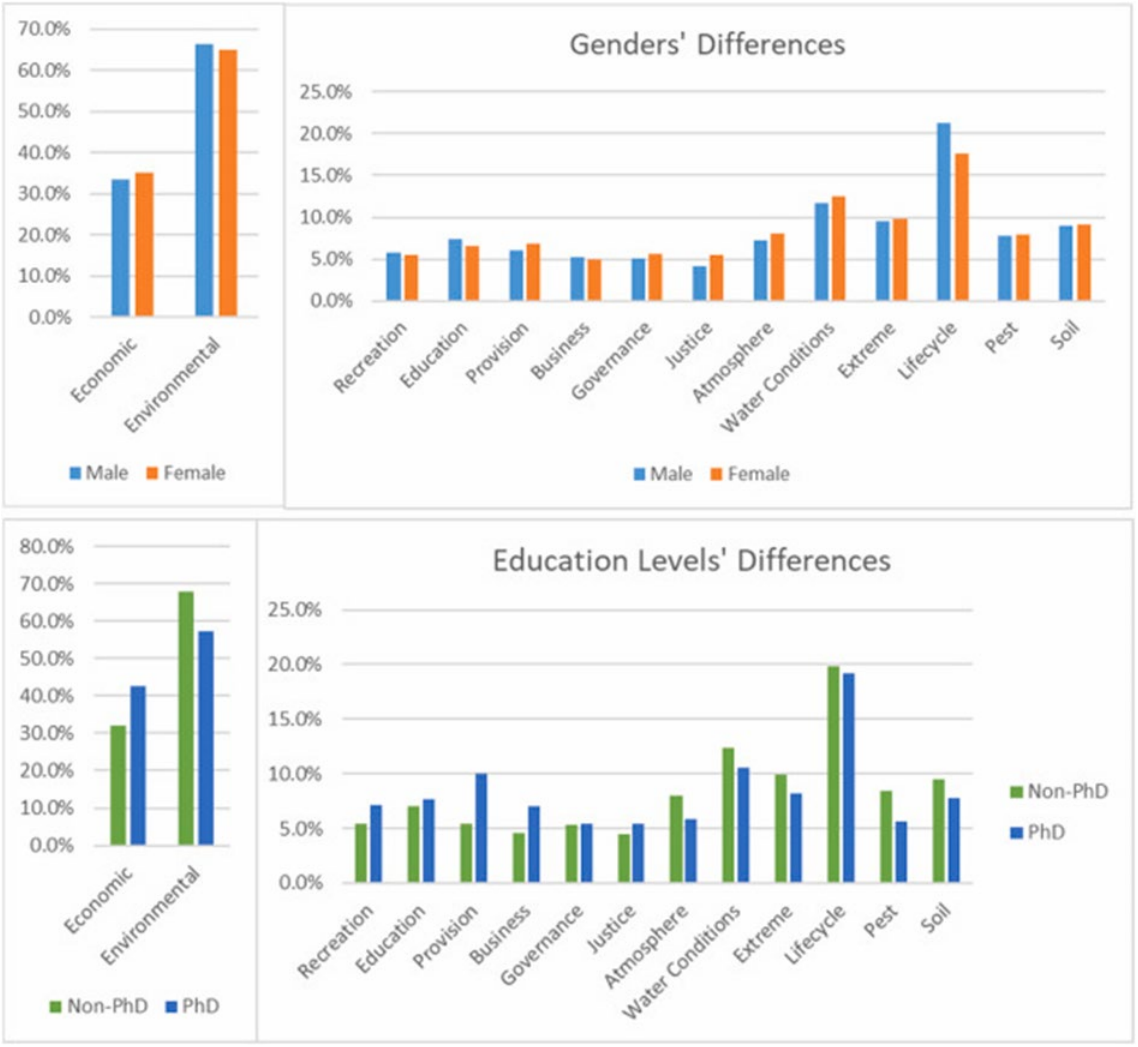

Figure 18. Differences from gender's and from education's perspective. Source: Vo et al. (2023)

Table 5. Stakeholder group aggregation by preferences for several contribution sub-criteria

	Recreation	Education	Provision			Jobs & Business	Governance	Justice	Atmosphere		Water Condition	Extreme Event			Lifecycle		Pest	Soil
			Agriculture	Water	Energy				Chemical	Physical		Erosion	Flood	Fire	Nursery	Pollination		
CH	5.4%	6.1%	7.4%			4.3%	5.5%	4.2%	7.6%		12.0%	8.1%			18.8%		7.8%	12.9%
			2.2%	3.4%	1.8%				3.7%	3.9%		2.8%	3.0%	2.3%	13.5%	5.3%		
DE	6.5%	7.6%	4.0%			3.7%	4.7%	4.5%	9.3%		13.2%	12.1%			19.0%		6.9%	8.5%
			1.3%	1.9%	0.8%				3.0%	6.3%		2.7%	5.6%	3.8%	12.5%	6.5%		
TU	4.3%	6.3%	5.8%			4.1%	10.2%	7.2%	9.5%		10.4%	10.4%			13.0%		9.3%	9.5%
			2.0%	2.1%	1.6%				4.7%	4.8%		3.3%	4.7%	2.4%	7.0%	5.9%		
UK	5.9%	8.2%	6.1%			6.1%	4.6%	4.4%	8.3%		12.4%	10.0%			16.5%		8.2%	9.2%
			2.2%	2.4%	1.5%				4.1%	4.2%		2.9%	5.0%	2.2%	10.4%	6.1%		
ES	5.1%	6.0%	3.1%			3.2%	4.5%	3.1%	7.8%		11.2%	9.8%			27.0%		9.3%	9.9%
			1.1%	1.3%	0.6%				3.3%	4.5%		2.6%	4.2%	3.0%	18.8%	8.2%		
BE	5.2%	6.5%	4.4%			3.1%	4.5%	3.7%	9.4%		13.1%	10.4%			22.6%		8.0%	9.0%
			1.4%	1.9%	1.1%				3.9%	5.5%		3.0%	5.2%	2.3%	16.5%	6.1%		
UY	7.3%	6.9%	16.4%			11.2%	6.4%	6.7%	3.3%		10.1%	8.3%			11.9%		5.3%	6.2%
			8.1%	5.8%	2.5%				1.2%	2.1%		1.9%	4.1%	2.3%	7.4%	4.5%		
DK	7.2%	10.1%	3.7%			3.5%	4.4%	5.5%	6.1%		15.7%	8.0%			22.4%		6.2%	7.0%
			1.0%	1.7%	1.0%				2.6%	3.5%		2.4%	3.6%	1.9%	15.7%	6.7%		

Note: Stakeholders' group of demo-sites in CH: Switzerland, DE: Germany, TU: Turkey, UK: United Kingdom, ES: Spain, BE: Belgium, UY: Uruguay, DK: Denmark.

Source: Vo et al. (2023)

Quantification of contribution criteria

The aggregation of contribution data with the Benefit-of-the-Doubt method allows us to quantify multi-dimensional performances, without making *a priori* assumptions on the importance of each variable. We carry out the aggregation at two separate levels, criteria and sub-criteria, to provide additional insights on pondscape characteristics. Detailed results can be found in D1.5.

Effectiveness

Our analysis identifies which pondscapes are most effective in delivering the benefits that the stakeholders prefer. Highly effective pondscapes excel in ecosystem services (ES) and nature's contributions to people (NCP) relevant to their social context. For example, Uruguayan pondscapes which deliver a high amount of provisioning benefits are considered quite effective, given their destination of use. However, given the environmental inclination of most European stakeholders, here consistently top-ranked pondscapes excel in sub-criteria like Lifecycle and Recreation. Lower-ranked pondscapes provide only few of the relevant sub-criteria benefits, and/or focus instead on contributions that are not interesting for the local stakeholders.

Efficient and effective pondscapes

The DEA results highlight some specific pondscapes that are particularly efficient in delivering contributions, given their available inputs. Once we look into the outcomes of the MCDA analysis for such observations, we obtain a final subset of effective and efficient strategies. These are the pondscapes that are able to fulfil the stakeholders' needs in the most efficient way, and thus can be considered as successful examples by decision-makers wanting to implement pondscapes as NBS, in similar contexts.

3 PONDERFUL Framework

The studies conducted within WP1 shed light on the social, policy, financing, and economic context of ponds and pondscape NBS. Such investigation is important to provide necessary context when planning creation, restoration, or management of ponds/pondscapes as NBS.

In this section we present a refined PONDERFUL Framework, i.e. we build on Deliverable 1.1 and the experiences from the WP1 work in PONDERFUL project to capture lessons learned about key barriers and opportunities for implementation of ponds and pondscapes as NBS. The ultimate aim is to provide recommendations both for assessing pondscapes and associated relevant NBS and for improved implementation of ponds/pondscape NBS.

The Framework was refined based on two main types of inputs:

1. Insights of the project partners responsible for leading particular tasks – written inputs to the Deliverable, and discussion on the WP1 meetings

2. Insights of the DEMO-site teams who conducted large parts of the work on the ground – workshop organised in October 2024 at the PONDERFUL meeting, and written inputs to the Deliverable.

Key lessons learned from the main tasks in the WP1 of the PONDERFUL project, as well as the recommendations include:

1. Summary of lessons learned and recommendations from the organisation of stakeholder workshops (section 3.1);
2. Lessons learned and recommendations on the methodological aspects of the work, i.e. refined Assessment Framework (Deliverable 1.1) that constitutes the final PONDERFUL Framework. The recommendations are aimed at supporting the future assessments of social, policy, financing and economic context of ponds and pondscape NBS (section 3.2); and,
3. General recommendations for better implementation of ponds and pondscapes NBS, considering the social, policy, financing, and economic context (section 3.3).

3.1. Summary of lessons learned and recommendations from the workshops

General lessons learned and recommendations from the organisation of stakeholder workshops (Task 1.2) is presented in Deliverable 4.4. Below is just a short summary of key recommendations/lessons learned.

Firstly, organising workshops for a project focused on ponds as NBS highlights the challenge of balancing scientific goals with local stakeholder needs. Participants, in particular stakeholders without a scientific background, often struggle to grasp complex concepts like NBS, NCP, and “pondscapes”. Without clear definitions from the start, engagement can suffer. Likewise, discussions about the difference

between natural and existing ponds confused some participants, raising questions about whether existing ponds should be classified as “new”. Such academic distinctions can feel obscure to stakeholders more concerned with practical issues.

Another key tension lies between generating broad, generalizable data and addressing site-specific concerns. Each pond and its surrounding landscape are unique, making it difficult to apply universal assessment criteria. Managing existing ponds differs from creating new ones, and priorities shift depending on whether the focus is on individual ponds or larger pond networks. This complexity makes it challenging to develop research approaches that are both rigorous and locally relevant.

To address these conflicts, future workshops should clearly define scientific terms, balance research goals with local concerns, and focus on site-specific issues to ensure stakeholders understand the value of their contributions. In addition, results gathered throughout the project should be ‘fed back’ to stakeholders at workshops, so that stakeholders do not feel as if information was only extracted from them. Ultimately, it should be remembered that the workshop is first of all for the stakeholders. This approach should increase motivation to participate and is expected to help generate both scientifically valuable and locally meaningful results.

Secondly, and closely related to the first point, a key challenge in organizing workshops for pond-related NBS is balancing the needs of local stakeholders, focused on small-scale, site-specific issues, with those of higher-level stakeholders concerned with broader regional, or even national, goals. Ponds, being small in scale, make it difficult to generate insights that apply across regions. Local stakeholders, such as farmers and landowners, prioritize immediate land impacts, while higher level stakeholders focus on wider environmental and policy implications, potentially creating tension in discussions. Getting senior decision-makers, legislators, and managers to participate in detailed-focused workshops is particularly challenging, as they often perceive such discussions as the responsibility of their staff, even though their perspectives are key in decision-making.

Each pond and site have different needs, complicating the identification of the most important aspects in generic terms. Contextual considerations regarding policies, funding, outreach, and actual NBS action are crucial, as priorities depend on the scale and type of pond NBS. Many stakeholder inputs were site-specific, while broader themes—such as improving education, securing funding for pond NBS, and enhancing pond connectivity—applied across multiple pondscapes. However, finding common solutions was generally difficult due to the unique conditions of each location.

Future workshops could address these challenges by dividing sessions by stakeholder focus or inviting participants to attend only the parts most relevant to them. While this would improve engagement, it would also impose an additional

burden on the project team, requiring more planning, resources, and coordination to meet the diverse needs of each group. Nevertheless, this approach could lead to more effective workshops and productive outcomes.

Thirdly, the limited time available creates a conflict between generating comparable data across cases and fostering open, free-flowing conversations among stakeholders. While strict timetables are necessary for conducting planned research activities, they can hinder meaningful exchanges. Additionally, stakeholders must see tangible results from previous workshops and ongoing project work, requiring sufficient time at the beginning to present these outcomes, which further constraints available time.

To navigate this contradiction, careful planning is essential, along with skilled moderators who can balance time constraints and address the needs of both researchers and stakeholders. There is no point in squeezing all the activities into a few hours in a conference room. Conducting some individual activities, such as questionnaires or interviews, before the workshop could free up valuable time for collective activities and enhance discussion quality. However, encouraging stakeholders to participate in project-related activities outside of workshops can be challenging unless those activities are quick and straightforward. Some stakeholders also expressed that they would have preferred meeting at the pond/pondscape site, and having a more dynamic workshop while visiting the site. This could offer more possibilities for participants to express their opinions and thoughts while they experience a place which they know. This could foster better outcomes and also more spontaneous ideas, coming from the stakeholders that have a personal relationship with the pond/pondscape at stake.

Overall, from a researcher's perspective, workshops provide significant value by identifying additional data and information critical for successful pondscape NBS. They facilitate discussions around policy implementation, desirable development scenarios, and the evaluation of costs and benefits, leading to a more comprehensive understanding of the context in which these solutions are applied. Feedback from stakeholders enhances the quality of research by deepening contextual understanding, providing researchers with insights into the barriers that need to be addressed.

From the participants' perspective, the workshops hold the potential for valuable gains, although concrete data is lacking to substantiate this. Stakeholder contributions can clarify competing interests and potential trade-offs, potentially supporting pond implementation efforts. While it remains speculative, these workshops may also enhance stakeholder knowledge and understanding of ponds, contributing to the mainstreaming of pond management practices in their communities.

3.2 Assessing ponds and pondscapes – lessons learned and recommendations

The work within WP 1 revealed different methodological challenges involved in the assessment of, in relation to data gathering and analysis (Table 6).

Table 6. Methodological challenges involved with data gathering and analysis of different tasks of PONDERFUL.

Task	Data gathering	Data analysis
1.3 Social analysis	The NCP concept can lead to confusion Contributions of pondscapes to society are subjective Different local contexts make it difficult to conduct standardised assessment It is challenging to gather enough data from social surveys	It is vital to consider the opinions of both local residents and stakeholders and analyse the potential divergences Mix closed questions with open-ended ones allows to get more in-depth information.
1.4 Policy analysis	SH mapping is a useful first step to gather information about SH, their power and interest. Desk study is a good start but needs to be complemented with local data and analysis. Gathering data on a workshop saves time and enables SH interactions, but can be at expense of data depth.	There are trade-offs between the high-level national/regional and local analyses Barriers/enabling factors are heavily intertwined
1.5 Sustainable financing	Different financial accounting systems are in place There is both a lack of finance data and lack of consistent in methods for data collection at the pond and pondscape levels Costs of pondscapes creation, restoration and management can differ a lot	Calculating the monetary value of non-financial costs are most challenging Multiple actors are involved, with costs spread across multiple actors and their budgets There is a significant uncertainty in how/to what extent pondscape NBS will effectively address societal challenges

Task	Data gathering	Data analysis
	Many stakeholders are not involved in financing It is difficult to bring in opportunity costs	There is absence of a clear delineation of pondscape boundaries
1.6 Socio-economic analysis	The definitions of benefits and their classifications are not consistent There is a trade-off between collecting local in depth insights or covering larger areas	To compare relatively heterogeneous data in a statistically sound manner requires a very well-planned data collection campaign The difference between NDB effectiveness and their efficiency need to be considered

Social analysis
The work done for the social analysis indicates that the NCP concept can lead to confusion. This term was unclear to both stakeholders and some of the consortium members. It seems that the concept of NCPs is too academic and not adapted to the general society. Particularly, the NCP "Maintenance of options" was prone to different interpretations. While the Handbook developed during the project clarifies the NCPs, it was not available at the time of the interaction with the stakeholder. In relation to that, we suggest that one should tailor the questions in surveys and at the workshops specifically to the information one wants to elicit and there is no need to complicate matters unnecessarily by using jargon or academic terms.

Moreover, what contributions pondscapes provide to society can be seen as rather subjective – they depend on the beneficiary and local context. Because of that, it is important that any assessment of societal benefits from pondscape NBS should involve a diversity of stakeholders at different governance levels. At the same time the different contexts pondscapes represent make it difficult to conduct a standardized assessment that would enable comparisons between several pondscapes and the NCPs they deliver.

It can also be difficult to gather enough data from surveys to citizens, so different ways of distributing the surveys need to be considered, e.g. street surveys. In general, it is very important to have surveys for both stakeholders and citizens, if one wants to get a comprehensive view on what benefits from a pondscapes are important. Stakeholders usually have fairly clear ideas about the ecological status, NBS and NCPs of the pondscapes studied, while citizen perceptions may depend more on their personal values, and emotions. Insights from both types of survey

help to have a full picture of what is important in the area. It is also good to mix open ended questions with closed questions, to get more in-depth information.

Policy analysis

To set a scene for the policy analysis stakeholder mapping is a useful first step to gather information about stakeholder, their power and interest. We suggest that mapping stakeholders systematically helps ensure that they are representative for particular NBS context. Stakeholder mapping can also enhance understanding of priorities and motivations of different stakeholders, including who could block NBS implementation and why.

Our work has shown that a desk study is a good start for policy analysis, but needs to be complemented with local data and analysis, and specifically, practical insights from stakeholders. Possibly, although it may seem counter-intuitive, it could be useful to select a smaller sample of policies through an early policy mapping. These could then be thoroughly assessed through frequent interactions with stakeholders throughout the project.

Data from stakeholders was gathered at a workshop, saving time relative to potential interviews and enabling interactions and exchange of knowledge among different types of SH at various governance levels. However, where feasible, interviews can facilitate gathering of more in-depth information that is not possible at a workshop.

It is important to consider in the policy analysis that there are trade-offs between the high-level national/regional and local analyses. Thus, it is useful to use the two-pronged approach. The high-level analysis focuses on overarching policies and trends that affect a wide geographic area, offering general insights into barriers and enabling factors at the national or regional level. Meanwhile, the local-level analysis examines specific contexts, allowing for 'groundtruthing' of these broader findings by looking at how policies are implemented on the ground and capturing the unique challenges or opportunities at the local scale. However, such an approach adds complexity and makes comparisons difficult.

Finally, barriers and enabling factors, assessed during policy analysis, are heavily intertwined. These interactions are important to be accounted for, as strategically addressing them is fundamental for transformative change.

Financing analysis

We have found out that pondscape projects apply different accounting systems with no consistent approaches, lack of standard practice, lack of accounting expertise, which makes the assessment of costs and benefits difficult. There is also lack of data and lack of consistent methods for collecting data on benefits generated by pondscapes, which is challenging particularly because the costs of creation, restoration, and management can differ a lot. Absence of a clear

delineation of pondscape boundaries further challenges cost estimations. In addition, multiple actors are involved, with costs spread across multiple actors and their budgets. As not many stakeholders are involved in actually financing, it is important to contact specific individuals when gathering data on the costs.

Moreover, there is a significant uncertainty in how and to what extent pondscape NBS will effectively address societal challenges, making estimation of benefits difficult. Particularly, it is very challenging to calculate the monetary value of non-financial costs (e.g. opportunity costs of land). Thus, there is a need to how to bring in opportunity costs in the future work

Socio-economic analysis
One of the key challenges in this task was that definitions of benefits from NBS and their classifications are not consistent. Thus, a more structured and agreed classification is important in any future economic analysis. There is also always an important trade-off between collecting in-depth insights from all possible stakeholders of a few locations, or less data across several heterogeneous sites. When resources are not available for extensive data gathering, a more targeted data gathering campaign could focus on several selected sites.

When it comes to analysis, it is important to remember that to compare relatively heterogeneous data in a statistically sound manner requires a very well-planned data collection campaign.

Finally, it is important to remember a difference between NBS effectiveness and their efficiency. Effectiveness is about to what extent a particular benefit can be delivered for the NBS, which is different from how efficient this particular NBS is in delivering the particular benefit.

In conclusion, commonalities for data gathering and analysis across tasks concern the following matters: on the one hand, there are challenges regarding collecting consistent or representative data, whether through surveys, policy mapping, or financial assessments. This is compounded by the challenge to involve a diverse set of stakeholders to gather comprehensive insights, from citizens and experts to decision-makers and financiers. On the other hand, it is difficult to align the requirements of broad and local analyses, as well as compare diverse data or contexts, especially due to the heterogeneous nature of pondscape benefits, costs, or policies.

3.3. Insights for improved implementation

Trust building and mitigating conflicts
There is a wide range of stakeholders and benefits that they may value, some of them potentially in conflict with each other (e.g., regarding land use, pond design

and management, etc.). As such, we recommend that the implementation of pondscape NBS should follow a co-design approach (Chambers et al. 2021), where the needs and perceptions of the different stakeholders are explored and translated into commonly acceptable actions. To facilitate that it would be useful to produce, together with stakeholders, different scenarios on e.g., changes in land use, pond creations/restoration for the future of pondscape (going beyond expert-created scenarios) to support transparent and well-informed decisions. In addition, it is crucial to build confidence and foster trust between researchers and stakeholders over a longer time to develop long-term strategies for the area.

Improving policies

The insights from our policy work suggest that there is a general need for improving policies on NBS, and particularly with regard to small water bodies such as ponds. Stronger binding regulations for ponds and pondscapes are needed at EU level. This could be done as part of protected areas or by incorporating considerations for ponds into CAP or WFD. At the same time, there is a need for better financial mechanisms, to increase financial compensation for landowners implementing NBS.

At the local level the protected areas could be expanded to pondscapes, which could facilitate acquiring funding for the NBS. Comprehensive, integrated NBS plans which consider ponds and pondscapes would also be an important tool for better implementation of ponds. As landowners are crucial players when it comes to pond NBS implementation, stewardship agreements with them should be supported. In addition, outreach to private stakeholders about the benefits of pond(scape) NBS and guidance on how to create, restore, or manage them are necessary.

Finally, to simplify management and monitoring of pond NBS, it can be useful to group ponds into larger groups or units.

Financing of ponds

Private finance may not always align seamlessly with environmental projects like ponds and pondscapes, where the benefits are often ecological rather than financial. To upscale private finance there is a need for the establishment of relevant markets for environmental goods (e.g., biodiversity credits; carbon credits; payments for ecosystem services). Pondscapes could also be deliberately incorporated into profitable landscape projects. While private financing is desirable, initial public investments might be necessary in many cases. With regards to that a supportive regulatory and legal framework is necessary.

Costs of pondscapes creation, restoration, and management can differ a lot depending on local context, which is important to consider. In relation to that, robust stakeholder relationships, active participation, effective leadership, and

meticulous planning are necessary for adjusting to the local context and achieving success in integrated landscape management.

While financing is important, some practical challenges that pond managers and developers face go beyond financing. In some cases, funding may be available, but is not being used, because landowners do not want to implement ponds. The reasons for that can be: lack of full coverage of the costs by the funding, limited information, lack of technical expertise or bureaucracy, which leads to delay between application and getting money, constituting a barrier to apply for existing funding. Another widespread challenge towards not implementing ponds is the misconception of pond construction being relatively more expensive than for example installing pathways. Such a comparison is subjective to logistics and parameters, which can be used as a tool to convince, for instance, municipalities and private land owners to make decisions backed by the parameters, in case the incentive to increase biodiversity does not suffice.

As such there is need for the funds to cover 100 % of ponds implementation costs and supporting landowners through the whole process. It is also important to ensure quality of the outcome – for that there is a need to have people on the ground. This shows that to implement ponds and pondscapes NBS the whole "package" is needed – i.e. it is not sufficient to provide financing and wait for results, but many other factors need to be considered.

Finally, new markets could be developed to support pondscape NBS, as e.g. carbon or biodiversity markets. There is a need for high quality carbon mitigation that is quantified and more evidence is still needed for that. Also, as biodiversity is the biggest benefit from ponds, development of biodiversity credits system linked to ponds seem as potential tool for better financing of these NBS. However, such credit system needs to be designed with caution to avoid potential "greenwashing". However, with the standardisation of ponds such as CLIMA-ponds developed in PONDERFUL, greenwashing can be avoided due to the concrete parameters and guidelines that ensure the benefitting of native biodiversity and, for example, the application of indicator species as a condition to fulfil biodiversity criteria.

Socio-economic assessment

The socio-economic assessment of the benefits from ponds as NBS is necessary to measure their performance. In such an analysis, it is important to distinguish between NBS effectiveness and efficiency (see definitions of these two concepts in section xx), and reflect on which stakeholders are the subject of investigation.

In general, comparing the two measures can be useful as either an *ex ante* decision tool (using local SH preferences), or for an *ex post* assessment of impacts (assessment of performance). A policy maker having to decide on a specific NBS

could assess the preferences of its local stakeholders, and use them to weigh the contributions of the available options. The result would provide insights in support of the measures with the highest potential benefits for the local context. On the other hand, whenever several comparable NBS are implemented, the use of our framework allows their comparison in terms of effectiveness and efficiency, either from a shared perspective (a shared set of SH preferences), or with a local perspective (each measure's performance assessed through the local SH preferences). The results of both applications can differ depending on whose perceptions are used. For example, local stakeholders may be interested in provisioning NCPs, while higher level stakeholders may care more about GHG sequestration to mitigate climate change – and thus the effectiveness of particular pondscapes in delivering the benefits will differ depending on the benefit in focus.

4 Looking ahead

Our research on social, policy, financing and socio-economic issues linked to pond and pondscape NBS have revealed useful insights into how to apply the different assessment methodologies and how to support broader implementation of ponds and pondscapes NBS. Below we look ahead, drawing from our work and highlight pathways for future research – both regarding pondscape NBS and NBS generally.

Research opportunities for pondscape NBS

Our work relied substantially on the inputs of citizens and stakeholders. Gathering data on their perceptions are helpful indicators for the acceptability for future NBS actions (Ferreira et al. 2020, Ruangpan et al. 2021). Future research should be conscious of the agendas of, in particular, stakeholders when sharing their perspectives with the project team, addressing questions such as: Who are the people that do not care about ponds? Why do they not care about ponds? Are ponds or pondscapes perceived as isolated ecosystems or part of a broader landscape?

In addition, so far, we have little data on how stakeholder perceptions change over time, not least due to results from the project work. In other words, it would be valuable to understand how, if at all, biophysical and socio-economic evidence impacts perceptions and whether this can in the long run affect the acceptance of NBS implementation. While this kind of research would be of value for all kinds of ecosystems as NBS, we deem it especially relevant for ponds as they have been largely overlooked in implementation, so far (Cuenca-Cambronero et al. 2023).

For policy-focused research, we recommend concentrating on how higher-level policies are translated into and implemented at the local level. This could involve assessing the relevance of specific EU or national policies for pondscape NBS. In our work, we mapped the potential impact of numerous policies, providing a broad overview of the policy landscape. However, our approach meant we did not engage deeply with any one policy. Given the significance of the recently passed Nature Restoration Law (NRL), we particularly recommend examining its potential impact on pondscape NBS. Additionally, our research suggests that the influence of higher-level policies on pondscape NBS implementation is shaped by the decisions made by lower-level authorities. Thus, it would be valuable to explore how local decision-makers perceive and apply higher-level policies in practice. This approach could offer deeper insights into the barriers and enabling factors affecting pondscape NBS implementation across governance levels. In addition to policy-focused research, the weightage or impact of the NBS implementation needs to be focused on, especially to exploit it as an incentive to gain credits in for example, building certifications. As ponds as NBS are implemented in urban, rural and natural areas, for example CLIMA- ponds developed in PONDERFUL can be inculcated as an action for increasing biodiversity, which can incentivise the implementation of ponds as a NBS. Addressing the local biodiversity of the region in question, relevant standards

can be created based on the research on ponds and potentially be implemented, to ensure credible increase in native biodiversity. For example, Figueras-Anton et al. (2024) have formed standards for CLIMA-ponds in rural, urban and nature, based on research and expert input across countries. A similar approach can be developed to connect ponds as NBS, with the goal of acknowledging ponds such as CLIMA-ponds for biodiversity credits in standards such as BREEAM, DGNB etc.

The relevance of the local context also extends to the financing of pondscape NBS. This is to say that some broad nation-wide financing instruments may not work to promote NbS implementation unless local specificities are accounted for (for example: local level land-use planning regulations and policies; Naumann et al., 2020). Further, Longato et al., (2024) reviews successful examples on the use of national level financing instruments (incentives) mixed with local level urban plans as an effective tool to promote NbS implementation. This is a field of research that could be expanded outside urban settings.

Beyond consideration of the local context, it is necessary to expand research particularly evaluating pondscapes NBS at landscape scale. For example, we can assume that benefits delivered at pondscape scale may differ from the ones from individual ponds (cf. Hambäck et al. 2023 on 'wetlandscapes'). Particularly, the potential trade-offs that exist in relation to implementing ponds and pondscapes NBS need to be looked at across scales, as benefits and beneficiaries at different scales can differ. For example, individual ponds can be seen as important as a source of water for agriculture at local scale, while they also, together with other ponds, contribute to overall biodiversity and water holding capacity at a pondscape level. Which benefits are valued in particular context depend on the beneficiaries, e.g. local farmers may focus on water availability, while regional or national actors may be more concerned with pondscape's function of maintaining biodiversity.

Scalar considerations are also important in the policy context. Most policies, as currently designed, do not specifically protect ponds. Instead, high-level policies like the Water Framework Directive and the Common Agricultural Policy, as well as instruments like Natura 2000, are aimed at managing or protecting broader landscapes, with ponds being merely nested into these landscapes. However, ponds have complex interactions with these surrounding landscapes, and these interactions need to be considered. Future research could focus on how policy implementation addresses these landscape-level interactions.

Research opportunities for NBS generally

The research conducted in WP1 of PONDERFUL bears meaning beyond only the implementation of pondscape NBS, but actually also highlights knowledge gaps regarding NBS generally.

Our analysis of social perceptions of pondscape NBS suggests that future research could explore the development of a more accessible classification of benefits than ecosystem services or NCPs for stakeholders. This may not only enhance the gathering of meaningful research results but also facilitate dialogue among stakeholders. An interesting avenue for further research would be to investigate the potential value of a 'common language of benefits' that stakeholders can use to discuss and understand key aspects of NBS. Such a framework could help address uncertainties, non-market values, scalar and temporal trade-offs, and equity concerns, while still leaving room for the context-specific nature of NBS. This could also help overcome the current barrier posed by the lack of clear data to inform decision-makers (Dorst et al. 2022).

Additionally, future research might delve into how the 'fear of the unknown' – the uncertainty surrounding the effects of NBS (Frantzeskaki et al. 2020; Kabisch et al. 2016; Raška et al. 2022) – can act as a barrier, particularly in the case of ponds. Investigating how a shared language could help stakeholders better understand and navigate these uncertainties might provide insights into mitigating this fear and improving engagement in NBS implementation.

Standardised approaches are crucial for accurately accounting for the potential costs and benefits associated with the implementation of NBS, too. A consistent framework for evaluation can streamline the estimation process, which currently faces challenges due to variations in methodologies and data sources. Difficulties in estimating costs and benefits hinder NBS implementation by creating uncertainties that deter investment and decision-making (Deely et al. 2020; Dorst et al. 2022; Sarabi et al. 2020). Without standardised metrics, stakeholders may struggle to compare different NBS projects, leading to misinformed choices and reluctance to adopt innovative solutions. Additionally, inconsistencies in accounting practices can obscure the true economic value of NBS, making it difficult to justify funding and support for these initiatives. By addressing estimation challenges through standardised methods, we can enhance the attractiveness of NBS, foster broader adoption, and contribute to sustainable environmental management.

Our policy assessment was guided by a framework identifying barriers and enabling factors for NBS implementation. While we noted their presence, we did not assess their relative importance, which future research should address to prioritize interventions effectively. Our analysis revealed only pairwise relationships between these factors, but the interconnections are often more complex. For example, in Brandenburg, Germany, limited administrative capacity and missing drainage management plans create financial risks for water boards, underscoring the need for tailored, context-specific interventions (Dorst et al. 2022; Raška et al. 2022). Future research should focus on the contextual relevance of barriers and enabling factors, helping to identify interconnected clusters and enhance understanding of their influence on NBS implementation.

Additionally, future research could replicate the socio-economic assessment we did for ponds, to both increase its precision and comprehensiveness. The first aspect mostly concerns the level of detail at which SH preferences are collected. In the Ponderful project, we could count on very specific data for pond's contributions, however we had to generalise the SH preferences at the national level. The collection of preference data is highly time and resource-intensive, plus it requires a lot of planning. These challenges generate a trade-off between the geographical coverage of an assessment, and the possibility to collect precise data at a high level of spatial resolution. Furthermore, there is a gap between the theoretical classification of NBS contributions and the possibility to quantify them into measurable variables. We faced this gap when we realised that there would not be available indicators for some of the criteria and sub-criteria in the original classification from Vo et al. (2024) (Figure 17 and 18). Future research could tackle these challenges by replicating the study in other locations, thus providing additional valuable insights on local stakeholder preferences. Moreover, empirical applications of our approach would contribute to the literature by highlighting alternative indicators that could be used to quantify several aspects of ponds' contributions.

Finally, there is a strong potential to expand our assessment of ponds' effectiveness and efficiency to additional measures. Such comparison is theoretically feasible among any set of NBS whose contributions can be mapped to common criteria and sub-criteria. Indeed, once the proper classification is identified, the quantification of desirable and undesirable outputs would proceed exactly as in the case of ponds. Furthermore, after properly organising the inputs into common categories, the evaluation of the measures' efficiency with DEA would also be possible. Such an extended approach would allow a quantitative, more objective, and comprehensive comparison of alternative NBS, which would not rely only on qualitative data and experts' opinions. This kind of assessment would potentially lead to very practical insights, with important policy implications. Finally, we wish to stress that the requirement of sharing a common classification for outputs and inputs is not a downside of our approach. It is a necessary conceptual boundary that can help identify which options are really worth comparing, and which are completely unrelated instead.

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Annex 1. Sustainable Finance Workflow DEMO-site Spain

PONDERFUL Task 1.5 – Sustainable Finance Workflow – DEMO-site SPAIN, LA PLETERA

1.a. Who? Describe pondscape developer, land-ownership, project manager

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Ownership: The land is publicly owned and protected as a Partial Natural Reserve. The land is owned by the state under the Spanish coastal law [Ley de Costas], which holds that all terrains affected by sea flooding must be publicly owned. The land had been partially developed before the financial crisis of 2008 lead to a ceasing of the private development, after which the saltmarsh was ecologically restored.[3] Since 2010 the land is included in the Montrigí Natural Park as a Partial Reserve.

Project management: LIFE Project that restored ecosystem was coordinated by the local municipality Torroella de
Montgrí Municipality. The project also featured University of Girona, the regional government and natural park (Generalitat de Catalunya – Parc Natural del Montgrí, les Illes Medes i el Baix Ter), and an engineering company (Empresa de Transformació Agrària – TRAGSA)[4].

1.b. What? Describe current pondscape NbS and context

Overarching description and key data:

· NBS type: New pond creation, former pond restoration
· Location: La Pletera is located in Torroella de Montgrí-l´Estartit (Girona), Catalonia, Spain.
· Pond #: 20 ponds
· Pondscape surface area (km2): 0,6
· Water surface area in the pondscape (km2): 0,33

[3] In March of 1998, the Direcció General de Costes changed the limits of the maritime-terrestrial public domain from behind the urban zone, considering the whole area as salt marsh area to be protected under the Coastal Law 22/1988. Thus, it was declared non-urban zone and was included as EIN (Interesting Natural Space). In 2016, the
Generalitat approved the areas that were included in the Nature 2000 Network, where La Pletera was included. In 2010, the law for the creation of the Natural Park of the Montgrí, Medes Isles and Baix Ter was approved, with the same limits of the area ES5120016 Nature 2000.

[4] University of Girona demonstration project: Deurbanization and restoration of Platera's marsh (2014-2018).
http://lifepletera.com/en/

· Level of protection: The entire area is protected as a Partial Natural Reserve (Reserva Natural Parcial), which constitutes a higher category of protection than Natural Parks.
· Mediterranean bio-climatic zone
· Nature's Contributions to Peoples (benefits):
  - Place regeneration
  - Health and wellbeing
  - Biodiversity enhancement
  - Climate resilience
  - Knowledge and societal capacity building for sustainable transformation
· Land use: Built coastal environment, agricultural land use, coastal marshes

Lead by the Torroella de Montgrí Town Council, the main objective of the LIFE Pletera project was the reconstruction of the salt marsh system (in which the coastal lagoons are a key element) and the restoration of its ecological functionality, which was altered by abandoned infrastructure, a promenade, and streets. The actions planned in order to achieve this goal were the deconstruction of the built-up areas and the restoration of the previous wetlands and their ecological functioning. The objective of the project included developing a good response to climate change (sea level rise and more storms) and to restore the ecological functioning of the entire system, over both short and long term.

The second objective of La Pletera is the dissemination of the results. On the one hand, the project seeks to demonstrate, both to the local population and to tourists, the importance of the conservation of these ecosystems in order to recover the ecological functioning. On the other hand, the project seeks to demonstrate how an area that has been critically harmed by the urban expansion can still be restored ecologically. The third objective is the increase of the capacity of carbon fixing of the coastal systems and the reduction of CO2 emissions.

Specific NbS actions *Break-down of specific actions, technical and non-technical measures to implement the NbS*

Planning	A1. adaptation of the construction project and arrangement of accesses A2. topographic update and underground circulation map A3. revegetation preparation and support tasks
Technical measures	C1. Correction of affected services C2. Creation lagoon system C3. Improvements C.4 dune system restoration C.5 itineraries and arrangement of accesses
Maintenance	Ongoing maintenance of infrastructure

Monitoring	D.1 ecological status monitoring D.2 vegetation monitoring D.3 monitoring water levels and salinity D.4 Carbon balance D.5 Fish (Fartet) monitoring D.6 Socio-economic impact monitoring
Outreach	E.1 Actions to raise local awareness E.2 Demonstration project
Project management	F.1 Project Management F.3 Engagement actions with other projects

Benefits

Habitats and biodiversity	Aquatic plant species richness (submerged, floating, helophytes), including Charophytes	3
	Water bird species richness (nesting, mating, overwintering)	104
	Amphibian species richness	3
	Dragonfly species richness	1
	Number of families of invertebrates belonging to Ephemeroptera, Plecoptera, Trichoptera, Odonata, Coleoptera and Gastropoda. (aquatic stages)	10
	Number of species of invertebrates belonging to Ephemeroptera, Plecoptera, Trichoptera, Odonata, Coleoptera and Gastropoda. (aquatic stages)	30
	Number of conservation priority species (N)	3
	Conservation score : total value for the pondscape	60%
	Number of non-native species introduced	33
	Number of invasive alien species (N)	5
	Proportion of regional species richness (for each taxonomic group whose species richness is measured)	30%
	Total surface of water (ha)	0,33
	Dragonfly species richness	3
Pollination	Number of pollinator species	1
Climate regulation	Capacity of C storage in the ponds (by primary production, by organic matter accumulation) (gC /m3 /y)	-270
	Net carbon removed or stored in vegetation and soil (t CO_2e/pondscape/y)	337

Physical and psychological experience	Number of persons frequenting the pondscapes (leisure, tourism, fishing, nature watching, ...) (nb/year)	>60.000
	Area inside the pondscape accessible to the public	10%
	Self-reported satisfaction/wellbeing (scale)	7,95
Physical and psychological experience	Number of studies driven for acquisition of knowledge (nb/year)	0,6
	And, if data are available: Number of artistic productions Number of mobilised animators of environmental education Citizen involvement in environmental education activities (N of people)	5

Pressures:

Climate change (major pressure): Sea level rise and higher intensity in flooding episodes.

Traffic and overcrowded parking lots during summer (minor pressure): Tourism puts pressures on local communities and their infrastructure and increases littering.

2.a. Scenarios

Concrete description of the different scenarios considered for financing.

Scenario 1: No actions taken. No costs. Site will slowly deteriorate.

Scenario 2: Maintain existing site. Ongoing maintenance costs. Site will continue to deliver current level of benefits and ecological functions.

Scenario 3: Expansion In addition to maintaining existing site, expand existing site by 21ha. Large NbS creation costs as well as ongoing maintenance costs. Site will deliver additional benefits and ecological functions (on the expanded area), such as new temporary ponds (during flooding events) and new permanent ponds on the lowest points of the newly restored salt marches. This would come in addition to the current level of benefits and ecological functions on the existing area.

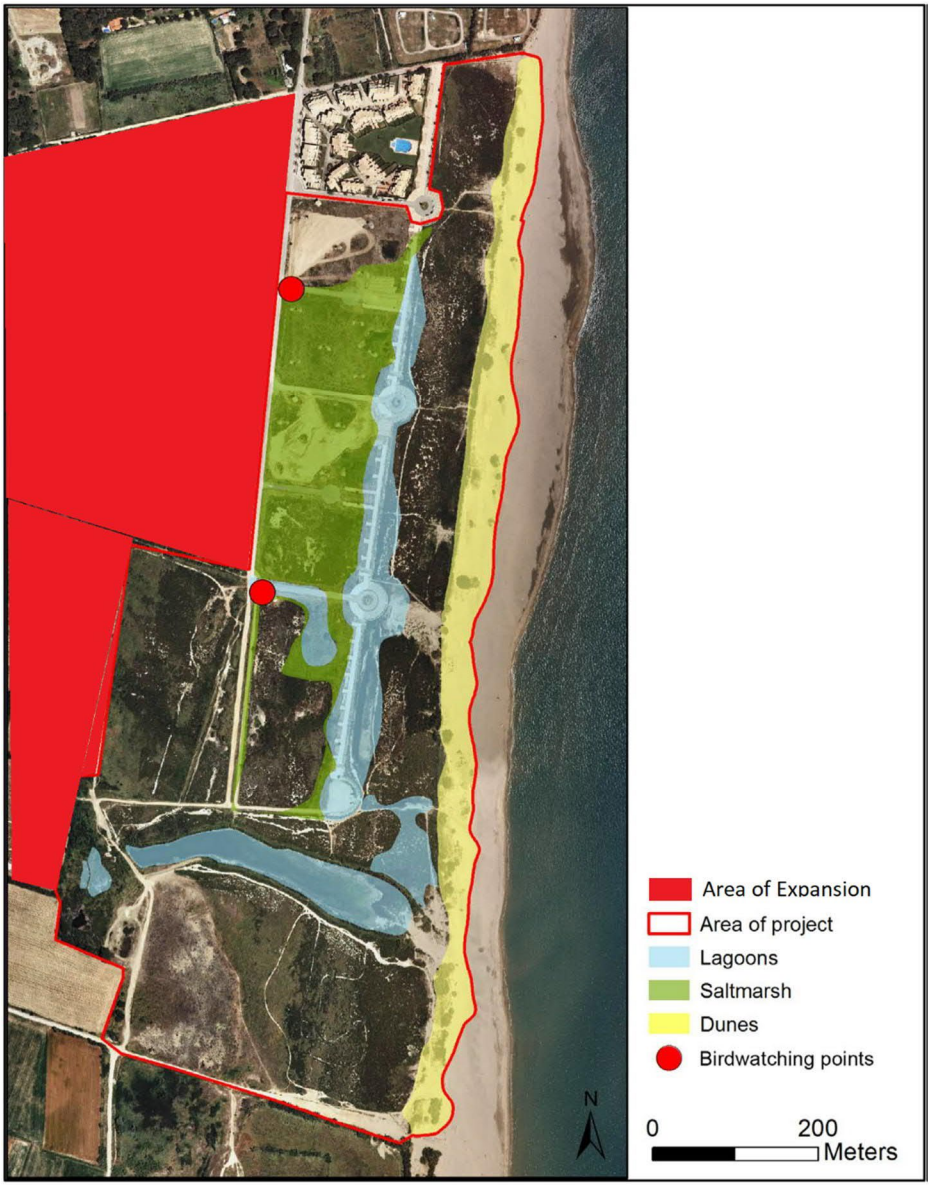


Figure 1 Map of current site and scenarios (from Pueyo-Ros et al 2018)

		Scenario 3: Expansion (scenario 2 + expansion)	
	Scenario 1: No action	Scenario 2: Maintain current NbS	Expansion to additional 21ha
Planning	None	None	· A1. adaptation of the construction project and arrangement of access[5] · A2. topographic update and underground circulation map · A3. revegetation preparation and support tasks · Land purchase/rental agreement[6]
Technical measures	None	None	· C2. Creation closes system[7] · C.5 itineraries and arrangement of accesses
Ongoing maintenance	None	· Maintain infrastructure · Revegetation of dunes, river Ter mouth, walkways · Installation of sand traps · Cleaning	· Maintain infrastructure (on expansion) · Revegetation of walkways (on expansion) · Cleaning (on expansion)
Monitoring	None	· Minimal socio-economic monitoring	· Increased socio economic and environmental monitoring for existing and additional area.[6]

[5] The expansion differs from the original LIFE project as there is no urban infrastructure to remove (A1, A2). Nevertheless, we keep these actions in as there will still be some related costs (e.g. access, flooding of agricultural land). We assume that the A1 and A1 costs are per ha 25% of the LIFE Platera costs.

[6] Based on discussion with project leads, we assume costs of zero for land purchase/rent.

[7] Based on discussion with project leads, technical measure costs will be considerably lower for the expansion than for the original LIFE Platera. Assume zero C1 and C3 costs (corrections, improvements) and that C2 and C5 costs are only 10% of the total technical measures from LIFE Platera costs. [6] We assume double per ha monitoring costs.

		· Minimal monitoring (water bodies, species, invasive species, habitats, and dune morphology)	
Outreach	None	· Managing education programs · Guided visits · Communication and outreach	· E.1 Actions to raise local awareness [8]
Project management	None	Minimal	· F.1 Project Management

[8] Same as under LIFE Platera, per ha for E1 and F1.

Expenses related to the different activities of the three scenarios are based on discussions with experts from the University of Girona[8], the previous cost for implementing the La Pletera LIFE Project, and the conservation plan for the site after the Life Project[9].

		Scenario 3: Expansion (scenario 2 + expansion)	
	Scenario 1: No action	Scenario 2: Maintain current NbS	Expansion to additional 21ha
Planning	None	None	€4.942[10]
Technical measures	None	None	€104.873€[11]
Ongoing maintenance	None	10.350€/year	7.245€/year
Monitoring	None	9.150€/year	6.405€[12]/year
Outreach	None	3030€[13]/year	17.845€/5 years[14] = 3.569€/year
Project management	None	Minimal	81.236€/5 years[15] = 16.247€/year
Total costs	0	No one-off costs 22.530€/year ongoing costs	109.815€ one-off costs 33.466€/year ongoing costs

2.b. Cost avoidance and reduction

Reducing project costs is one approach to reduce funding needs. For this, it is important to find cost reduction opportunities that do not impair the project's success or its long term sustainability. Below is a list of a few options that could help to reduce project costs for La Pletara. Each of these points is explained in more detail in the Ponderful financing inventory.

<u>Contracting approach:</u>

· Community asset transfer

[8] Xavier Quintana and Diego Pereira

[9] Quim Pou i Rovira Sorelló & Santi Ramos López. 2019. Plan de conservación After-LIFE del proyecto Life Pletera,available here: http://lifepletera.com/wp-content/uploads/2015/03/Plan-de-conservaci%C3%B3n-AfterLIFE_F2_1.pdf

[10] 10% of the LIFE Project cost (A1+A2+A3).

[11] 10% of the LIFE Project cost (C2+C5).

[12] Assume double monitoring costs/ha of post LIFE conservation plan.[13] From post-LIFE conservation plan: A.21+A.19+A.18 [14] 1/3 of the LIFE Project costs (E1). [15] 1/3 of the LIFE Project costs (F1).

Voluntary contributions:

· Volunteering, Citizen Science (?)
· In-kind contributions

Subsidies:

· Tax rebates (where applicable)

Resource pooling, sharing

· Sharing machinery, cars, offices, labour, software packages, consultancies, etc. with other projects or local businesses.

Section 3: Revenue and funding/financing gap

3.a. Revenue options[16]

During the second workshop, the participants identified several income instruments, which could help to sustain La Pletara in the long term. The ideas are listed in the table below. Additionally, some rough estimates for possible revenues are provided.

Income instrument	**Possible revenues**
Parking fees. Parking fees could also regulate the number of visitors coming, or provide incentives to avoid busy times.	€2 parking fee * 18.000 cars[17] = €36.000
Entrance fees for consolidated areas (la Pletera + Baix Ter)	Share of €1 * 15.000 paying visitor = €15.000
Guided tours under public concessions	25 tours per year * 10 participants * €5 = €7.500
Concessions for food trucks, bars, cafés, or bike renting businesses. The lessee, moreover, could be made responsible for the maintenance of public services, such as restrooms.	€1.000/month * 6 months[18] = €6.000
Cultivating pasture for cattle ranching as a source of income. The idea is, after an agreement with farmers, 21ha of agricultural land would be restored as "closes"[19].	10 sold animals per year * €1.000 profit = €10.000/year

[16] These revenue options were identified by stakeholders at the PONDERFUL La Platera stakeholder workshop,2022

[17] Based on 60.000 visitors/year, of which 30% come by car.

[18] Considering a six month main season.

[19] The "closes" are pasture meadows typical of l'Empordà´s marshes (where la Pletera is), surrounded by drainageditches bordered by riparian trees. They are often flooded during periods of rain as they lie on top of small ponds. The rain (or any other source of fresh water) would wash away the salt of such marshes

3.b. Funding/finance gap

	Scenario 1	**Scenario 2 (five years)**	**Scenario 3 (five years)**
Funding requirements	0,-	5 x 22.530€ = **112.650€**	109.815€ + 5 x 33.466€ = **277.145€**
Parking fees	X	€36.000/year x 5 years = **180.000€**	
Entrance fees	X	€15.000€/year x 5 years = **75.000€**	
Guided tours	X	€7.500€/year x 5 years = **37.500€**	
Concessions	X	€6.000€/year x 5 years = **30.000€**	
Cattle	X	X	10.000€/year x 5 years = **50.000€**

This is an example of how revenues can be approximately calculated. We present them as gross values, however, proponents must also consider the costs associated with gathering these revenues (e.g. staff costs to gather fees). Costs are calculated over five years as net present values with discount rates of 3.5%.

Section 4: Funding/finance

This section identifies potential sources of funding and financing to cover the financing gap for the future scenarios. This information was gathered through expert input and through two stakeholder workshops. In the first workshop, stakeholders identified a longlist of funding and financing options; in the second they developed detailed proposals for four options. Opportunities/barriers were discussed at both meetings.

At the first meeting, the following financing instruments for La Pletera were identified by stakeholders:

- EU, national and local grants
- Direct public funds
- Sectoral subsidies to agriculture (CAP) and other sectors
- Earmarked Touristic tax
- CO2 payments and offsets at local level.
- Private sector direct payments linked to increased value for tourism.
- Donations
- User fees attached to the delivery of certain ecosystem services (education)

These instruments that were identified and discussed as part of a group exercise, were useful for the development of the finance inventory and helped to understand the particular setup in La Pletera. The group also identified the following as the need for financing behind the necessary management actions to achieve the objectives of the restoration/maintenance exercise in La Pletera:

- Ecological restoration maintenance actions
- Maintenance measures to keep the infrastructure to achieve recreational values (road, bird watching hut)
- Maintain existing infrastructure
- Maintain existing communication plans (education programme)

At the second workshop, the group exercises allowed for a deeper understanding of the specific financing instruments that could be put in place. The table below provides a list of the financing instruments identified, an assessment of their suitability and limitations.

Instrument	**Suitability**	**Comments**	**Limitations**
User Fees – Parking fees	Medium Between €2-5 /visitor = 120.000 – costs Our calculations: €2 parking fee * 18.000 cars = €36.000	The (parking) fee could be modulated to penalize stays longer than necessary for the visit and to benefit earlymorning visitors to encourage ornithological tourism. An example close by, at Aiguamölls de l´Empordà Natural Park, next to Montgrí Natural Park, where la Pletera is, the entrance is free, but there is a fee of €5 for a full-day parking.	Questions about management: under municipal or natural park. If the parking service management is under natural Park control, it cannot be free of charge for residents.

User fees – Guided tours	Low	Under public concession. a guided tour with access to areas with more restricted use could be charged. This charge could be increased if there was a visit to a visitors center. To charge entrance, the business unit should be larger than the area of La Pletera. For instance, la Pletera + Baix Ter (Lower Ter river protected areas). It could also charge for parking.	There is a need to assess if the area would attract visitors' interest. A successful business model for prospective tour operators. Demand from visitors to the area needs to be appraised.
Market goods – cultivating pasture for cattle	High	After an agreement with farmers, 21ha of agricultural land could be restored as " closes". Pasture meadows	Attract farmers' interest. Land acquisition costs challenging. Obtain a competitive price for cattle.
		typical of l'Empordà´s marshes (where la Pletera is), surrounded by drainage ditches bordered by riparian trees. They are often flooded during periods of rain as they lie on top of small ponds. The rain (or any other source of freshwater) would wash away the salt of such marshes. The area refers to the expansion: the inland area next to la Pletera that is already suffering a salinization process by the salt water intrusion and,	

		because of that, is losing agricultural value.	
Lease	Low	Leasing the parking lot. Leasing space for restaurant, bars etc Leasing for bike renting business Affect existing leases, concessions and fees for conservation. For instance: concessions for bars at the beach; touristic fee; blue zones for parking.	High if the planning is in the context of the whole Natural Park. Little tangible if only la Pletera is considered. Regulation of the Natural Park´s norms for no-built zones

Section 5 Conclusion and financing recommendations

The table below identifies our assessment of financing options for the extension of La Pletera pondscape. Based on our assessment and work with DEMO-site leads and stakeholders, we identify financing instruments used in the past, and those that could be implemented in the future.

Category	Instrument	Past finance options	Notes	Future finance option	Additional Notes (if relevant…)
Income instruments	User fees	no		maybe	Parking and guided tours
	Business improvement districts	no		no	
	Betterment levies	no		no	
	Development rights and leases	no		no	
	Sale of market goods	no		yes	Selling pastures for cattle feed
	Other revenue raising measures	no		no	
Contracting approach (cost reduction/restructure)	Community asset transfer	no		no	
	Public private partnership	no		no	
Voluntary contributions	Philanthropic contributions	no		maybe	Corporate sponsorship could be an option (e.g. sponsor a pond)
	Voluntary beneficiary contributions	no		no	
	Crowdfunding	no		no	
Tradable rights/permits and payments for ecosystem services	Payment for ecosystem services	no		yes	Informal agreements with farmers possible about traditional farming practices – cultivating pasture for cattle
	Voluntary carbon markets	no		no	

	Biodiversity offset and habitat banking	no		no	
	Water quality trading systems	no		no	
Subsidies	Environmental subsidies	no		no	
	Tax concessions	no		no	
	Grants	yes	Research grant from EC LIFE project	yes	EC grants offers opportunities for expansion
Debt instruments	(Green) loans	no		no	
	(Green) bonds	no		no	
Equity finance	Impact investing	no		no	
	Commerical investing	no		no	
Other (please explain)		yes	Co-financing by university of Girona and central, regional, and local government		

Annex 2. Sustainable Finance Workflow DEMO-site Turkey

PONDERFUL Task 1.5 – Sustainable Finance Workflow – DEMO-site METU_DG

Context

1.a. Who? Describe pondscape developer

The pondscape NbS project is managed by PONDERFUL partners METU university.

· Meryem Beklioğlu (meryem@metu.edu.tr)
· Antoine Dolcerocca (adolce@metu.edu.tr)
· Deniz Başoğlu (denizbasoglu@gmail.com)

1.b. What? Describe pondscape NbS and context

Context: The Imrahor River Valley is located in Çankaya, Ankara. It is one of three pondscapes within the Ankara DEMO-site, located downstream and to the north-east of the two other pondscapes, much closer to Ankara's city centre, in a rapidly urbanising area. The peri-urban landscape is categorized as a centralAnatolian arid-cold steppe climate bio-climatic zone.

For a long time, the valley was inhabited by small (animal) farming communities, with a few small industries. But in the last decade, the previous Greater Ankara municipality (AKP) initiated the "Kanal Ankara" Project. The zoning was changed from "village land" (extensive housing with low land/building ratio) to "neighbourhood land" (very dense housing). Since the change of municipal majority, the project has been cancelled but many buildings have already been erected and stand empty.

The valley as a whole covers 241ha. Imrahor River Valley consists of several ponds that make a periurban pondscape within Ankara's ecological and hydrological corridors. These ponds make up a small section of the valley – approximately 5ha with a total of 10 ponds. The PONDERFUL project is focussed principally on two ponds:

· DP2: A pond located close to a village, surrounded by extensive small scale agriculture. The pond is in relatively good condition.

· DP5: A pond next to a brick factory. Restoration would aim to restrict impacts of brick factory. Unclear if brick factory has rights to dump their rubbish.

Important stakeholders include the Natural Resources Protection GD (of the Ministry of Environment and City Planning), who are making plans for the pondscape areas that are still under discussion (they may opt for a recreational-oriented project which does not prioritize the safeguard or creation of ponds); the DSI - State Hydraulic Works (Min of Agriculture), who created dams upstream in the past few years for flood management; and the Golbasi Industry Association, as representatives of the actors in industrial activities immediately surrounding the ponds, who partly use the land to illegally expand their available land area, partly to dump refuses (oil, etc.). In addition, the following stakeholders should be involved: Ankara Creeks (NGO), Nature Conservation and National Parks, 9th Region, Ankara Water and Sewerage Administration (especially wastewater), Ministry of Environment, Urbanization and Climate Change, Province Environment Directorate, Ankara Metropolitan Municipality, Çankaya Municipality, Brick Factory and private property owners. **Key challenges** identified by stakeholders included local political polarization, the unclear status of the cancelled "Kanal Ankara" construction project, and pressures associated with being close to city center as the former brick factory, which has been polluting the local water bodies.

Uncertainties: Stakeholders also identified a couple of areas of uncertainty in the proposed plan that will need to be further investigated. These include whether additional water will need to be added and whether wastewater entering the ponds is a risk to water quality and will need to be controlled or treated, and whether land is publicly owned or access would need to be negotiated. [9]

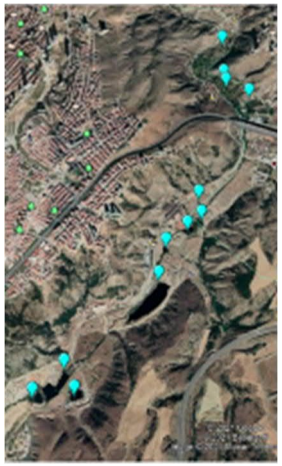
Societal challenges and NbS: The PONDERFUL NbS project is still under development but the draft proposal aims to principally address the following societal challenges:

- **Natural and climate hazards**: Flood prevention - As the pondscape is located downstream of Lake Eymir, it is anticipated that the pondscape has the potential to protect the city downstream from floods.
- **Place regeneration/biodiversity enhancement/greenspace management**: restoring pondscapes will support local biodiversity and also beautify the area, with many local beneficiaries.

[9] If the lands are not publicly owned, then expropriation or an arrangement with the landowner (excluding financial payment for the land) may be required, e.g. for DP2. Land ownership could be a challenge if larger expansions were planned.

- **Knowledge/capacity building**: The site can act as a best-practice example of peri-urban pond restoration, and used as a tool for teaching.

Location: Imrahor Valley, Turkey[10]



Nature's contributions to people (NCPs) – pondscape benefits: Stakeholders selected the following NCPs, as currently important for pondscape Imrahor:

· N°1 regulation of water quality
· N°2 physical and psychological experiences
· N°3 regulation of water quantity

The NCPs that were seen as important in the future were the following:

· N°1 creation of habitat and maintenance
· N°2 regulation of water quality

[10] Google maps reference: 39.84882258023275, 32.87075847922451 to 39.89745632190715, 32.90253823811112

Stakeholders also identified that the NbS would increase the aesthetic value of the pondscape, and increase the perception or "brand value" of the area.

2.a. Scenarios

The Imrahor Valley NbS is still under development. This was the conclusion of the first Turkey DEMO-site workshop. To support the development of the NbS, in this section a proposed NbS plan is described and costed. Generally, the NbS involves restoring two ponds. This includes onsite infrastructure and pond management measures, including cleaning the sites and removing rubbish, as well as interventions including area restrictions, riparian planting and development of a buffer area, as well as introducing native species and removing invasive species. Monitoring will also be implemented, and the potential for protecting the area (i.e. through municipality protections) will be explored.

Scenario 0: No change at site.

Scenario 1 Restoration: The explicit actions to be implemented included the following (see costing in table below):

- Pond restoration
    - DP2: A pond located close to a village, surrounded by extensive small scale agriculture. The pond is in relatively good condition.
    - DP5: A pond next to a brick factory. Restoration would aim to restrict impacts of brick factory. Unclear if brick factory has rights to dump their rubbish.
- Onsite infrastructure measures/pond management measures ○ Removal of rubbish and e.g. concrete
    - Infrastructure: Area restrictions (fencing), management of riparian vegetation, manage buffer area (to maximise flooding protection)
    - Species management: Remove invasive species; remove fish; reintroduce threatened plants/species; replanting as necessary ○ Monitoring
- Pondscape-scale land use and management ○ Investigate protected status options, e.g. municipality protections

The Restoration NbS will generate numerous benefits. Table 1 summarises these benefits in the form of nature's contributions to people, and identifies the beneficiaries.[11]

Table 1Imrahor Valley NbS scenario 1 - expected benefi

Nature's contribution to people	Importance	Beneficiary
Water quality improvement	++++	Society
Water source		
Flood management	++++	At risk locals + society
Groundwater recharge		
Habitat provision	+++	Society
Cooling		
Greenhouse gas sequestration	+	Society
sequestration		
Erosion control		
Recreation and well-being	+++	Visitors
Education and research	+++	Visitos
Food and materials		
Conservation value	+++	Society

[11] These results were gathered from stakeholders by PONDERFUL colleagues from ISARA at the first workshop. All stakeholders completed surveys at the workshop to indicate which aspects of ponds they valued the most. The The survey was at entire DEMO-site scale (i.e. also covering the other DEMO-sites). We took these results and applied expert judgment to scale them to the Imrahor pondscape.

Other (please explain)		

One-off costs	Unit: €	Additional Notes
Design and planning:	5,000	
Land acquisition costs:		No land purchases (expropriation can be applied, if necessary)
Legal and regulatory fees:	5000	Costs associated with Flood Management Acts (per stakeholder)
One-off equipment purchases:	25,000	Monitoring tools, e.g. long-term monitoring system
Construction and development	7500-15,000	Construction/restoration of 1-2 ponds, including cleaning and waste removal (assume €7500 per pond). In case of 2 ponds, change €7500 to €15000.
	1000	Fencing - assuming 330m of fencing, revised based on stakeholder feedback
	5,000	Optimisation of NbS site for flood management as discussed above
	2,000	Removal of invasive species
	15,000	Planting etc for biodiversity across site
		Wastewater redirection or treatment (if necessary)
Other types of one-off costs		
Total one-off costs:	65,500 - 70,500	

Yearly ongoing costs	Unit: €/Year	Additional Notes (if relevant…)
Maintenance and operation costs:	4,800	Monitoring (4000 per year) + pond maintenance of €2000 per pond every 5 years
Regulatory costs:		
Depreciation:	1000	Monitoring gear depreciation
Other types of on-going costs (please explain):	10,000	Project management including volunteer management, monitoring management, communications etc.
Total yearly ongoing costs:	15,800	

2.b. Cost avoidance and reduction

The following options have been identified as possible cost avoidance/reduction options:

Contracting approach:

· *Public-private partnership:* Stakeholders proposed seeking an agreement with the brick factory, e.g. in exchange for access to pond and end of dumping, the brick factory could receive support to install solar panels on their roof.

Voluntary contributions:

· *Volunteering:* Costs could also be reduced through volunteering and in-kind support from government agencies, e.g. in the form of use of machinery and skilled labour to support pond restoration (e.g. from Nature Conservation and National Parks, 9th Region, Ankara Water and Sewerage Administration).

Section 3: Revenue and funding/financing gap

3.a. Revenue options

No current revenue streams were identified

3.b. Budget gaps

Currently available budge		
Expenses:	Scenario 2 – upfront costs	Scenario 2 – ongoing costs
	€65,500 - 70,500	€15800 per year
Current revenue	0	0
Financing gap:	**€65,500 - 70,500**	**€15800 per year**

Section 4: Funding/finance

Future funding and finance options

This section identifies potential sources of funding and financing to cover the financing gap. This infromation was gathered through expert input and through two stakeholder workshops. In the first workshop, stakeholders identified a longlist of funding and financing options; in the second they developed detailed proposals for four options. Opportunities/barriers were discussed at both meetings.

Section 4.a. Funding/finance conditions

Ownership of project is not yet clear, and given mix of public and private land and actors involved, this means many financing options are open (including public financing options). For the same reason, it is not clear what can be exchanged in return for financing/funding (e.g. exchange of ownership, promise to pay interest, etc. are all still open options, depending on final financing plan. Timing is not a significant constraint, as project work can wait until funding/financing is secured.

Section 4.b. Funding

Funding refers to upfront or ongoing money that does not need to be repaid, such as grants, donations, etc.. This offers a useful source of money to cover NbS costs. Funding is often motivated by the positive externalities generated by the NbS, including recreation, conservation, climate adaptation etc., many of which would be generated by pondscape NbS.

Longlist of funding options

Stakeholders identfiied the following potential sources of funding:

· Income can be generated from the use of recreational areas
· Sectors and individuals that can benefit from the pondscape from the first hand can be convinced to have some amount of financial contribution. Volunteers can make donations. · Working with private companies as sponsors for recreation activities
· Public funds ○ Budgets of local municipalities
- ○ Ministry of Environment, Urbanization and Climate Change ○ A mechanism can be planed such as the one for the Nation Gardens
- ○ A mechanism can be planed similar to the one General Directorate of Forestry's Afforestation works ○ Ankara Development Agency
- ○ Expanding the support programs of Development Agencies ○ Private Environmental Protection Agency funds

- EU funds

Shortlisted funding options

Stakeholders identifed and developed four funding options. For each, they propose an idea, estimate potential revenue, and identify any likely barriers to implementation.

Sale of goods and services

Definition: Selling commodities produced in the pond or surrounding pondscape, such as wood or fish, or services, e.g. solar power

Idea: Fishing, visiting, and sale of local products

- Charging a fee for hand-line/thread-line fishing
- Charges for visitors and users of the pondscape area
- Sale of medicinal leeches, if applicable
- Snail collection (Provincial Directorate of Agriculture provides quota)

Revenue: if there are leeches and snails, estimated €5000 per year

Barriers (Is there anything that would be a barrier to this being implemented, or would mean you wouldn't want to? Describe

- legal difficulties,
- private property situation,
- having a large number of stakeholders,
- confusion of authority and/or conflict of authorities/power,
- not being in the priority area in prioritizing environmental awareness.

Voluntary beneficiary contributions/beneficiary levies

Definition: Voluntary beneficiary contributions: Negotiated, voluntary payments from beneficiaries (i.e. private companies or individuals who would receive a benefit from the development of the pond) to help cover NBS costs. Generally, these are for benefits that are localised and non-market, or for those that accrue indirectly through e.g. property value increases.

Betterment levies: very similar, except they are compulsory, and levied by the government.

Idea: Polluter pays tax[12]

1. (Additional) tax to be collected from the facilities that dispose of industrial waste (for example, the brick factory, livestock farms in Imrahor Valley) with the "polluter pays principle" and the use of this tax to restore the Imrahor Valley
2. These taxes can be collected in a national fund like the Environment Agency.
3. Allocating a part of the "Special Communication Tax" and "Excise tax" for restoration **Revenue:**

    1. Annually €1250 (25.000 TL, assuming 5000 TL tax on 5 industrial establishments)
    2. Annually €3000 (60.000 TL, from Turkey, for imrahor Valley pondscape)
    3. Monthly€40,000 (800.000 TL, 80 million citizens x 1 penny TL i.e. from every citizen in Turkey) **Barrier:**

- Legal difficulties and private property situation,
- Large number of stakeholders,
- Difficulties with implementing authority, conflict with their objectives - Lack if public/administrative support for environmental issues.

Public funding

Definition: Public sources of funding for pondscape implementation.

Idea: EU-funded projects that ensure the creation of artificial flood-resistant wetlands in the vicinity of the ponds located near urban areas so that they can take a more active role in case of floods, and the protection of cities in case of floods.

[12] Additional proposals included: Use of income tax from start-ups, industrialists, companies, private sector for restoration; Transfer of part of carbon taxes to restoration works from airline companies (to reduce the carbon footprint of airline companies); Allocating appropriations for the restoration works by the industrial establishments that produce wastewater; Using "Environmental Clean-up Taxes" for restoration in three neighbourhoods in Imrahor Valley

Revenue: With the implementation of the above-mentioned project, income will be equal to the reconstruction costs of structures that have the potential to be damaged by floods.

Barriers:

- Lack of suitable space
- Resistance from attitude of local people
- Lack of environmental awareness

Charitable donations

Definition: Charitable donations for nature-based solution projects from private individuals, companies, or other private actors (e.g. foundations, NGOs).

Idea: Charitable agreement with a company, who donate a proportion of revenue from selling products to pondscape NbS implementation and upkeep.

A company, which produces products subject to export (especially cosmetics, which is frequently the subject of daily consumption), allocates a certain percentage per product sold to the pond/scape restoration project. This could be in return for expected carbon sequestration at the pondscape, with payments linked to carbon emissions related to the production of the product to a project that increases carbon sequestration. This could "offset" carbon emissions associated with production and boost the visibility/prestige of the company. It would be important that the produce was produced ecologically (e.g. that medicinal aromatic plants and/or raw materials that do not consume much water).

Revenue: Would depend on the specifics of the arrangement.

Barriers:

-Product sales are not realized at the targeted level

Section 4.c. Financing

Financing (i.e. money that needs to be repaid or that otherwise has claim on future revenues) is the final option to cover any financing gap. It is well-suited for smoothing cash flow issues, e.g. if you do not have enough money to cover upfront investments (but expect to have sufficient revenue to cover this in the future). However, no financing options were identified as appropriate.

Section 5 Conclusion and financing recommendations

The table below identifies our assessment of financing options for the extension of La Pletera pondscape. Based on our assessment and work with DEMO-site leads and stakeholders, we identify financing instruments used in the past, and those that could be implemented in the future.

Category	Instrument	Past finance options	Notes	Future finance option	Additional Notes (if relevant…)
Income instruments	User fees	no		no	Parking and guided tours
	Business improvement districts	no		no	
	Betterment levies	no		no	
	Development rights and leases	no		no	
	Sale of market goods	no		yes	fishing, leaches, snails
	Other revenue raising measures	no		no	
Contracting approach (cost	Community asset transfer	no		no	
	Public private partnership	no		no	

reduction/restructure)					
Voluntary contributions	Philanthropic contributions	no		yes	Trying to shape a project with a solar company (not official); nature-based business of some sort (looking at how to make money for restoration/through restoration).
	Voluntary beneficiary contributions	no		yes	Possibly from local corporate entities
	Crowdfunding	no		yes	Voluntary contributions from local businesses or developments downstream,
Tradable rights/permits and payments for ecosystem services	Payment for ecosystem services	no		yes	Payments for floodwater control, however unsure if actually possible to implement
	Voluntary carbon markets	no		no	
	Biodiversity offset and habitat banking	no		no	
	Water quality trading systems	no		no	
Subsidies	Environmental subsidies	no		no	
	Tax concessions	no		no	
	Grants	no		yes	Municpality or national funding. Research funding.
Debt instruments	(Green) loans	no		no	
	(Green) bonds	no		no	

Equity finance	Impact investing	no		no	
	Commerical investing	no		no	
Other (please explain)		no		no	

Annex 3. Sustainable Finance Workflow DEMO-site UK

PONDERFUL Task 1.5 – Sustainable Finance Workflow – DEMO-site UK_WFF

1.a. Who? Describe pondscape developer

Main contact: Jeremy Biggs, Freshwater Habitats Trust

1.b. What? Describe pondscape NbS and context

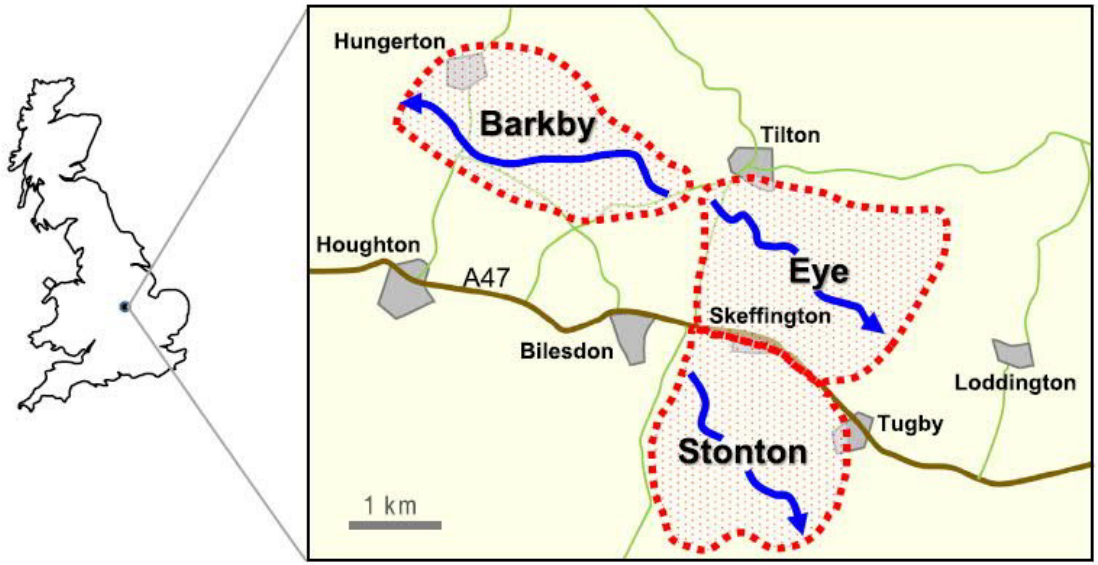


Figure 1 Map of Water Friendly Farming catchments with NbS actions (Eye and Stonton) (Williams et al. 2020a)[13]

Water Friendly Farming is part of a FHT demonstration project containing 102 ponds within an agricultural landscape. Clean water ponds and retention ponds (for flood and pollution control) were created from 2014 onwards. Pond creation was through digging of ponds using an excavator, following standard guidance (Williams et al 2020b; Frehwater Habitats Trust undated)[14]. The ponds were created to test their ability primarily to provide biodiversity habitats and services, such as regulation of flood hazards, the regulation of water quantity and regulation of water quality. Benefits for freshwater biodiversity have been exceptional but evidence from the project indicates less impact on the delivery of flood and pollution services in this landscape type (delivering flood and pollution control would require additional interventions beyond ponds, such as installation of leaky dams on watercourses for flooding and changes in sewage works and farming practices for water quality).

The land where the project is located is owned by multiple single land-owners. Their cooperation is coordinated by Chris Stoate from the Game and Wildlife Conservation Trust (GWCT). Land owners are not financially incentivized to participate in the project. However, the GWCT enjoys a close relationshsip with the local farmers based on common interests (e.g. provision of advice on farming, the economic value of game hunting, fishing), trust (e.g. cultural credibility with farmers), and previous experiences (e.g. training, scientific advocacy). Hence, farmers participate out of intrisnsic motives and to demonstrate good practice and environmental awareness to policy makers, with learning considered an additional benefit. It is also important to cosnider actors (and tenure arrangements) – farmers, tenants, landowners, and shared farming arrangements should be consideed.

Some of the sorrounding woodland are under nature protections (Sites of Special Scientific Interest), while some ponds might become Priority habitats. However, the project area's ponds are, like most UK farmland freshwater habitats, not well-protected and there is a lack of suitable policies to increase protection. The pondscape is subjected to land use pressures in its immediate environment, especially

[13] Williams, P., Biggs, J., Stoate, C., Szczur, J., Brown, C., Bonney, S. (2020) Nature based measures increase freshwater biodiversity in agricultural catchments. *Biological Conservation*, 244. https://doi.org/10.1016/j.biocon.2020.108515

[14] Freshwater Habitat Trust. undated. Pond Creation Toolkit. Available here: https://freshwaterhabitats.org.uk/projects/million-ponds/pond-creation-toolkit/#Core%20factsheets;
P. J. Williams, J Biggs, M. Whitfield, A. Thorne, S. Bryant, G. Fox, P. Nicolet. 2020. The Pond Book: A Guide to the Management and Creation of Ponds 3rd Ed. Headington: Ponds Conservation Trust.

intensive grass and arable farming resulting in pollution from nutrient run-off. The complexity of the stakeholder management can be considered another risk for the long-term existence of the ponds.

Societal challenges and NbS: The PONDERFUL Water Friendly Farming project explicitly aims to address the following societal challenges:

- Biodiversity enhancement
- Natural and climate hazards (flood management)
- Water management (water quality)

Benefits: The existing Water Friendly Farming project has been evaluated as to the benefits that it generates[15]. Williams et al (2020) identify that the implementation of clean water ponds in the agricultural landscape increases species richness and uncommon wetland plant scores. They also find that pondscapes generate some small water flow regulation benefits but there is no evidence that pollutants are regulated. Stakeholders also identified that pondscapes generate leisure benefits and value for those who value the ponds.

2.a. Scenarios

Concrete description of the different scenarios considered for financing.

Scenario 0: No actions taken. No costs. Site will slowly deteriorate.
Scenario 1: Maintain the ongoing long-term management of the project as it exists at the moment, including basic outcome monitoring, and room for some additional minor improvements and repairs. Within the catchment, there is no further space to create new ponds without funding change of land use. This scenario would maintain the current levels of benefits.

Scenario 2: Expansion of the the WFF project to a carefully selected neighboring catchment, e.g. the remainder of the Eye Brook catchments. This would involve expanding all habitat creation elements of the current WFF project by an additional 50km² (expanding total size of the WFF project to 60 km^2. The expansion would not include additional scientific investigative work that is currently done in WFF. We assume the expansion would be implemented over five years.

[15] Williams, P., Biggs, J., Stoate, C., Szczur, J., Brown, C., Bonney, S. (2020) Nature based measures increase freshwater biodiversity in agricultural catchments. *Biological Conservation*, 244. https://doi.org/10.1016/j.biocon.2020.108515

Scenario	**Scen. 0: No action**	**Scen. 2: Maintain and Expand**					
		Scen. 1: Maintain			**Expand**		
		Maintaining Activities	Expenses	Notes	Expanding activities	Expenses	Notes
Planning	None	- None	*0*	*No planning expenses in maintain*	- Stakeholder engagement - Site selection and preparation - Management plan	One-off: £30,000	*Assuming approximately 60 days management plan writing general planning (at* £500 per day)
Construction and develop.	None	- Minor improvement	Approximately 0 cost for minor improvements		- Pond creation: 510 new ponds (on 50km^2 of new area) - One-off pond restoration of existing ponds	*Pond creation:* £2,550,000 (one-off cost for whole expansion) *Restoration of existing ponds*: £275,000 T*otal*: £2,825,000	*Creation*: On average assume £5000 per pond created. Expansion area is 5x as large as original WFF; assuming same density, 510 new ponds. *Management:* Survey costs: £1000 per km^2; Management costs calculated as €5500/km^2 (assuming lowland England average of 2.5 ponds/km^2)
Ongoing maintenance	None	- Ongoing repairs to maintain storage	£200/pond per year £20,400 per year for whole project	If we wanted to keep ponds open to maintain storage assume £1000 / pond every 5 years /year	- Ongoing repairs	£100/pond per year £ 51,000/year for whole expansion area	Assume £500 / pond every 5 years

Monitoring	None	- Minimal outcome monitoring (pond site visit every five years)	£2000/year	Calculated assuming visit each pond once every five years; pond visit cost approx. £100 (£500 per day to visit 5 ponds); 102 ponds in total. 102ponds x £100 per pond/5 years = £2040 per year/catchment.	- Additional outcome monitoring: - Pond site visit every five years - Downstream flow gauging (3 gauges for whole catchment	Pond visit every five years: £100/pond/5 years Ongoing: 10,200/year/whole expansion area Gauge checks: One-off: Setup: £45,000/whole expansion area Ongoing: Maintenance repair: £3000/year/whole expansion area Data collection: £10,000/year Ongoing total: £23,200	Pond visit: assuming visit each ponds once every five years; pond visit cost approx. £100 (£500 per day to visit 5 ponds); 510 ponds in total. Gauge checks Setup: One-off setup: Assuming average of £15,000 per gauge Maintenance/repairs: £1000 per year Data collection/analysis: Assuming 20 days per year for whole catchment at £500/day
Outreach	None	- –Minimal - 1 press release per year	£2500/year	*1 press release a year, approximately 5 days work at* £500/day	- Two publicity events / year to promote outcomes	£16,000/year/whole expansion area	*20 days per large publicity event at* £500 per day
Project management	None	- Minimal site management - Ongoing stakeholder management through Allerton Project	£5000/year	*10 days per year for ongoing project management*	- Additional management	£25,000/year	50 days management a year

Total Expenses:	0	**Total scenario 2: Maintain expenses**	**29,900/year**		**Total scenario 3: expansion**	***One-off*: £2,900,000** **Annual: £115.000 (over 5 years: £575,000** ***Total 5 year project:* £3.475.000 total project costs**	

2.b. Cost avoidance and reduction

Voluntary contributions:

- *Volunteering*: Number of interested community groups and individuals, who are eager to support environmental projects.
- *In-kind contributions*: Farmers and landowners already make many in-kind contributions as part of the Water Friendly Farming project. Farmers are not paid for their participation in the project or for the various actions that they take to support it. This is likely to continue. It is already considered in the scenarios.

Section 3: Revenue and funding/financing gap

This section draws on workshop #1, workshop #2, and workshop #3 and discussions with Freshwater Habitats Trust on existing/potential funding instruments for the three scenarios.

3.a. Budget gaps & surpluses

Please use the following table to indicate your total budget, currently available to pay for any of the given future scenarios. If you currently do not have any funding to pay for these scenarios, please write zero. The aim is to identify the current funding gap (or surplus), which will allow us to develop a finance strategy.

Currently available budget:	0		
Expenses:	Scenario 0	Scenario 1	Scenario 2
	£0,-	£29.900,-/year	One-off: £2,900,000 Annual: £115.000 5 years: £3.475.000
Budget gap & surplus:	£0,-	£29.900,-/year	One-off: £2,900,000 Annual: £115.000 5 years: £3.475.000

3.b. Revenue options

Current revenue

No current revenue streams were identified

Section 4: Funding/finance

This section identifies potential sources of funding and financing to cover the financing gap. This infromation was gathered through expert input and through two stakeholder workshops. In the first workshop, stakeholders identified a longlist of funding and financing options; in the second they developed detailed proposals for four options. Opportunities/barriers were discussed at both meetings.

Section 4.a. Funding/finance conditions

Project is coordinated by Jeremy Biggs of Freshwater Habitats Trust. The land where the project is located is owned by multiple single land-owners. Their cooperation is coordinated by Chris Stoate from the Game and Wildlife Conservation Trust (GWCT).

Public and private fincing options are open.
Given the voluntary nature of farmer participation in the project, it is not clear what can be exchanged in return for financing/funding (e.g. exchange of ownership, promise to pay interest, etc.) Therefore, preference for funding approaches, rather than financing.

Section 4.b. Funding

Funding (i.e. upfront or ongoing money that does not need to be repaid, such as grants, donations, revenue, etc.) offers a useful source of money to cover NbS costs. Funding is often motivated by the positive externalities generated by the NbS, including recreation, conservation, climate adaptation etc.
Workshop participants developed detailed proposals for the following funding options: 1) Payment for ecosystem services, 2) sale of market goods, 3) user fees/development rights, 4)voluntary contributions 5) grants

1) Payment for ecosystem services (and other tradable rights/permits)

Biodiversity offsets (also framed as "biodiversity net gain") approaches are growing in UK and offer potential source of funding. E.g. District Level Licensing scheme for Great Newts requires that developers impacting Great Newt habitats must more than offset (+10%) the damage by funding Great Newt habitats elsewhere. Freshwater Habitat Trust develops ponds for a habitat bank to feed into this programme.
Scenario 3 (expansion of pondscape) could very likely benefit from the Great Crested Newt habitat banking program. FHT does develop ponds with this mechanism (with partner body Newt Conservation Partnership) and is closely involved in the management of the organisation. Farmers would receive payments for 25 years to maintain habitats for great crested newts.
Stakeholders identified that in the WFF context, a landscape vision could be effective: developing a portfolio of mixed habitats (including ponds, but also e.g. hedgerows), which could meet a range of different biodiversity net gain requirements. The demand (and level of funding) would depend on the number and size of developments occurring in the relevant area – a major development could provide up to £250,000; a small house £500.
Stakeholders identified as potential barriers competition from other biodiversity projects, as well as a potential lack of expertise in biodiversity net gain and planning.
Other tradable rights/permits could also offer future revenue. **Nutrient PES schemes** for nutrient neutrality are being developed in the UK but currently largely depend on the proximity to protected areas (SSSIs or SACs) which are regarded as needing protection from nutrient

pollution. A deintensification of land-use in the immediate surrounding could mitigate that pollution. PES schemes for natural flood management are still experimental and not yet at the stage of directly generating income for landowners.

Carbon credit: The sale of carbon credits under the Peatland Code could be viable option more generally, but the WFF site is not technically a peatland area. Whether other carbon credit schemes could be beneficial was unclear, as the scientific evidence related to mitigation affect of ponds is currently not strong enough. Stakeholders mentioned the importance of including/allowing for ponds in existing carbon credit mechanisms (e.g. Woodland Carbon Code should not penalize spaces left open for ponds).

2) Sale of market goods

Stakeholders identified that revenue could feasibly be raised through price premiums for products produced in the WFF area. This could be done through existing production labels – e.g. red tractor, organic farming, pasture for life etc. – but with the additional proviso that ponds are required within habitats.

Stakeholders also identified agricultural supply chains as potential sources of funding. This would rely on tracing goods produced in the surrounding area (eg eggs from a local farm) through supply, logistics and sale, then working with supply chain companies to identify environmental impacts and benefits, and link this to their corporate ESR reporting etc.

Commercial production in ponds (e.g. fish production) would be challenging due to small scale of individual ponds and difficulties coordinating multiple small actors.

3) User fees

Stakeholders identified newt tours, invertebrate tours, and day fishing as potential small sources of revenue. However, this would be challenging to coordinate among private landowners and demand would be limited. Corporate tree planting projects potential model – “pond digging”, or simply corporate pond visits. Generally hunting and fishing activities in the region are rather small-scale and less organized.

4) Voluntary contributions

Stakeholders identified three potential options: 1) Fundraising/crowdsourcing fund; 2) corporate sponsorship of ponds; 3) regulatory requirement

Option 2 – Corporate sponsorship was identified as most viable. A range of donors (e.g. large supermarkets, Coca-Cola) might provide corporate donations or corporate sponsorship. WFF has also received donations from Syngenta (e.g. for research).

Stakeholders identified a rate of up to £10,000 per pond (similar to donations for Tiny Forests).

One barrier identified was the relative attractiveness of ponds versus other landscapes (e.g. forests).

5) Grants/environmental subsidies

Workshop participants identified two potential sources: DEFRA Countryside Stewardship scheme and the forthcoming Voluntary Environmental Land Management schemes.

- **DEFRA Countryside Stewardship Scheme** is being phased out from 2023. It has been an important source of funding supporting existing WFF activities, as it allows farmers to receive public grant payments in return for taking actions as part of WFF. These include the following payment levels:
  - Moorland re-wetting (£23/ha);
  - Wetland cutting/grazing (£407-480/ha);
  - Constructed wetlands for the treatment of pollution (50% of costs);
  - Buffering in-field ponds on improved grassland/arable land (£275-£563/ha);
  - Management of small (<100m2) and larger ponds (£114-202/pond); ○ Creation of sediment ponds and/or traps (£12/m2);
  - Creation or restoration of ponds (£282/pond if <100m2 or £189/100m2 if >100m2).4
- **Environmental Land Management schemes** are replacing the Countryside Stewardship Scheme. Aim to support greening of agricultural sector. Take three forms (at different scales):
    - The **Sustainable Farming Incentive**: farm-level activities over a span of three years that improve water quality, biodiversity, or climate change mitigation, or soil health. Includes moorland land (appropriate for WFF)
    - **Local Nature Recovery:** incentivises local-scale actions targeting reversing the biodiversity decline, improving water quality, net zero and building climate resilience. Targetted actions include managing, restoring, creating wetlands/ponds, salt marshes, peatlands/wetlands, buffer strips and other flood management
    - **Landscape Recovery: landscape-scale,** radical and large-scale (500-5000ha) changes to land use on any land type. These projects shall support long-term (min. 20 years) habitat restoration and land use change for climate mitigation and resilience. Stakeholders questioned feasibility, given difficulty of coordinating multiple farmers.

Section 4.c. Financing

Financing (i.e. money that needs to be repaid or that otherwise has claim on future revenues) is the final option to cover any financing gap. It is well-suited for smoothing

cash flow issues, e.g. if you do not have enough money to cover upfront investments (but expect to have sufficient revenue to cover this in the future).
No financing options explored due to prefernce for upfront funding.

[4] The Countryside Stewardship (England) Regulations 2020 (SI 2020/41). NOTE: Some rates have since been adjusted. The rates in the text reflect the latest rates.

Section 5 Conclusion and financing recomendations

The table below identifies our assessment of financing options for the Water Friendly Farming pondscape. Based on our assessment and work with DEMO-site leads and stakeholders, we identify financing instruments used in the past, and those that could be implemented in the future.

Category	Instrument	Past finance options	Notes	Future finance option	Additional Notes (if relevant…)
Income instruments	User fees	no		maybe	e.g. newt tours, invertebrate tours, and day fishing as potential small sources of revenue. However, barriers identified.
	Business improvement districts	no		no	
	Betterment levies	no		no	
	Development rights and leases	no		no	
	Sale of market goods	no		yes	Price premium for sustainably produced goods though labelling, supply chains. Commercial production in ponds unlikely.
	Other revenue raising measures	no		no	
Contracting approach (cost reduction/restructure)	Community asset transfer	no		no	
	Public private partnership	no		no	
Voluntary contributions	Philanthropic contributions	yes	Syngenta-funded research project: Snygenta paid for a lot of the initial research on what lived in the landscape (here and in EU).	yes	Corporate sponsorship could be an option (e.g. sponsor a pond)
	Voluntary beneficiary contributions	no		maybe	Stakeholders identified a rate of up to £10,000 per pond (similar to donations for Tiny Forests).
	Crowdfunding	no		maybe	Potential

Tradable rights/permits and payments for ecosystem services	Payment for ecosystem services	no	Not yet - but coming up	yes	Informal agreements possible
	Voluntary carbon markets	no	Not yet - but coming up	maybe	Potentially in the future, current science too unclear. WFF area not peatlands. Potentially if ponds accepted/promoted in existing schemes (e.g. Woodland Carbon Code, peatlands
	Biodiversity offset and habitat banking	no	Not yet - but coming up	yes	Significant potential - especially through District Licensing Scheme
	Water quality trading systems	no	Not yet - but coming up	no	
Subsidies	Environmental subsidies	no	Too hard to organise by pond developer (down to individual landowner) - so FHT paid for actions through major project	yes	Environmental Land Management offers opportunities
	Tax concessions	no		no	
	Grants	yes	Research grant from environment agency - practical delivery project. Funding comes through Regional flood and coastal committee, who are responsible for managing flooding in east Anglia (with some political representation): This is a pilot project.	yes	Environmental Land Management scheme offers opportunities
Debt instruments	(Green) loans	no	(loan from a charitable trust used to establish FHT DLL)	no	Preference for funding over financing; especially due to multiple private landowners
	(Green) bonds	no		no	Preference for funding over financing; especially due to multiple private landowners
Equity finance	Impact investing	no	Not here in WFF - but some rewiliding examples in the UK	no	Preference for funding over financing; especially due to multiple private landowners
	Commerical investing	no		no	Preference for funding over financing; especially due to multiple private landowners
Other (please explain)		yes	Voluntary participation by farmers, and support by other organisations e.g. Allerton Trust		

Ponderful

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