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PONDS FOR CLIMATE

Deliverable 1.3.

Synthesis report on policy context of ponds and pondscapes

Pond Ecosystems for Resilient Future Landscapes in a Changing Climate

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List of Acronyms

BHD	Birds and Habitats Directives
CSR	Corporate Social Responsibility
CSOs	Civil Society Organisations
DEMO site	Demonstration site
DMP	Drought Management Plan
ES	Ecosystem Services
ERDF	European Regional Development Fund
EU	European Union
FRMP	Flood Risk Management Plan
GHG	Greenhouse gas
HNV	High-nature value
N2000	Natura 2000
NBS	Nature-Based Solutions
NCPs	Nature's Contributions to People
NWRM	Natural Water Retention Measures
RBMP	River Basin Management Plan
WFD	Water Framework Directive
WP	Work Package

Executive Summary

The PONDERFUL project focuses on the role of ponds and pondscapes (i.e. networks of ponds and the surrounding landscape) for the delivery of different Ecosystem Services (ES) and Nature's Contributions to People (NCPs). Particular attention is paid to ponds and pondscapes as Nature-Based Solutions (NBS), their role in climate mitigation and adaptation, as well as in biodiversity conservation. Ponds are, both globally and in Europe, the most numerous standing water bodies. In spite of their great importance, ponds are currently under increasing pressures that impact their number and state. This in turn has consequences for numerous ES/NCPs that ponds and pondscapes deliver. The mission of the PONDERFUL project is to increase the understanding of the role of ponds and pondscapes in providing ES/NCPs and to promote greater implementation of pondscapes as NBS in order to mitigate or adapt to the current trends of environmental deterioration. While ponds are crucial for protection of freshwater biodiversity and delivery of numerous services to humans, they are largely neglected and overlooked in policies.

Work Package (WP) 1 of the PONDERFUL project aims to understand 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 ponds and pondscapes as NBS to address many societal challenges. In Task 1.4 we explore how EU-level policies and local/national policies in the DEMO-sites (can) support or hinder the implementation of multi-functional pond and pondscape NBS. This involves:

- Compiling a comprehensive policy inventory of EU policies to assess in terms of their potential to support or inhibit pond and pondscape NBS at the local level;
- Conducting an analysis of policies relevant for pondscapes in the DEMO sites in collaboration with a diverse network of stakeholders, and;
- Synthesising the main findings to identify key insights to the policy context and recommendations for implementing pond and pondscape NBS.

To understand how EU-level policies and local/national policies in the DEMO-sites (can) support or hinder the implementation of multi-functional pond and pondscape NBS, we conducted our analysis in two steps. Specifically, we first assessed the EU and subsequently the DEMO site policy context (local/national). The DEMO-sites are located in the following countries: Spain (2 DEMO-sites), Belgium, UK (2 DEMO-sites), Germany, Switzerland, Denmark, Turkey and Uruguay.

Our analysis shows that both EU and local/national policies contain barriers and enabling factors, which amount to opportunities and limitations for implementing ponds and pondscapes as NBS. For the EU analysis we first show cross-cutting findings. Thereafter, we present findings by NBS benefits intended by the policies. These findings apply, to some degree, to all types of land use and NBS types. Subsequently, we show findings specific to pond and pondscape NBS located in coastal, urban, and rural areas. Lastly, we capture findings for the different types of NBS (creation, restoration, and management of ponds and pondscapes). Tables 4, 5, and 6 summarise the findings. For the local/national level analysis we present the findings according to the main categories of barriers and enabling factors that guide the analysis.

Based on the results of the analysis, we developed a set of key recommendations:

1. *Award a legal status to more ponds/pondscapes*, as different types of statutory designations and legal classifications are the foundation for other enabling factors such as financing, monitoring, and planning.
2. *Define ponds in relation to wetlands, moorlands, and peatlands*: Many potential opportunities for the implementation of NBS are reserved for wetlands, moorlands, and peatlands. It is important to raise the profile and potential of ponds for the same benefits in this context.
3. *Assist with the translation of high-level policies into local actions*: National or regional policies have often already incorporated NBS into their set of possible measures to achieve their objectives. However, translation into local action is still deficient and needs to be improved.
4. *Improve the knowledge base on pond status*: Currently, the monitoring of ponds is spotty, at best. Positive experiences from DEMO sites show that major progress can be achieved if pond monitoring is integrated into larger monitoring efforts, such as national/regional wetland inventories or river basin management plans.
5. *Determine pond benefits in pilot projects*: Determining the benefits of potential NBS is key for their long-term consideration.
6. *Nurture local pond champions*: Research efforts should feed into identifying and nurturing potential pond champions amongst local policy-makers and landowners, to promote good practices.
7. *Support broad-based collaborations*: Private landowners are hesitant to cooperate with public institutions, as they are perceived as punitive and

bureaucratic. Financial and institutional support should be directed toward collaborations that bring together a large stakeholder base from the private, public, and civil society sectors.

8. *Couple long-term financial support with advisory services*: Local institutions need to build up capacities regarding pond and pondscape NBS over time so that they can give high-quality advice to other actors, ideally with sustained long-term financing.
9. *Make NBS without a business case attractive*: Not all NBS immediately 'pay for themselves'. Therefore, funders need to step in and steer investments toward NBS that are not economically viable at first.

While strengthening the role of ponds and pondscapes NBS and facilitating their broader uptake is a long term-process that requires removing substantial barriers/limitations, our DEMO-site analysis shows many positive examples and outline opportunities. Building on identified opportunities and utilising the recommendations above should enable broader implementation of ponds and pondscapes as NBS in the European Union and beyond.

1. Introduction

1.1. Background

The PONDERFUL project focuses on the role of ponds and pondscapes[1] for the delivery of different Ecosystem Services (ES) and Nature's Contributions to People (NCPs). Attention is paid to ponds and pondscapes as Nature-Based Solutions (NBS), their role in climate mitigation and adaptation, as well as in biodiversity conservation. Ponds are, globally and in Europe, the most numerous standing water bodies. Collectively, small water bodies dominate both area of standing water (Downing et al. 2006, Biggs et al. 2017) and contributions to aquatic biodiversity, supporting 70% of freshwater species in European landscapes (Williams et al. 2004, Davies et al. 2008).

In spite of their importance, ponds are under increasing pressure. Ponds are exposed to the same threats as larger waters (e.g. land and water use, pollution, invasive species), but they are more fragile. This is because of their size, but also because they are functionally different than other water bodies (i.e. lakes, shallow lakes, or wetlands) in terms of metabolism, nutrients, and gases fluxes (Richardson et al. 2022). In addition, they are particularly vulnerable to climate change, being less resilient to temperature extremes and changes in hydrology (Biggs et al. 2017, Boix et al. 2012; Gozlan et al. 2019; Oertli et al. 2009; Oertli & Parris 2019). Also, land-use change due to intensive agriculture and urbanisation cause in-filling, fragmentation, and/or pollution (Biggs et al. 2017; Blicharska & Johansson 2016; Boix et al. 2012; Boothby 1999; Hill et al. 2018; Oertli & Parris 2019; Sayer 2014; Sayer & Greaves 2020; Sousa et al. 2016). Beyond that, tourism and industrial production have also had negative impacts on ponds (Gozlan et al. 2019). All that impacts both their number and state. In Europe, specifically, ponds are disappearing or deteriorating disproportionately fast, especially in comparison to other aquatic habitats (Curado et al. 2011; Gozlan et al. 2019).

This in turn has consequences for numerous ES/NCPs that ponds and pondscapes deliver. 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. PONDERFUL will quantify the relations between biodiversity, ecosystem

[1] 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).

state, ES/NCP and climate change, develop scenarios for climate mitigation and adaptation using pondscapes, and test the implemented pondscape-based solutions using DEMOnstration sites (hereafter DEMO sites) co-developed with stakeholders. Ultimately, PONDERFUL will develop practical tools for creating, restoring, and managing pondscape NBS.

The mission of the PONDERFUL project is thus to increase the understanding of the role of pondscapes in providing ES/NCPs and to promote greater implementation of pondscapes as NBS in order to mitigate or adapt to environmental deterioration.

1.2. Objectives of Work Package 1

Work Package (WP) 1 of PONDERFUL aims to understand 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 ponds and pondscapes as NBS. As a result, WP1 will develop a multidimensional framework that offers robust advice for effective, efficient, and equitable implementation of ponds and pondscapes as NBS. The initial Framework was presented in Deliverable 1.1, while the final, refined framework will be published in the final Deliverable (1.7).

As such, the work of WP 1 is complementary to the work of other WPs in PONDERFUL as ponds should not only be assessed in terms of their ecological value (analysed in WP2 and WP3), but also in relation to their implementation. The objectives of WP 1 are summarised below:

1.1. Provide, in collaboration with all project participants, the conceptual standardisation for the PONDERFUL project work;

1.2. Co-design a multi-actor approach for the project's stakeholder interaction in collaboration with all WPs, with stakeholder mapping, organisation of stakeholder workshops and other stakeholder communication;

1.3. Develop the evaluation and implementation framework for pondscape NBS to be applied and implemented in all DEMO sites;

1.4. Explore the social perception of ponds and their importance for delivery of ES/NCP;

1.5. Analyse the pond policy context at multiple governance levels (from EU to DEMO sites) to identify enabling factors and barriers for implementing pondscape NBS, as well as instruments to finance pondscape NBS;

1.6. Analyse the economic context of ponds focusing on the economic assessment of risks associated with ponds NBS;

1.7. Synthesise WP1 insights into a final evaluation and assessment framework for pondscape NBS to support practitioners and policymakers.

WP1 activities focus primarily on the project's DEMO sites, and involve the gathering and integrating of social, policy, economic and financing data. This Deliverable focuses on the policy analysis that represents Task 1.4 in WP1 of PONDERFUL.

1.3. Deliverable 1.3: Policy analysis (Task 1.4)

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).

Thus, in Task 1.4 we *explore how EU-level policies*[2] *and local, regional, and national policies in the DEMO-sites (can) support or hinder the implementation of multi-functional pond and pondscape NBS*. Besides focusing on the policies of EU countries, we also analyse policies in two DEMO sites outside the EU: Turkey and Uruguay. The aim is to provide a broader perspective on ponds and pondscapes NBS, and develop recommendations that can be applied internationally. Based on that analysis, we *detect possible policy gaps to be addressed as well as opportunities that can be harnessed to implement pond and pondscape NBS*. This involves:

- Compiling a comprehensive policy inventory of EU policies to assess in terms of their potential to support or inhibit pond and pondscape NBS at the local level;
- Conducting an analysis of policies relevant for pondscapes in the DEMO sites, and;
- Synthesising the main findings to identify key insights to the policy context and recommendations for implementing pond and pondscape NBS.

[2] Public policy is "what governments choose to do or not to do" to maintain social order and address the needs of citizens. Policies are thus resulting of governmental decisions. Decision-makers can be found at many different governance levels (i.e. the local, regional, national, and international level). The policies can also take many forms, e.g. legal acts, ordinances, decrees, different types of strategies, spatial plans, as well as guidelines and recommendations issued by authorities. These can be both legally binding and non-binding documents. For more details on policies, see Milestone 5 of PONDERFUL "The PONDERFUL Concept Note".

2. Ponds and pondscapes as NBS

2.1. What is NBS?

We are currently facing many global challenges - key ones being biodiversity decline and climate change, as both have important consequences for both nature and humans (Cardinale et al. 2012, IPBES 2019). Biodiversity decline, driven by population growth and consumption of natural resources, 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 may have negative consequences, 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 such as floods, droughts and storms, 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 & 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 help us adapt to its consequences (Loreau et al. 2003; Yachi & Loreau 1999).

To counteract this, NBS shall simultaneously provide environmental, social, and economic benefits and address societal challenges as well as increase natural elements in a variety of landscapes. They have been hailed as locally adaptable, resource-efficient, and systemic interventions (EC 2021, Science for Environment Policy 2021), and are likely more cost-effective than grey infrastructure alternatives (Seddon et al. 2020; Souliotis & Voulvoulis 2022). As defined by IUCN, “Nature-based Solutions are actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits” (IUCN 2020).

NBS as a concept has emerged out of and incorporates under its ‘umbrella’ inter alia concepts such as ecosystem-based adaptation and green infrastructure (Cohen-Shacham et al. 2019; Pauleit et al. 2017). NBS was originally promoted by high-level stakeholders (Cohen-Shacham et al. 2019; Davies et al. 2021; Eggermont et

al. 2015; Faivre et al. 2017; Mendes et al. 2020). The EU in particular has positioned itself as a global leader in NBS (Davies et al. 2021; Hanson et al. 2020; Mendes et al. 2020; O'Sullivan et al. 2020). For the EU, the focus is supposedly on 'ecologically engineering' ecosystems, while other actors also consider the mere protection of ecosystems as NBS (Cohen-Shacham et al. 2016; Eggermont et al. 2015). Hence, despite its recent proliferation, what NBS means in practice can be fuzzy (Sowińska-Świerkosz & García 2022).[3]

NBS has been described as a 'boundary concept' (Hanson et al. 2020), as its broadness allows a range of disciplines to enter into dialogues (Cohen-Shacham et al. 2019; Hanson et al. 2020; Mendes et al. 2020; Seddon et al. 2021). Also, NBS, with its focus on 'solutions', has been found to be more palatable to decision-makers than comparable 'green' concepts (Melanidis & Hagerman 2022; O'Sullivan et al. 2020).

Yet, the catch-all concept can also hamper implementation due to the absence of clear delineations and guidance for decision-makers (Gómez Martín et al. 2020; Hanson et al. 2020; Mendes et al. 2020). It can even become corrosive to underlying objectives of NBS, for example, when projects oversell contributions of 'nature' or neglect biodiversity concerns and other societal co-benefits (Garmendia et al. 2016; O'Sullivan et al. 2020; Seddon et al. 2020; Welden et al. 2021).

Consequently, while NBS as a concept is certainly a powerful tool for communication, green transformation is not automatically realised (Melanidis & Hagerman 2022). Also, not all ecosystems have found equal consideration in the wake of the concept's emergence. One of these ecosystems are ponds and pondscapes.

2.2. Ponds and pondscapes as NBS

Ponds are diverse and exist in most types of landscapes, including urban areas, farmland, grassland, peatlands, salt marshes, and woodlands. Ponds provide a wide range of environmental and socio-economic benefits. It is difficult to generalise their benefits, as surrounding land use and proximity to other ponds affect the type and quality of benefits delivered (Oertli & Parris 2019).

[3] The United Nations Environment Assembly passed a resolution in May 2022 defining NBS as "actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits" (UNEA-5 2022). As the definition is multilaterally agreed, it may have substantial influence moving forward.

In general, though, ponds support the metapopulations of many aquatic species, such as invertebrates, amphibians, and aquatic plants - thus being important in supporting regional biodiversity. Ponds, in fact, collectively support a larger proportion of rare, endemic, and threatened freshwater species than lakes or rivers (Williams et al. 2004). They are also key elements of blue landscape connectivity, acting as 'stepping stones' between freshwater water habitats and refuges for many species (Davies et al. 2008).

In addition to the individual pond, the 'pondscape' plays an important role. Connectivity of ponds in the landscape or region, amongst others determined by the density of the ponds, will affect local persistence of species populations, metacommunity structure, and regional diversity (Borthagaray et al. 2023; Davies et al. 2008). Also, while the landscape around ponds is used during the terrestrial stages by amphibians, the group of ponds themselves, with variance in size, depth, and hydroperiod, collectively represent a range of habitat types and can still support other benefits - such as agricultural purposes: "[M]aximizing both agricultural function and habitat conservation in a single pond is […] impossible, but both goals could be met at a landscape scale" (Swartz & Miller 2019: 10).

Ponds may also have the potential to play a role in climate regulation, as they possibly sequester significant amounts of carbon in their sediments (Taylor et al. 2019), although further research is required in this regard (Holgerson et al. 2016). In addition, ponds deliver ES/NCPs such as water provision, flood control, freshwater recharge, pollution amelioration, and recreation (Cuenca-Cambronero et al. 2022; Bartrons et al. 2023). They matter to human well-being because they provide a space for leisure, inspiration, and learning. See Table A1 in the Annex (Section 8.1.) for a complete list of ES/NCPs of ponds and pondscapes.

Because of their role in delivering crucial ES/NCPs, using ponds is, as opposed to the use of grey infrastructure, a way of using nature to deliver diverse solutions to several environmental problems and societal challenges, i.e. NBS.

The pond and pondscape NBS considered for PONDERFUL are:

- Pond creation (e.g. digging a pond in a place where there was formerly no waterbody);
- Pond restoration (e.g. digging a pond in a place where formerly a pond was existing; regenerating a landfilled pond; undertaking important transformations on an existing pond), and;

- Management measures. They can be implemented at the pond level (waterbody scale) or surrounding landscape level (pondscape level), and also include pond protection measures.

Examples of pond and pondscape NBS can be found in Table A2 in the Annex (Section 8.1.).

Because ponds and their role for societies have been to date largely neglected in policies and action on the ground (Biggs et al. 2017), there is an urgent need to promote their broader implementation NBS to address the ongoing climate change and biodiversity decline (Williams et al. 2020). To achieve this, it is indispensable to understand the current policy barriers inhibiting the implementation of pond and pondscape NBS as well as the factors that are already enabling it and those that could do it in the future.

3. Barriers and enabling factors for NBS implementation

3.1. What are they, and how did we identify them?

To understand how NBS are implemented and which ecosystems are most likely to be used as such, it is useful to consider policy barriers and enabling factors to NBS implementation. We define 'barriers' as factors that hamper any stage of the implementation cycle of NBS, such as design, planning, financing, or upkeep, and 'enabling factors' as those that facilitate these processes.

Below we introduce six categories of barriers and enabling factors: 1) *legislation & regulations*, 2) *management approaches & tools*, 3) *institutional capacities & cooperation*, 4) *financing*, 5) *stakeholder awareness & engagement*, and 6) *knowledge production & dissemination* (see Table 1 for an overview with pond-specific examples). The typology is founded in a review of literature concerned with the policy aspects of ponds and pondscapes. The original collection of publications was identified based on a keyword search of journal articles combining 'pond' and 'policy' in title and abstract, which was then narrowed down through a first reading of abstracts. Ultimately, we assessed twenty-one publications in detail. Additionally, we supplemented the articles with seminal publications on barriers and enabling factors for NBS implementation generally, which we selected based on our own expert judgement (see Table A3 in the Annex/Section 8.1. for a list). After reviewing the categories separately, we elaborate on linkages between them, drawing from Sarabi et al.'s (2020) insights on relationships between barriers to NBS implementation.

Table 1: Overview of barriers and enabling factors with pond-specific examples.

Category	Barriers	(Potentially) Enabling Factors	Empirical Examples of Enabling Factors
Legislation & Regulations	EU legislation aims to protect all water bodies but monitoring water bodies <50ha is optional *(Biggs et al. 2017; Boix et al. 2012; Hill et al. 2018; Oertli 2018)* Pond(scapes) are rarely protected *(Boothby 1999; Hill et al. 2018; Sayer 2014)*	Adoption of 'no net biodiversity loss' at pondscape scale can ensure habitat connectivity and quality *(Boothby 1999; Hill et al. 2018; Oertli 2018)* Small water bodies receive statutory designations *(Biggs et al. 2017; Boothby 1999)*	Different variations of 'no net loss' have been adopted across Europe, with 'net gain' becoming more commonplace in the UK *(Sayer & Greaves 2020)* Two pond types (Mediterranean temporary ponds and Irish turloughs) are HD priority habitats (Hill et al. 2018)
Management Approaches & Tools	Management has focused on single pond sites, if at all *(Boothby 1999; Oertli et al. 2009; Sayer 2014)* Managers are overspecialised on lakes and rivers *(Boix et al. 2012; Osti 2017)*	Cost-effective monitoring tools are used *(Biggs et al. 2017; Boix et al. 2012; Hill et al. 2018; Oertli 2018)* Ponds are managed at landscape-level, incl. to identify biodiversity hotspots *(Biggs et al. 2017; Boothby 1999; Hill et al. 2018; Oertli 2018; Sayer 2014)*	eDNA has been trialled in experiments *(Biggs et al. 2017)* Local projects have yielded positive results with management at pondscape-level *(Sayer 2014)* Protocols for monitoring ponds exist in some EU Member States (*Agència Catalana de l'Aigua 2006*)
Institutional Capacities & Cooperation	Roles overlap and conflict with each other *(Linnerooth-Bayer et al. 2015; Trepel 2016)* Pond(scapes) and their benefits cross borders and fields of expertise, but there are siloed institutions (*Boothby 1999; Blicharska & Johansson 2016; Kati & Jari 2016; Oertli 2018)*	Practitioners from multiple disciplines and levels cooperate *(Blicharska & Johansson 2016; Oertli 2018)*	*No empirical example identified in the literature.*

Category	Barriers	(Potentially) Enabling Factors	Empirical Examples of Enabling Factors
Financing	Management agencies are underfunded, and may hence focus on large single sites *(Boothby 1999; Hill et al. 2018; Sayer 2014)* Pond and pondscape NBS may need high initial investments *(Blicharska & Johansson 2016; Linnerooth-Bayer et al. 2015; Villanueva & Glenk 2021)* Policies rather fund grey infrastructure *(Linnerooth-Bayer et al. 2015)*	Ponds can be flexibly fit into landscapes *(Blicharska & Johansson 2016; Linnerooth-Bayer et al. 2015)* Long-term costs of small-scale NBS, like ponds, are rather low *(Biggs et al. 2017; Blicharska & Johansson 2016)* Pond(scapes) are promoted, incl. through subsidy schemes (*Boothby 1999; Hill et al. 2018; Sayer 2014; Sayer & Greaves 2020*)	Experiments indicate the cost-effectiveness of natural wastewater drainage systems *(in Blicharska & Johansson 2016)*
Stakeholder Awareness & Engagement	Citizens are not consulted during planning processes which leads to resistance *(Kati and Jari 2016; Osti 2017)* Broader public is unaware of the benefits of or threats to ponds *(Boix et al. 2012; Boothby 1999; Sawadgo et al. 2021; Sayer 2014; Sayer and Greaves 2020; Sousa et al. 2016)*	Public engagement pre-empts conflicts and enhances valuation *(Blicharska & Johansson 2016; Kati & Jari 2016)* Outreach and education raise awareness *(Boix et al. 2012; Hill et al. 2018; Oertli 2018; Oertli et al. 2009; Oertli & Parris 2019; Sayer 2014; Sayer & Greaves 2020; Sousa et al. 2016)* CSOs promote ponds *(Biggs et al. 2017; Boix et al. 2012; Boothby 1999; Oertli 2018; Sayer 2014; Sayer & Greaves 2020)*	Civil society project has facilitated more than 100 restorations of farmland ponds in England and educated stakeholders on the importance of ponds *(Sayer & Greaves 2020)* Educational programs on the value of ponds in Portuguese schools raised awareness *(Sousa et al. 2016)*
Knowledge Production & Dissemination	Pond(scape) benefits are understudied *(Biggs et al. 2017; Blicharska & Johansson 2016; Boix et al. 2012; Hill et al. 2018; Linnerooth-Bayer et al. 2015; Oertli & Parris 2019)* Knowledge is not shared *(Oertli et al. 2009; Sayer 2014)*	Scientists exchange knowledge with practitioners *(Blicharska & Johansson 2016; Boix et al. 2012; Boothby 1999; Hill et al. 2018; Oertli et al. 2009; Sayer & Greaves 2020)*	EU finances research on pondscapes as NBS *(PONDERFUL Project)* European Pond Conservation Network is a forum for exchange with practitioners *(Indermuehle et al. 2008; Oertli et al. 2009)*

3.2. Key categories

3.2.1. Legislation & Regulations

This category encompasses first and foremost the legal protections and other classifications for ecosystems, land tenure and associated rights and duties of landowners, zoning policies, as well as legal principles and standards that may impact the state of ecosystems or their potential to be used as NBS.

Most regulatory frameworks favour or even mandate grey infrastructure, excluding NBS as viable options (Deely et al. 2020; Sarabi et al. 2020). Even environmental regulations occasionally omit the protection or regulation of some ecosystems (Sarabi et al. 2019), such as the EU Birds and Habitats Directives (BHD) which lay the legal foundation for the Natura 2000 network of protected sites, but have been criticised for biases toward some vertebrates and their habitats (Mammides 2019).

Some types of ponds are protected under European law, through the Habitats Directive, such as Mediterranean temporary ponds, Irish Turloughs, or those providing habitat for specific endangered species (Hill et al. 2018). Yet, in general, environmental legislation often overlooks small water bodies such as ponds and, even more so, pondscapes (Boothby 1999; Hill et al. 2018; Sayer 2014). The most important European legislation for water resources, the Water Framework Directive (WFD), does not mandate a ‘good status’ for water bodies smaller than fifty hectares, which effectively puts most ponds outside strong regulatory control (Biggs et al. 2017; Boix et al. 2012; Gozlan et al. 2019; Hill et al. 2018; Oertli 2018).

In response, there are calls for more pond types to receive statutory designations as protected sites on the national and local level (Biggs et al. 2017; Boothby 1999). Also, there is an argument to shift the focus of environmental legislation to the pondscape scale, including also areas that are heavily altered by human activities, such as rural and urban areas (Hill et al. 2018). In this context, one pragmatic way of integrating pond protection at landscape scale with socio-economic objectives could be the application of no net ecological loss in development projects, to acknowledge that the loss of a pond has impacts larger than merely its individual value (Boothby 1999; Hill et al. 2018). In fact, in the UK, there have recently even been efforts to pursue a net ecological gain policy for specific endangered species living in ponds - with plans to expand the policy’s scope (Sayer & Greaves 2020).

3.2.2. Management Approaches & Tools

This category describes both the larger planning capacities and focus of policy-makers, as well as the day-to-day ability of managers to monitor the state of ponds and survey the compliance of key actors with the practices permitted by law.

Short planning horizons can lead to unfavourable evaluations of NBS, which often need time to develop their full benefits (Deely et al. 2020; Sarabi et al. 2020). Also, many agencies plan at small spatial scales, which can lead to disregarding 1) interactions of NBS with other infrastructure, 2) spatially distant benefits from and threats to NBS, or 3) NBS altogether, as they often cannot be 'squeezed into' the landscape a posteriori (Deely et al. 2020; Nelson et al. 2020; Ramírez-Agudelo et al. 2020; Sarabi et al. 2019; 2020). This is compounded by inadequate monitoring standards for NBS (Deely et al. 2020; Nelson et al. 2020; Sarabi et al. 2020) and a lack of data, possibly resulting in a vicious circle with a low confidence in NBS (Nelson et al. 2020; Ramírez-Agudelo et al. 2020; Sarabi et al. 2019).

Perhaps due to the omission of ponds in legislation, there is also little attention paid to them in planning and monitoring processes (Biggs et al. 2017; Linnerooth-Bayer et al. 2015). Consequently, this focus on single sites tends to go along with a neglect of issues such as landscape fragmentation that could only be grasped and addressed at pondscape scale (Boothby 1999; Hill et al. 2018; Oertli et al. 2009; Sayer 2014).

In response, there are calls for policies that initiate NBS design, monitoring, and maintenance guidelines (Deely et al. 2020; Sarabi et al. 2019; 2020). One recommendation from scholars is to cluster ponds together with associated terrestrial and aquatic habitats into management/pondscape units (Hill et al. 2018; Oertli & Parris 2019). Pondscape management decreases the need to micromanage individual ponds. Together with setting acceptable or desirable levels of change, this approach could then streamline planning and decision-making (Boothby 1999; Sayer 2014). To further keep costs down, this pondscape approach could be combined with novel monitoring tools, such as the use of environmental DNA for rapid assessments of in situ biodiversity (Biggs et al. 2017; Hill et al. 2018), satellite imagery (Oertli 2018), and sentinel sites (Hill et al. 2018). In fact, both landscape pond management and innovative management tools have been trialled successfully on a small-scale (Biggs et al. 2017; Sayer 2014), but are yet to be widely applied.

3.2.3. Institutional Capacities & Cooperation

This category focuses, on the one hand, on the human resources and expertise of institutions involved or (potentially) responsible for pond and pondscape NBS. On the other hand, it also describes their ability to cooperate across governance sectors and levels, alongside with their rapport with key actors on the ground.

Organisational silos may inhibit cooperation across sectors and scales (Nelson et al. 2020; Randrup et al. 2020), which can lead to suboptimal outcomes in terms of plurality and quality of NBS benefits (Blicharska & Johansson 2016; Kati & Jari

2016; Oertli 2018). In fact, management-related barriers are often linked to unclear institutional arrangements (Deely et al. 2020; Sarabi et al. 2019; 2020) - not least due to a complex web of EU and lower-level policies (Linnerooth-Bayer et al. 2015).

Pondscapes sometimes cross administrative boundaries and information sharing mechanisms between responsible institutions can be insufficient (Boothby 1999). However, even within political boundaries it happens that a lack of coordination on pond designs and management across concerned departments leads to suboptimal outcomes in so far as potential benefits of ponds and pondscapes are not integrated or maximised (Blicharska & Johansson 2016; Kati & Jari 2016; Oertli 2018). In addition, some managers of responsible authorities are overspecialised on particular aquatic habitats, such as lakes or rivers, losing sight of connections between them and overlooking pond contributions; or the managers hold on to the idea that only large water bodies make meaningful NBS (Boix et al. 2012; Linnerooth-Bayer et al. 2015; Osti 2017; Sayer 2014). Possibly chronic underfunding of managing institutions also contribute to the focus on single large water bodies, as monitoring numerous ponds may seem a daunting task (Boothby 1999; Hill et al. 2018; Sayer 2014).

Altogether the application of cost-effective management approaches and tools may put less of a strain on institutional capacities. Also, it would be key to make staff of institutions aware of the valuable contributions that ponds and pondscapes can make as NBS. Lastly, policies should incentivise institutional cooperation (Oertli 2018).

3.2.4. Financing

This category is here a catch-all category encapsulating the money necessary to cover costs associated with NBS - their creation, restoration, and management. This includes all money loaned, invested, granted, donated, earned, or levied.

Currently, there is a lack of (long-term) financing dedicated to NBS, especially at lower governance levels (Deely et al. 2020; Sarabi et al. 2019; 2020; Seddon et al. 2020). Linnerooth-Bayer et al. (2015) find that major EU financing tools, such as the European Regional Development Fund (ERDF), still implicitly favour large-scale grey over green infrastructure - mostly because appraisal practices still underestimate costs of grey and benefits of green infrastructure. Even if financing is available stakeholders are often unaware of it or deem applying for funds (including EU funds) too complex (Kabisch et al. 2016; Linnerooth-Bayer et al. 2015; Villanueva & Glenk 2021). Therefore, it is important to either increase public financing directed to NBS or engage the private sector. Private financing is possible, but contingent on NBS offering a business case. This can be difficult, as often NBS benefits are undervalued by the market (Wild et al. 2017), difficult to measure (Mayor et al 2021; Watkins et

al 2019), or scattered across beneficiaries, timescales, and locations (Toxopeus & Polzin 2021; Sewell et al. 2016). In addition, NBS are often perceived as riskier investments than grey infrastructure (Mayor et al. 2021; Watkins et al. 2019).

Besides pond management, the creation or restoration can pose a financial obstacle, too - both for public entities as well as private individuals. To buy or reserve public land, especially in urban areas, can seem expensive (Blicharska & Johansson 2016). Likewise, investments into irrigation ponds by landowners may surpass an individual's willingness to pay - especially, if available support is unknown to stakeholders (Linnerooth-Bayer et al. 2015; Villanueva & Glenk 2021).

At the same time, often ponds and pondscapes tend to accrue lower maintenance costs compared to large-scale NBS or grey infrastructure and can also be repurposed, if need be (Boothby 1999; Hill et al. 2018; Sayer 2014; Sayer & Greaves 2020) - hence, running a lower likelihood to result in costly adaptation lock-ins (Blicharska & Johansson 2016; Linnerooth-Bayer et al. 2015). Current payment schemes should be expanded in terms of the kinds of NBS they support and supplemented with local schemes, going beyond a mere focus on water streams. Ideally, this would include provisions for an exponential valuation of protection at pondscape scale (Sayer & Greaves 2020). To then make use of financing, it would require a widespread awareness amongst decision-makers, planners, and private individuals for the societal benefits of ponds and pondscapes.

3.2.5. Stakeholder Awareness & Engagement

This category comprises stakeholders' perceptions of NBS benefits and the urgency to employ NBS. It also describes the engagement processes that stakeholders can participate in to influence the implementation of NBS.

An unwillingness by stakeholders to support the implementation of NBS may stem from a lack of awareness and underestimating net benefits from and threats to ecosystems (Deely et al. 2020; Nelson et al. 2020; Sarabi et al. 2020). For example, socio-cultural norms - shaped by a 'paradigm of growth' (Kabisch et al. 2016) - make stakeholders expect economic growth from investments and thus prioritise measures whose benefits are amenable to monetization, which currently is more likely to be grey infrastructure (Deely et al. 2020; Nelson et al. 2020; Ramírez-Agudelo et al. 2020; Sarabi et al. 2020).

Indeed, stakeholders are often unaware of pressures ponds are exposed to as well as pond benefits (Boix et al. 2012; Boothby 1999; Sawadgo et al. 2021; Sayer 2014; Sayer & Greaves 2020; Sousa et al. 2016). Consequently, ponds as NBS may seem cumbersome or unnecessary and appear to be in the way of other, seemingly more

productive land uses, such as agriculture. Even in places where ponds are constructed to support agriculture and cattle production, other benefits such as habitat creation and biodiversity enhancement are typically not considered by farmers or managers (Vo et al. 2023). This can then lead to pond and pondscape NBS to be resisted and ultimately delayed or derailed (Kati & Jari 2016; Osti 2017).

Working toward a more sustainable knowledge base amongst stakeholders would require continuous engagement through environmental education or citizen science programs (Sayer & Greaves 2020; Sousa et al. 2016). There is also a need for policies to promote participatory processes around NBS to raise awareness, distribute benefits equitably, pre-empt conflicts, and nurture stewardship (Boelee et al. 2017; Deely et al. 2020; Kati & Jari 2016; Nelson et al. 2020; Osti 2017; Sarabi et al. 2019; 2020; Randrup et al. 2020; Seddon et al. 2021; Welden et al. 2021). This may additionally help to ascertain NBS benefits more precisely (Blicharska & Johansson 2016), strengthening their position vis-à-vis other alternative development actions through a more realistic valuation.

3.2.6. Knowledge Production & Dissemination

This category relates to determining NBS benefits, their valuation, and the transmission of this knowledge.

Understanding, particularly, social and environmental NBS benefits is still in its infancy, particularly over long temporal and wide spatial scales (Deely et al. 2020; Nelson et al. 2020; Ramírez-Agudelo et al. 2020; Sarabi et al. 2020; Seddon et al. 2020). Consequently, NBS fare poorly compared to grey infrastructure in standard valuation methods (e.g. Linnerooth-Bayer et al. 2015). Also, available knowledge is rarely transmitted to policy-makers (Deely et al. 2020; Sarabi et al. 2019).

Ultimately, the negative trend in terms of pond quality and quantity also often comes down to a limited knowledge base. Currently, the benefits for biodiversity and, particularly, climate change mitigation are still understudied (Biggs et al. 2017; Boix et al. 2012; Oertli 2018; Oertli & Parris 2019). Together with knowledge gaps regarding the approximation of immaterial values of ponds, it becomes difficult to ascertain costs and benefits. This is an obstacle to implementation, as it complicates comparisons with other NBS or grey infrastructure (Blicharska & Johansson 2016; Linnerooth-Bayer et al. 2015). In addition, there is scholarly agreement that the science-policy gap regarding ponds is still too wide. Consequently, newly generated knowledge rarely finds its way into policy-making and planning measures (Boix et al. 2012; Oertli et al. 2009; Sayer 2014; Sayer & Greaves 2020).

There is a need for action-focused research that ascertains NBS benefits (Dumitru & Wendling 2021), including stakeholder preferences, and implements NBS accordingly (Nelson et al. 2020; Sarabi et al. 2019; 2020). For ponds, in particular, the European Pond Conservation Network attempts to intensify research efforts and provide a platform for exchange between scientists and practitioners (Oertli et al. 2009; Sayer & Greaves 2020).

3.3. Relationships between categories

Listing barriers and enabling factors helps with putting the main issues into focus. Yet, the separation is not representative of their interwoven nature. Sarabi et al. (2020) show interdependencies between barriers to NBS implementation, suggesting that legal frameworks have knock-on effects for planning choices, learning and knowledge transmission, institutional cooperation, public awareness and acceptance, as well as financial resources or incentives.

The review of the pertinent pond literature suggests, and occasionally makes explicit, similar linkages. Specifically, the omission of ponds from most relevant EU policies likely has ramifications for the monitoring and planning priorities of Member States, which largely focus on lakes and rivers. Likewise, limited knowledge development and transmission may contribute to deficient cost-benefit analyses as well as stakeholder awareness, which in turn could result in a lower acceptance and adoption rate of pond and pondscape NBS.

It follows that addressing one barrier, such as the non-protection of many ponds, could also drive knowledge development and open up investment opportunities or financial resources for managing institutions. In addition, many barriers can be addressed through policy, although it does not seem like that at first. For example, stakeholder engagement can be prescribed by policies, or research can be financed through policies, etc.

All in all, the understanding of barriers and enabling factors for the implementation of NBS is still in its infancy, however, and requires further exploration (Sarabi et al. 2020), even more so when it comes to ponds and pondscapes.

4. Methodology

4.1. Methodological approach

To *understand how EU-level policies and local, regional, and national policies in the DEMO sites (can) support or hinder the implementation of pond and pondscape NBS*, we conducted our analysis in two steps. We first assessed the EU and then the DEMO site policy context -- for analytical and organisational reasons: Firstly, the EU policies set the framework in which actors at lower levels at many of the DEMO sites operate. At the same time, many EU policies do not have an immediate effect on NBS implementation, but develop their impact indirectly through local policies. By first analysing EU policies, we could formulate assumptions about opportunities and limitations for the implementation of pond and pondscape NBS imposed by those policies, but refine those based on insights gathered later at DEMO site-level. Additionally, first assessing EU policies facilitated an understanding which lower-level policies may have an impact independent from higher-level policies, as well as more insightful comparisons with the policies in DEMO sites located outside the EU. Importantly, the analysis at DEMO site level also shed light on practices outside of written policies that however impact the implementation of pond and pondscape NBS. Secondly, the sequence of other activities in WP1 suggested starting with the EU analysis before the one of the DEMO sites: the second project workshops, focused on the policy context in DEMO sites, were not scheduled until the project months 21-27. Therefore, a desk-based analysis of EU policies was the initial focus.

4.2. Data set

4.2.1. EU policy documents

Based on the literature, snowball sampling (i.e. based on policies referring to other relevant policies), and a targeted search, we selected 37 EU policies to assess the barriers and enabling factors for implementing pond and pondscape NBS (see Table 2). The analysis was done by conducting a qualitative content analysis of these policies (see Section 4.3.1. for details). Given the manifold benefits of ponds and pondscapes, as well as multiple drivers of pond deterioration, we considered an array of policy areas (see Table 2). We sought out the most recent binding policy in each policy area, supplemented by relevant non-binding policies (see List A1 in Annex/Section 8.1. for selection criteria). Ultimately, our data set consists of many policies that are not specifically focused on NBS - with some predating the NBS concept. They still bear relevance for the implementation of NBS however, as they potentially affect many of the barriers and enabling factors mentioned above.

Table 2: Assessed EU policies, including acronyms used in the Results section

Policy area	Name of the policy	Year	Binding	Acronym
Agriculture	Nitrates Directive	1991	Yes	ND
	Pesticides Directive	2009	Yes	PD
	Common Agricultural Policy 2023-2027	2021	Yes	CAP
	Farm to Fork Strategy	2020	No	F2F
Biodiversity Conservation	Habitats Directive	1992	Yes	HD
	Birds Directive	2009	Yes	BD
	Green Infrastructure Strategy	2013	No	GI
	Invasive Alien Species Regulation	2014	Yes	IAS
	Action Plan for Nature, People, and the Economy	2017	No	APNPE
	Pollinators Initiative	2018	No	PI
	Biodiversity Strategy 2030	2021	No	BS
	Zero Pollution Action Plan	2021	No	ZPAP
	Nature Restoration Law	2022	Proposed	NRL
Climate & Environment	Strategic Environmental Assessment Directive	2001	Yes	SEA
	Environmental Impact Assessment Directive	2011	Yes	EIA
	Adaptation Strategy	2021	No	AS
	Climate Law	2021	Yes	CL
	Forest Strategy 2030	2021	No	FS
	Just Transition Fund	2021	Yes	JTF
	Programme for Environment and Climate Action (LIFE)	2021	Yes	LIFE
	8th Environmental Action Programme to 2030	2022	Yes	EAP
Economic Development	Making Public Procurement Work in and for Europe	2017	No	PP
	Circular Economy Action Plan	2020	No	CEAP
	Taxonomy Regulation	2020	Yes	TR
	Financing the Transition to a Sustainable Economy	2021	No	FTSE
	Common Provisions for the MFF 2021-2027	2021	Yes	MFF
	EU Regional Development Fund and Cohesion Fund	2021	Yes	ERDF/CF
	Recovery and Resilience Facility	2021	Yes	RRF
Tourism	Strategy for Sustainable Tourism	2021	No	SST
Research	Horizon Europe	2021	Yes	HE
Water	Urban Waste Water Treatment Directive	1991	Yes	UWWTD
	Water Framework Directive	2000	Yes	WFD
	Integrated Coastal Zone Management	2002	No	ICZM
	Dangerous Substances Directive	2006	No	DSD
	Floods Directive	2007	Yes	FD
	Industrial Emissions Directive	2010	Yes	IED
	Water Blueprint	2012	No	WB
	Priority Substances Directive	2013	Yes	PSD

4.2.2. DEMO site and pondscape selection and material collected

A total of 18 pondscapes in 8 DEMO sites - totalling ca. 490 ponds - have been selected for their potential to represent good practices of NBS implementation in Europe as well as Turkey and Uruguay. Basic information about each pondscape is presented in Table 3.

The pondscapes selected represent a variety of circumstances under which pond and pondscape NBS are or could be implemented. Specifically, the pondscapes are in:

- Different bioclimatic zones;
- Are exposed to or integrated in a variety of land uses;
- At different stages of the NBS implementation process;
- Have various ownership and protection statuses.

Although we do not consider our sample representative of pondscapes as a whole (as the selected pondscapes are managed by actors known to or affiliated with PONDERFUL partners), the sample constitutes a width of circumstances under which pond and pondscape NBS are implemented.

For each pondscape we collected and assessed information on the socio-economic context, on the most consequential policies for pond and pondscape NBS, and recorded workshop discussions amongst invited stakeholders (see Section 4.3.2. for details). Specifically, we conducted the following steps of the *preparatory analysis* to assemble the final data set for the local/national policy analysis:

- Step 1A: Mapping the political and socio-economic context, in which we asked DEMO site colleagues to describe the main land uses, conflicts, stakeholders, and implemented or planned NBS for each pondscape (see Table A4 in Annex/Section 8.2.1. for instructions and template);
- Step 1B: Mapping the policy space, for which we asked DEMO site colleagues to compile a long list of policies potentially impacting pond and pondscape NBS (see Table A5 in Annex/Section 8.2.1. for instructions and template);
- Step 2A: Reviewing the long list of policies together with DEMO-site colleagues, and providing suggestions for additional relevant policies based on previous EU policy analysis, as well as the socio-economic and political context of each pondscape;

Table 3: Selected DEMO sites, PONDERFUL pondscapes, and key information *Note: We refer to the pondscapes investigated in depth as 'PONDERFUL pondscapes'. If we refer to a 'DEMO site', we mean the overarching policy context of the country (or, where relevant, the region the respective PONDERFUL pondscapes are located in).*

DEMO site	PONDERFUL Pondscape	Bioclimatic zone	Main land use	# of ponds
Belgium (Flanders)	Gete Vallei	Atlantic	Pasture/arable land	16
	Pikhakendonk		Pasture	12
	Tommelen		Nature reserve	22
Denmark	Fyn Islands	Continental	Pasture/arable land	>30
	Lystrup		Suburban/arable land	>14
Germany (Brandenburg)	Schöneiche	Continental	Arable land	12
Great Britain (England)	Pinkhill Meadows	Atlantic	Floodplain	50-60
	Water Friendly Farming		Pasture/arable land	120
Switzerland (Geneva)	Bois de Jussy	Continental	Woodland	25
	Rhône genevois		Pasture/arable land, peri-urban	40
Spain (Catalonia)	Albera	Mediterranean	Mediterranean scrub	23
	La Pletera		Coastal marshes	20
Turkey	Gölbaşı Düzlüğü	Central-Anatolian arid-cold steppe	Peri-urban	50
	Imrahor Valley		Peri-urban	6
	Lake Morgan		Peri-urban	10
Uruguay	Humedales de Maldonado	Subtropical/ temperate-humid	Peri-urban	6
	La Pedrera		Extensive grassland / arable land	11
	Sierra de los Caracoles		Extensive grassland / intensive pastures	10

- Step 2B: Assessing in detail the impact/barriers and enabling factors contained in selected key national/local[4] policies (5-10 per pondscape), for which we assisted DEMO site colleagues with discussions, advice, and two options for structured analysis (see Tables A6 and A7 in Annex/Section 8.2.2. for templates).
- Step 2C: Collecting additional details through selectively engaging in in-depth interviews with a small set of stakeholders and reviewing academic and/or media sources.

Based on the information gathered through the steps described above, we drafted a script for a workshop session to be organised in each DEMO site, in which we presented the main results of the preparatory analysis to stakeholders. Subsequently, we discussed and validated our main insights with the stakeholders present at the workshops, recording the key discussion points. Lastly, during the workshops we conducted a group work on barriers and enabling factors for pond and pondscape NBS, again recording key statements from stakeholders in these groups (see Table A8 in Annex/Section 8.2.3. for an example of the template). Collectively, these summaries of the mapping and analysis prior to the workshops, as well as recordings/minutes of workshop discussions formed the data set for our qualitative content analysis of the local/national policy context.

4.3. Data analysis

4.3.1. EU policy analysis

We conducted an extractive qualitative content analysis of the policies to familiarise ourselves with the data, filter out and synthesise relevant information, and highlight first linkages, commonalities, and contradictions between policies (Gläser & Laudel 2013). We supplemented this with analytic matrices to identify key relations and comparisons (Miles et al. 2013). See Figure 1 for a graphic illustration of the process.

In the first stage of the analysis, we read the policies paragraph by paragraph through the lens of the categories of barriers and enabling factors identified in the literature. These functioned as our initial theory-derived ‘categories’, to which we assigned summarised text segments. Each category was broken down into ‘dimensions’, namely: time frame, geographic and thematic scope, type of policy measure or tool, roles and responsibilities for the implementation of a policy aspect,

[4] While the focus was on the particular local context of the PONDERFUL pondscapes, their policy context is sometimes inevitably linked to national level policies. For example, national statutory designations may be applied to the respective pondscapes. Likewise, for example, a national CAP Strategic Plan may have relevance for a specific PONDERFUL pondscape, but also for pondscapes in the DEMO site as a whole.

rationale, objective, and (expected) effects – which provided a standardised template for data entries. In the process, we also identified policy goals, objectives, and targets as their own 'category' because we deemed them relevant but dissimilar from the information recorded under the other barriers and enabling factors.[5] Subsequently, we subsumed (near-)identical data entries and supplemented each of the remaining entries with our reflections on the implications of the recorded information for the implementation of ponds and pondscapes as NBS.

In the second stage, we rearranged the information into three themes, according to 1) landscape type (all landscapes, coastal, rural, urban), 2) NBS type (all NBS types, NBS creation, NBS restoration, and NBS management), and 3) intended benefit of an NBS measure (biodiversity; climate change adaptation and/or mitigation; water and soil management; other benefits). In addition, we sorted information into sub-themes (e.g. land use restrictions for water and soil management in rural areas), where appropriate. The first two themes were informed by literature which suggests that the type of NBS can vary depending on the landscape (see e.g. Eggermont et al. 2015; Krauze & Wagner 2019), whereas the themes on benefits and any sub-themes emerged empirically.

Although the themes were still relatively coarse, we were able to explore relationships between categories (i.e. barriers and enabling factors) by rearranging the information. In the process we realised that many of the barriers and enabling factors do not work in isolation, but interlink within and across policies. For example, a policy may award a statutory designation such as Natura 2000 status to a habitat, which in return makes this habitat eligible for financing and receive prioritisation for land use management activities or knowledge development support decreed by other policies. To account for such interactions, we conceived the concept of 'opportunities', which refers to the collective effect of different enabling factors creating favourable circumstances for responsible political entities and private stakeholders to implement one or several types of NBS for a given purpose and/or in a given landscape. Likewise, we conceptualised 'limitations' which describe the collective effect of barriers negating or narrowing opportunities. In short, individual barriers and enabling factors add up to opportunities and limitations for implementing pond and pondscape NBS.

[5] We also carried this analytical category over to the local/national policy analysis.

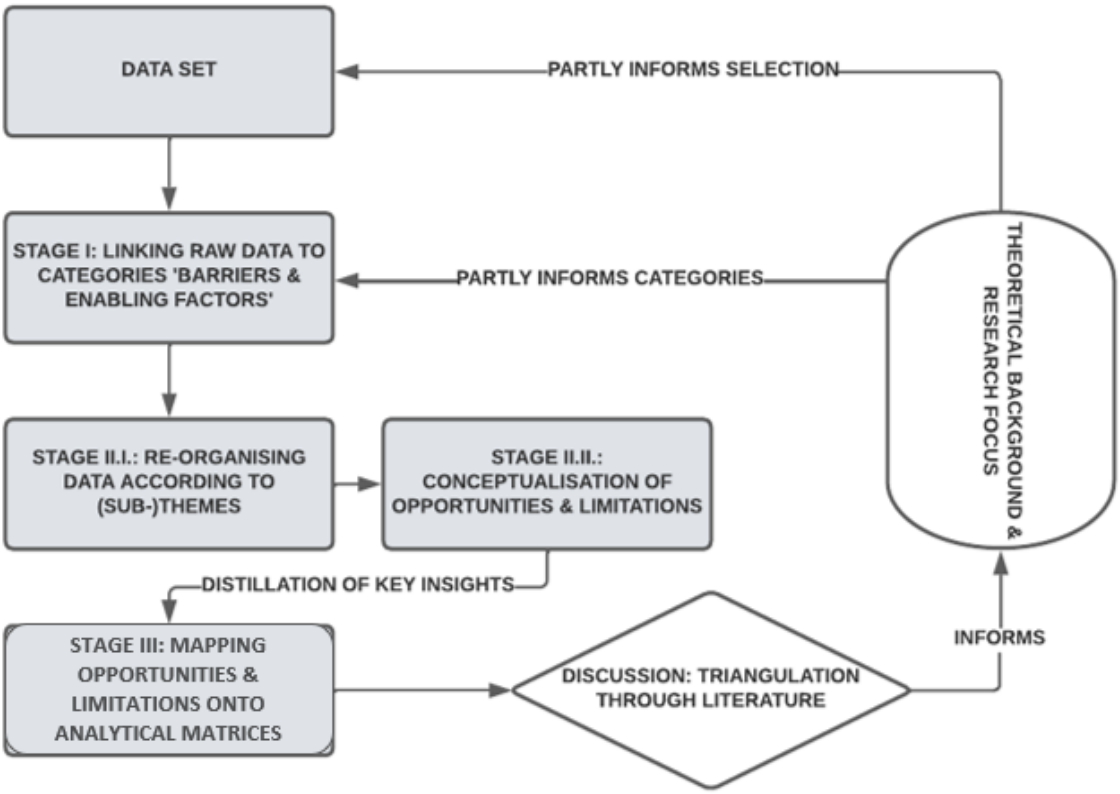

Figure 1: Graphic illustration of the process of the EU policy analysis

In the last stage, we mapped opportunities and limitations on matrices with changing combinations of themes to obtain “a workable and productive set of partitions and/or clusters” (Miles et al. 2013: Ch. 6). Matrices are not only tools to display information, but also a heuristic to make comparisons and note relations (Miles et al. 2013). We discussed each entry in the matrices iteratively to a) eliminate information that did not provide sufficient substance to understand implications for the implementation of pond and pondscape NBS, b) identify relationships between opportunities that were originally mapped separately and merge this information, and c) recapitulate how entries emerged from the original data set to ensure that there are no distorted findings. In the results section, we display our final matrices which show salient opportunities and limitations for the implementation of pond and pondscape NBS provided by the EU policy framework. We also include a column that displays information for which it remained ambiguous or uncertain whether barriers and enabling factors would amount to opportunities or limitations. Additionally, we present relevant cross-cutting findings that apply to all themes and could not be assigned to a particular matrix.

4.3.2. Local/national policy analysis

For the local/national policy, we employed a similar, yet slightly distinct approach. Small variations to the approaches described above were necessary to accommodate

the different levels of experience of the DEMO site colleagues conducting the analysis (where required due to unavailability of adequate language skills of the researchers involved in this Task).

Firstly, since a majority of the DEMO site colleagues are not profoundly familiar with social science methods, we developed a guide and provided the option to conduct an extractive qualitative content analysis of the key policies identified for each pondscape. Here, DEMO site colleagues were asked, same like with the EU policy analysis, to go through the policies paragraph by paragraph and to record relevant information under each of the predetermined categories (i.e. barriers and enabling factors). However, some DEMO site colleagues did not feel confident in applying the method. Therefore, we also provided a simplified template for the analysis of the policies (see Table A6 in Annex/Section 8.2.2. for templates).

Secondly, the information compiled through the analysis above, the overview of the socio-economic context of each pondscape (which DEMO site colleagues had provided previously), and additional information on the policy context collected via selected interviews with local experts were merged into a ‘script’. This ‘script’ functioned both as a summary of the policy context, as assessed prior to the workshop, and the content of the presentation to stakeholders at the workshop. Before the summary was presented to and validated with stakeholders, the ‘script’ was once more examined and, if necessary amended, by DEMO site colleagues.

Thirdly, at the workshops at each DEMO-site, we presented the summary to stakeholders and discussed our main findings with them. This had several purposes: it allowed us to validate our insights gained through the desk-based research and compare them with the actual situation ‘on-the-ground’. Also, it helped address any possible knowledge gaps that we had identified but could not fill prior to the workshop. The entailing discussions at the workshop were recorded by note-takers.

Fourthly, we conducted a break-out group activity at the workshops, during which stakeholders were asked to score and discuss different possible barriers and enabling factors in the context of their PONDERFUL pondscape and/or DEMO site. Additionally, they were asked to record the main points of their discussion in writing. Where possible, we supplemented the stakeholders’ records with the notes from DEMO site colleagues participating in the respective workshops.

The material collected prior (the ‘script’) and during the workshops (discussion minutes and notes from break-out groups) were then analysed through a qualitative content analysis using the software NVivo. For this purpose, we assessed the data through the categories of barriers and enabling factors previously identified in EU level analysis. Through several rounds of coding we then refined the analysis through

identifying sub-categories. Importantly, in addition to barriers and enabling factors, we also compiled a list of potentially enabling factors, which describe either policy instruments which have not been implemented (and it is not clear whether they will be) or they describe a policy or practice that stakeholders would desire to advance the implementation of ponds and pondscapes as NBS (i.e. a 'wishlist').

In the results section, we presented a summary of our findings, showing which barriers and enabling factors occur across DEMO sites. Importantly, the pondscapes investigated in depth in PONDERFUL ('PONDERFUL pondscapes') only provide a snapshot of the policy context under which the implementation of pond and pondscape NBS is enabled or inhibited. In most, but not all, of the PONDERFUL pondscapes NBS implementation is more advanced (e.g., because of longstanding relationships between stakeholders, an active civil society, a sustained period of research projects in the area, etc.), which is why we differentiate, where useful, between the policy context in DEMO sites as a whole and the PONDERFUL pondscapes located within them.

Unlike with the EU policy analysis, we did not distil the cumulative opportunities and limitations that emerge out of the interlinkages between barriers and enabling factors. This is because the way barriers and enabling factors interlink in the various DEMO sites is characterised by many idiosyncrasies. Nonetheless, we did record the interlinkages and briefly highlight those that occur in the majority of DEMO sites.

5. Summary of results

Below we show a summary of our results. The first section (i.e. Section 5.1.) focuses on the EU policy analysis and the second section (i.e. Section 5.2.) on the local/national policy analysis. Where relevant linkages between the two contexts are highlighted in the text, but first and foremost addressed in the final chapter. Additionally, the local/national policy analysis, of course, also sheds light on policy contexts outside of the EU (specifically on GBR, TUR, URY).

5.1. EU policy analysis

EU policies contain barriers and enabling factors, which amount to opportunities and limitations for implementing pond and pondscape NBS. First, we show cross-cutting findings. Thereafter, we present findings differentiated by intended NBS benefits. These findings apply, to some degree, to all landscapes and NBS types. Subsequently, we show findings specific to pond and pondscape NBS located in coastal, urban, and rural areas. Lastly, we capture findings for the different types of NBS, (creation, restoration, and management of ponds and pondscapes). Acronyms in the brackets indicate the policies where the respective information is found. Tables 4-6 summarise the findings.

5.1.1. Cross-cutting findings

The EU intends to improve the monitoring of NBS and their benefits (EAP). This aligns with an ambition to incorporate non-cost-based selection criteria in tenders, which shall boost the integration of NBS into decision-making processes (BS; PP), next to planning guidelines for lower-level authorities (AS; CAP; GI; PI). In addition, stakeholders' awareness of threats to ecosystems and NBS benefits shall be nurtured via citizen science and education (AS; EAP; NRL). Some policies even earmark financing for community-led strategies, which may include NBS (CAP; MFF). Yet, whether these findings will benefit ponds and pondscapes may depend on which NBS and benefits will be monitored and raised awareness for under these policies.

5.1.2. Opportunities & limitations for pond(scapes) depending on NBS benefits

Biodiversity: A main objective of the EU is strengthening inland aquatic biodiversity and connected terrestrial ecosystems and wetlands (EAP; WFD), including through a wide adoption of the 'net gain' principle (BS; NRL). Furthermore, habitat connectivity and pollinator health are foci to enhance biodiversity. Habitat connectivity is a common motif (BD; CAP; EAP; GI; HD; PI), and reflected in proposed conservation

targets, of which one mandates reconnecting rivers with floodplains and wetlands (NRL). Likewise, Member States shall be obliged to reverse pollinator decline by 2030, lower-level authorities shall receive support with planning for pollinator needs, and there is funding for researching and implementing relevant NBS (BS; PI; NRL; CAP). There is even funding for landscape-level strategies and projects incorporating NBS (ERDF/CF; PI). In fact, ponds, and natural water retention measures (NWRM), are suggested as 'stepping stones' to improve Natura 2000 network connectivity (HD; PI).

Yet, opportunities for pond and pondscape NBS may be limited by a focus on habitats and habitats of the species listed in the Birds and Habitats Directives (BHD). Policies underscore the need for good health of all ecosystems (EAP; NRL), but proposed biodiversity targets emphasise re-establishing BHD habitats, expanding Natura 2000, or better managing existing sites (BS; NRL). Thereby, ponds - besides Mediterranean temporary ponds and some turloughs that are explicitly mentioned by the HD - remain outside key targets and linked policy mechanisms. For example, the WFD and the Strategic Environmental Assessment Directive command strict monitoring of Natura 2000 sites, but not of other areas (SEA; WFD). Likewise, biodiversity monitoring shall eventually be enhanced generally, but initially focus and rely on reporting under Natura 2000 and WFD (IAS; NRL; PI). This is compounded by funds particularly financing measures identified in Natura 2000-focused biodiversity strategies (HD; LIFE) or determining progress by Natura 2000 surface area supported (CAP; ERDF/CF).

Climate Change Adaptation and Mitigation: When Member States select BHD habitats to re-establish or protect, they must prioritise those with adaptation and mitigation co-benefits (BS; CL; NRL). In particular, carbon-rich areas (e.g. peatlands, salt marshes, wetlands) with "swift and predictable" (CL: Art. 4) mitigation contributions shall be strictly protected (BS) and restored (CAP; ERDF/CF). Beyond protecting and restoring BHD habitats, the EU strives to use "nature as an ally" for adaptation and mitigation generally (BS). In this context, measures for disaster risk reduction, and particularly NWRMs, receive strong support - both as a financing and research priority (AS; BS; CL; EAP; ERDF/CF; FD; GI; HE; PP; WB).[6] Also, public entities are encouraged to conduct 'climate proofing' of budgets and investments, considering effects for resilience and carbon storage of green infrastructure (AS; BS; MFF).

[6] After the analysis was concluded the EC adopted in June 2023 a Delegated Act to the Taxonomy regulation which underlines the relevance of detention basins and retention ponds for flood and drought risk prevention and protection. This further buttress the support of NWRM as NBS.

Table 4: Opportunities and limitations for pond(scape) NBS divided by intended benefit, as revealed by the EU policy analysis. *Legend: ++/-- also in binding policies, +/- only in non-binding policies. G Goals, Objectives & Targets, L&R Legislation & Regulations, M Management Approaches & Tools, IA Institutional Arrangements & Capacities, F Financing, K Knowledge Development & Transmission, SH Stakeholder Awareness & Engagement*

	Opportunities	Ambiguous	Limitations
Biodiversity	Boost inland water biodiversity (incl. via NBS), and promote the net-gain principle globally (++G-L&R-M-K) Ensure habitat connectivity, incl. via NBS (e.g., restoring rivers, ponds as 'stepping stones') (++G-L&R-F-K-SH) Reverse the pollinator decline (++G-M-F-K)	Re-establish BHD habitats and protect 30% of EU territory, esp. BHD habitats disappearing and habitats with 'umbrella effect' (G-L&R) Better biodiv. monitoring (incl. via citizen science), using existing data (M-SH) Generate €20bn/year for N2000 and green infrastructure (F)	Focus on N2000 and priority habitats, which impacts monitoring, management and planning, and financing (--G-L&R-M-F)
Climate Change Adaptation and Mitigation	Boost resilience through NBS (esp. NWRM) via research, planning, and funding (++G-M-IA-SH-K-F) Provide guidance on 'climate proofing' investments regarding climate risks (+F-K) Make citizens and policy-makers aware of climate risks and NBS benefits (++SH-F-K)	Restore all ecosystems, but first BHD habitats with adaptation or mitigation co-benefits (G-L&R-M) Study and finance NBS with mitigation potential and develop a system for carbon removal certification (L&R-M-F-K) Identify NWRM (mainly in wetlands) in FRMPs (M-F-K)	*No identified clear limitations.*
Water & Soil Management	Achieve Zero Pollution via monitoring, investments, stakeholder platforms, and pledges (+G-M-F-SH-K) Revise wastewater/water reuse regulations; research and finance NBS (++L&R-F-K)	Research and finance NBS based on aquatic ecosystems for the integration of water, soil, and land use objectives, and plan them (e.g., retention ponds) in RBMPs/FRMPs (G-M-F-K)	Achieve a 'good status' for water bodies >50ha (<50ha is optional), incl. through NBS, and control emissions of dangerous substances through inventories (--G-M)
Other Benefits	Determine and meet human need for green infrastructure (++G-K-SH)	Research potential of NBS for job creation and reducing inequalities (F-K) Finance measures for natural and cultural heritage sites to exploit economic potential (F)	Study and use natural capital for economic growth (-G-K) EIAs/SEAs are not required or recommended, unless cultural heritage is affected (esp. at N2000 sites) (--L&R)

Opportunities for ponds as NBS for adaptation and mitigation remain unclear. In general, most ponds are not BHD habitats, which means they may not be prioritised when Member States decide which habitats to maintain and restore first. Also, uncertainty remains about the relationships between ponds and wetlands, which is relevant because the latter is identified as a key ecosystem for both climate change adaptation and mitigation with financing and planning instruments being available to implement the respective NBS (e.g. ERDF/CF; FD). In addition, ponds for climate change mitigation may find more application in the long run if research into NBS as carbon sinks were to focus on them and prove their value for such purposes (HE). When it comes to adaptation, most policies focus on floodplains, wetlands, and soils, but a consideration as NWRM can be an opportunity for ponds. In fact, the non-binding Green Public Procurement criteria suggest ponds as part of artificial wetlands for stormwater retention (EC 2016). Likely, opportunities will hinge on choices that implementing authorities make when drawing up strategies such as CAP Strategic Plans, Drought and Flood Risk Management Plans, National Adaptation Plans, etc. This, in turn, may depend on which NBS will be developed and disseminated through exchange platforms and research efforts such as the HE Mission 'Adaptation to Climate Change', which shall help two hundred communities to develop adaptation actions and explore synergies with EU-funding instruments (AS; HE).

Water & Soil Management: There is commitment to a zero-pollution target, to be achieved through improved monitoring, stakeholder platforms and pledges, and NBS investments (ZPAP). Particularly, amending key regulations, research, and funding shall propel wastewater treatment and water reuse via NBS (CEAP; FS; GI; HE; WB; ZPAP). While these aspirations are non-binding, regulations already allow villages and small coastal cities to use wetlands and ponds for wastewater treatment (UWWTD).

Newly created and restored ponds could help integrate water, soil, and land use management objectives, for example by reducing mud floods (FS; WB). As for existing ponds, they may be exposed to pollution and in-filling as land use and the use of water resources is mainly defined by WFD-related River Basin, Flood Risk, and Drought Management Plans (AS; WB), and the WFD makes managing water bodies smaller than fifty hectares optional. Consequently, most ponds do not have a defined reference condition that should prevail in the absence of human disturbance, are not monitored or covered in inventories that track emissions of 'priority substances' into water bodies, and are unprotected from detrimental measures (WFD).

Other Benefits: Overall, the EU wants to generate green growth through natural capital, including via NBS (e.g. BS; CL; NRL). Research shall focus on economic

growth opportunities and contribute to the economic valuation of NBS (HE). Likewise, funding shall target NBS with job creation potential (ERDF/CF; LIFE; RRF). A preoccupation with nature as a service provider is also reflected in policies that shall protect ecosystems, as they allow for activities with detrimental ecological impacts if there is an 'overriding public interest' (EIA; PD; SEA). In fact, even policies that acknowledge intangible natural and cultural heritage contextualise it with economic use (e.g. through eco-tourism) (CAP) - unless Natura 2000 is affected, as heritage is then treated as a greater intangible good (EIA; FD; SEA). This may limit the implementation of NBS without an apparent business case, as is often the case for ponds and pondscapes.

Yet, some policies do indicate non-economic benefits, acknowledging a human need for a healthy environment or green infrastructure for well-being (BS; EAP; ICZM; ZPAP). Research shall help ascertain these benefits (HE), but there are no dedicated policy mechanisms to foster NBS providing primarily non-economic benefits.

5.1.3. Opportunities & limitations for pond(scapes) depending on landscape types

Coastal areas: There are no concrete opportunities for pond and pondscape NBS located in coastal areas, but the EU intends to better understand and make use of coastal wetlands as NBS (BS; EAP; GI; NRL). In general, the implementation of coastal NBS should be coordinated through Integrated Coastal Zone Management (ICZM) Plans, which can include a wide range of NBS and shall help maintain the ecological and cultural integrity of coastal ecosystems. Importantly, the ICZM Recommendation states that economic concerns shall not be prioritised over other matters. The impact of these provisions depends on whether decision-makers consider ponds and pondscapes ecologically and culturally significant components of coastal ecosystems.

Urban areas: There are a range of provisions which may affect the implementation of pond and pondscape NBS in cities. The objective to study the potential of NBS and their integration into urban planning is often reiterated (BS; ERDF/CF; GI; MFF: NRL; PI). NBS shall also improve habitat connectivity through planning at landscape scale and strengthening urban-rural linkages, which shall be supported via 'integrated territorial strategies' and Urban Greening Plans (BS; EAP; ERDF/CF GI; MFF; PI).

While ponds and pondscapes are not directly mentioned, their potential to address various urban societal challenges (e.g. water retention and purification, leisure spaces, cooling) and them being stepping stone habitats may help with achieving the mentioned objectives and provide implementation opportunities. Further opportunities may come out of the planned EU Strategy for a Sustainable Built

Environment which shall promote the reduction of soil sealing and the restoration of brownfields with NBS (BS; CEAP; MFF), which could be implemented inter alia via Flood Risk Management Plans (WB).

Table 5: Opportunities and limitations for pond(scape) NBS divided by landscape type, as revealed by the EU policy analysis. *Legend: ++/-- also in binding policies, +/- only in non-binding policies. G Goals, Objectives & Targets, L&R Legislation & Regulations, M Management Approaches & Tools, IA Institutional Arrangements & Capacities, F Financing, K Knowledge Development & Transmission, SH Stakeholder Awareness & Engagement*

	Opportunities	Ambiguous	Limitations
Coastal	Maintain eco. and cultural integrity of ES, incl. through ICZM and collaborating with stakeholders (++G-M-SH-F)	Make use of and study coastal ES for biodiversity and/or climate change mitigation (+G-K)	*No identified clear limitations.*
Urban	Ensure habitat connectivity, incl. through studying and integrating NBS into landscape-level planning (++G-M-F-IA-K) Meet human need for GI, focussing on reducing social inequities in access (++G) Limit soil sealing via FRMPs and Strategy for Sustainable Built Environment (+M-K)	Ensure 'no net loss' and medium-term increase of green space (G-L&R)	*No identified clear limitations.*
Rural	Ensure a positive trend of high-diversity landscape features (incl. ponds) (++G) Reduce pesticide/fertiliser inputs (incl. via research) or use statutory designations and management plans to protect aquatic and connected ecosystems (++G-L&R-K-M) Protect/restore peatlands and wetlands, incl. beyond N2000 sites (++G-L&R-F) Accelerate the green transition of agriculture via NBS from farm to landscape level (++G-F-K) Invest in energy and water-efficient irrigation projects (++F)	Manage pollution of WFD/N2000 protected areas, providing resources to landowners for extra management requirements and incentives to change practices (G-L&R-F-SH-M) Plan a WFD-aligned greening of and better land use in agriculture, with Member States steering the implementation of NBS with adaptation, mitigation, and soil co-benefits (L&R-M-F-SH) Manage NWRM as high-diversity landscape features, with ambition being up to Member States (L&R-M-F)	Consider N2000 (and to some extent HNV) needs and related NBS measures in planning (e.g. CAP Strategic Plans), finance esp. community project for greater impact, and reimburse landowners for additional burdens due to N2000 (--G-L&R-M-F-SH-K)

The non-binding Biodiversity Strategy stresses the importance of physical and mental well-being through urban green spaces and reducing inequities in terms of access to such spaces. This could offer opportunities for pondscapes, as they are relatively easy to construct and accessible compared to other NBS. However, the proposed binding targets to increase urban green space (NRL) currently does not mention aquatic ecosystems or 'blue spaces' in the list of considered ecosystems.

Rural areas: There are opportunities for pond and pondscape NBS in rural areas, as there is an ambition to advance NBS from farm to landscape level (CAP; HE). For example, on-farm ponds could be used as NWRM, including to make irrigation less water and energy-intensive (CAP; WB), or benefit from wetland and peatland restoration and protection (CAP). The latter is also supported by proposed targets for nature restoration (NRL) and the target to turn 10% of agricultural area into high-diversity landscape features (including ponds) by 2030 (BS). Ponds and pondscape NBS could also benefit from efforts to reduce pesticide and fertiliser inputs, which threaten their ecological state. This shall be achieved through research, statutory designations, and management plans for 'Nitrate Vulnerable Zones' or National Action Plans for pesticide reduction (BS; CAP; NRL; PD).

However, the majority of policies have unclear implications for pond and pondscape NBS in rural areas, mainly because their implementation is up to Member States. They largely control the implementation of NBS via CAP Strategic Plans (in alignment with RBMPs and DMPs), detailing how landowners can fulfil the CAP's mandatory conditionality rules and which voluntary environmentally-friendly measures to finance (AS; CAP). Therefore, it is undetermined whether NWRMs, and particularly ponds, as a type of high-diversity landscape feature, will find widespread consideration.

Another challenge is that nature management and restoration in agricultural areas, and related planning processes and financing support, are focused on Natura 2000 sites, excluding most pond types (CAP). Likewise, mandatory pollution management focuses on Natura 2000 sites and other protected areas as per the WFD (e.g. drinking water sources and nitrate vulnerable zones) (PD; ZPAP), whereas other efforts, such as 'codes of good agricultural practice', are defined by Member States (ND; CAP). However, the CAP does not exclusively emphasise the value of Natura 2000, and there might be some openings for ponds if considered 'high nature value (HNV) farmlands' and if Member States prioritised support for such areas (CAP).

5.1.4. Opportunities & limitations for pond(scapes) depending on NBS type

Creation and Restoration: There are few concrete opportunities for the creation and restoration of ponds and pondscapes. An obstacle is the non-integration of objectives

or targets with other enabling factors. For example, the Birds Directive recommends creating biotopes between protected areas, and NWRM shall provide biodiversity as well as climate change adaptation and mitigation benefits (EAP; ERDF/CF; GI; WB). However, except for the target to re-connect 25.000 km of rivers longitudinally and laterally (NRL), there is a lack of specificity regarding targets, planning guidelines, and financing instruments that would promote small-scale NBS (CAP; ERDF/CF).

Sometimes, enabling factors for NBS implementation are integrated with each other, but not necessarily in an advantageous way for ponds and pondscapes. For example, the re-establishment of BHD habitats is supported through targets as well as planning and funding mechanisms (CAP; ERDF/CF; LIFE; NRL); yet, most ponds are not listed under the BHD. Moreover, even when there is a wider focus - like in rural areas, where HNV farming can be financed - planning guidelines only emphasise restoring Natura 2000 sites (CAP). Similarly, the proposed target to increase urban green spaces implicitly excludes blue spaces (NRL), and hence research and financing may not benefit associated ecosystems equally. However, ponds and pondscapes might be considered as NBS for wastewater treatment and water reuse (GI; HE; UWWTD; ZPAP).

Management: When it comes to NBS as management, there are policies that suggest both strict measures (e.g. eminent domain or access restrictions) and amicable agreements with stakeholders to preserve ecosystem integrity while acknowledging the socio-economic context (ICZM; ZPAP). However, these policies are non-binding and do not provide legal levers. On the contrary, for policies with strong legal tools, particularly in the agricultural sector, priorities often depend on Member States. For example, policies pertaining to pesticide and nutrient input provide reduction targets (BS), and mandate management (ND; PD), financing, good practice guidelines, and advisory services (CAP). However, defining good practices and mandated measures is the prerogative of Member States, which may focus on water bodies that have a defined reference condition under the WFD, i.e. those larger than fifty hectares, or have any other protective status. Similar factors come into play regarding the retention of landscape features on farm land, for which Member States can principally define themselves which features shall be prioritised to achieve EU targets (CAP).

Lastly, Natura 2000 sites and particularly ones with priority habitats, protected areas as per the WFD, and carbon-rich areas (e.g., grasslands, peatlands, and wetlands) have protections which have been or are set to be extended (CAP; EIA; FS; NRL; SEA). The CAP limits the conversion of grassland to cropland. Meanwhile, conversion in Natura 2000 is banned altogether. Moreover, awareness-raising and funds shall incentivise farmers to implement joint Natura 2000 projects (CAP; ZPAP).

Table 6: Opportunities and limitations for pond(scape) NBS divided by NBS type, as revealed by EU policy analysis. *Legend: ++/-- also in binding policies, +/- only in non-binding policies. G Goals, Objectives & Targets, L&R Legislation & Regulations, M Management Approaches & Tools, IA Institutional Arrangements & Capacities, F Financing, K Knowledge Development & Transmission, SH Stakeholder Awareness & Engagement*

	Opportunities	Ambiguous	Limitations
Creation and Restoration	Control pollution and improve energy efficiency through water reuse and wastewater, including via research, investments into NBS and a review of key legislation (++G-L&R-F-K)	Create/restore NRWM for 'good status', connectivity between N2000, and adaptation/mitigation, via funds for landscape features and ones gauging outputs by population benefitting (G-M-F) Increase green space in cities by 2050 (G-M-F-K)	Restore priority habitats (or generally N2000 and HNV in rural areas) for habitat connectivity, prioritising climate and economic co-benefits (--G-M-F)
Management	Maintain the integrity of coastal ecosystems, incl. through access restrictions and voluntary agreements with local stakeholders (+G-M-SH-F) Achieve zero pollution through stakeholder pledges (+SH)	Minimise pesticide and nutrient input through reduction targets, plans, research, WFD protected areas, providing resources to farmers for additional burdens (G-L&R-M-F-SH) Retain high-diversity landscape features, considering NWRM (L&R-F) Fund econ. diversification, e.g. via eco-tourism (F)	Manage protected habitats (esp. priority habitats) through dedicated plans and funds or consider N2000 and HNV needs in rural planning, reimbursing farmers (--G-L&R-M-F-SH) EIAs/SEAs or development bans do not apply, unless WFD protected areas, waters not in 'good status', or wetlands and peatlands are affected (--L&R-M)

5.2. Local/national policy analysis

In the following, we show the findings regarding the barriers, enabling factors, and potentially enabling factors present at the DEMO sites. We present the findings according to the seven categories of barriers and enabling factors that guided the analysis. Tables 7, 8, and 9 summarise findings and details are provided in the text.

Alike to the barriers and enabling factors at the EU level, the ones at lower governance levels also interlink. However, many of these relationships between barriers and enabling factors are idiosyncratic of particular DEMO sites or countries. Some relationships are prevalent though across the majority of DEMO sites or countries - those we briefly present at the end of this section.

Table 7: Barriers to the implementation of pond and pondscape NBS in DEMO sites. *Coding levels describe the granularity of the findings within the overarching categories. An asterisk (*) denotes that the respective barrier is only identified in PONDERFUL pondscapes in the DEMO site, and may thus not be present in other pondscapes of the country. Legend: Belgium (BEL), Switzerland (CHE), Denmark, (DNK), Spain (ESP), Great Britain (GBR), Germany (GER), Turkey (TUR), Uruguay (URY).*

Category	Coding level I	Coding level II	DEMO site where barrier exists (#)
Goals, Objectives, & Targets	Goals	Focus on economic value extraction	DNK, GER, TUR*, URY (4)
	Objectives	Conflicting objectives for pond(scape) use	BEL, CHE, DNK, ESP*, GBR, GER, TUR, URY (8)
		Detrimental land uses as a priority	BEL, CHE*, DNK, ESP*, GBR, GER, TUR, URY* (8)
		(Pond) NBS as a non-priority	BEL, CHE, DNK, GBR, GER*, URY (6)
		Scalar mismatches	BEL, ESP*, GER* (3)
	Targets	Non-biodiversity targets with negative impacts on ponds	DNK, ESP*, GBR (3)
		Unambitious biodiversity targets	BEL, GBR*, GER (3)
Legislation & Regulations	Land tenure	Private land ownership	BEL, CHE, DNK, ESP, GBR, TUR* (6)
		Small, scattered parcels	BEL, DNK, ESP (3)
	Legal status	Non-existent or inadequate legal classifications	BEL, CHE, DNK, ESP, GBR, GER, TUR, URY (8)
		Non-existent or ineffective statutory designations	BEL, CHE, DNK, ESP, GBR, GER, TUR, URY (8)
		Poor zoning policies	BEL*, CHE*, ESP*, TUR*, URY (5)
	Poor regulations	Inadequate regulations in the agricultural sector	BEL, DNK, ESP*, GBR, URY (5)
		Difficulties translating higher into lower-level regulations	BEL, GBR, GER, URY (4)
Financing	Costs of NBS	Costs for creation/restoration	BEL, ESP*, GBR, GER*, URY (5)
		Costs for management	BEL, CHE*, DNK, ESP*, GBR, URY (6)
	Difficulties to use existing funds	Bureaucracy complicates access to funds	BEL, CHE, ESP*, GER (4)
		Misuse of funds	BEL (1)
	Financing priorities	Focus on short-term funding	BEL*, GBR, TUR*, URY (4)
		Focus on other ecosystems	BEL, GBR, GER (3)
		Focus on small scales	DNK, GBR, URY (3)
		Focus on protected areas	CHE, DNK (2)

Category	Coding level I	Coding level II	DEMO site where barrier exists (#)
Financing (ctd.)	Institutional funding	Pond(scape) NBS as financial risk for institutions	GER (1)
		Lack of baseline funding	DNK, ESP*, GBR, URY (4)
	Opportunity costs for landowners	Opportunity costs of pond(scapes) vs. other land uses	BEL, CHE, DNK, GBR, GER, URY (6)
Management Approaches & Tools	Day-to-day management	Insufficient biophysical monitoring	BEL, DNK, ESP, GBR, GER*, TUR*, URY (7)
		Inadequate permitting and surveillance	BEL, ESP*, GBR, GER, TUR, URY (6)
	Strategic planning	Ignored plans	BEL, ESP*, GER, TUR*, URY (5)
		Inadequate scales	BEL, GBR, GER, URY (4)
		Non-existent plans	BEL, GBR, GER, ESP* (4)
Institutional Capacities & Cooperation	Interpersonal factors	Missing leadership	BEL*, GER (2)
		Missing rapport with key actors	BEL, GER (2)
		Power struggles	BEL, TUR* (2)
	Structural factors	Legacy of focus on other water bodies	CHE, GBR*, GER* (3)
		Low capacities	BEL, ESP*, GBR, GER, TUR*, URY (6)
		Non-cooperation	BEL, CHE, ESP, GER, TUR*, URY (6)
Stakeholder Awareness & Engagement	Stakeholder awareness	Active resistance against pond(scape) NBS	BEL, DNK, ESP*, GBR, TUR* (5)
		Difficulties to educate people	DNK, GBR, URY (3)
		Neglect of or non-interest in protection or management	BEL, DNK, ESP*, GBR, GER, TUR*, URY (7)
		Non-awareness of (non-economic) benefits	BEL, DNK, GBR, GER*, URY (5)
	Stakeholder engagement	Difficulties to 'activate' people	BEL, GBR, GER (3)
Knowledge Production & Dissemination	Data base	Lack of baseline data	ESP, GBR, URY (3)
		Uncertainty about pond benefits	BEL, CHE, GBR, URY (4)
		Uncertainty about impacts on ponds	GBR, URY (2)
	Knowledge dissemination	Missing or poor advisory services	BEL, GBR, URY (3)
		Missing or outdated technical guidelines	GER, URY (2)

Table 8: Enabling factors for the implementation of pond and pondscape NBS in DEMO sites. *Coding levels describe the granularity of the findings within the overarching categories. An asterisk (*) denotes that the respective barrier is only identified in PONDERFUL pondscapes in the DEMO site, and may thus not be present in other pondscapes of the country. Legend: Belgium (BEL), Switzerland (CHE), Denmark, (DNK), Spain (ESP), Great Britain (GBR), Germany (GER), Turkey (TUR), Uruguay (URY).*

Category	Coding level I	Coding level II	Country where enabling factor exists (#)
Goals, Objectives, & Targets	Goals	Goals supportive of pond(scape) NBS	ESP*, GER* (2)
	Objectives	Maintaining or restoring habitats	BEL*, CHE, ESP*, GBR, GER, TUR* (6)
		Using pond(scapes) to achieve NBS co-benefits	BEL*, ESP, TUR*, URY (4)
	Targets	Maintaining or restoring habitats	BEL*, DNK, ESP (3)
		Using pond(scapes) to achieve NBS co-benefits	URY (1)
Legislation & Regulations	Land tenure	Private landowners provide land for pond(scape) NBS	BEL, CHE, GBR* (3)
		Public/civil society actors use own land for pond(scapes)	CHE, TUR* (2)
	Legal status	Legal classifications facilitate pond(scape) NBS	BEL*, DNK, ESP*, GBR, TUR* (5)
		Statutory designations facilitate pond(scape) NBS	BEL, CHE, DNK, ESP, GBR, GER, TUR*, URY (8)
		Zoning facilitates pond(scape) NBS	CHE*, DNK, ESP, GER*, TUR* (5)
Financing	Private finance	Donations and foundations	BEL, DNK, GBR* (3)
		Biodiversity offsetting funds and CSR	BEL*, CHE, DNK*, GBR, GER* (5)
	Public finance	International project financing	BEL, DNK, ESP*, GER* (4)
		Non-international project financing	CHE, DNK*, GBR, TUR* (4)
		Continuous financing for management	BEL*, CHE, DNK*, ESP* (4)
		Subsidies to landowners	BEL, CHE, GBR, URY (4)
Management Approaches & Tools	Day-to-day management	Adequate biophysical monitoring	BEL, CHE, DNK, ESP, GBR, TUR*, URY (7)
		Adequate permitting and surveillance for pond use	DNK, GBR, GER*, URY (4)
	Strategic planning	Plans provide clarity and specificity	BEL, CHE*, DNK, GBR, URY (5)
		Holistic approach in planning	BEL*, DNK, ESP (3)
		Plans function as an overarching steering tool	DNK, ESP, TUR* (3)

Category	Coding level I	Coding level II	Country where enabling factor exists (#)
Institutional Capacities & Cooperation	Interpersonal factors	Political leadership	ESP* (1)
		Sufficient rapport with key actors	BEL, GBR* (2)
	Structural factors	Adequate capacities	ESP, GBR* (2)
		Fruitful cooperation amongst key actors	BEL*, CHE, ESP, GBR, GER* (5)
Stakeholder Awareness & Engagement	Civil society activism	Civil society advocacy	CHE, DNK*, ESP, TUR (4)
		NBS implementation by civil society organisations	BEL, CHE, GBR*, GER* (4)
	Stakeholder awareness	Awareness of pond benefits	BEL*, DNK, ESP*, URY (4)
		Citizen science, env. education, and info campaigns	CHE, ESP, GER*, GBR, TUR* (5)
		Identification with local pondscape	BEL, ESP*, GBR, GER* (4)
		Positive experiences with pond(scape) NBS	BEL*, ESP*, GBR (3)
	Stakeholder engagement	Stewardship agreements between CSOs and landowners	BEL, CHE, ESP*, GBR, URY* (5)
		Stewardship agreements between public actors and landowners	CHE, GBR (2)
		Adequate stakeholder cooperation and consultation	BEL, DNK*, ESP, GBR, GER*, URY (6)
Knowledge Production & Dissemination	Research	Research in support of policies	DNK*, ESP*, GBR*, URY (4)
		Research on specific benefits	DNK*, ESP* (2)
		Research to increase public commitment	ESP*, URY (2)
	Knowledge dissemination	High-quality advisory services	CHE*, DNK*, URY (3)
		High-quality technical guidelines	BEL*, ESP, URY (3)

Table 9: Potentially enabling factors for the implementation of pond and pondscape NBS in DEMO sites. *Coding levels describe the granularity of the findings within the overarching categories. An asterisk (*) denotes that the respective barrier is only identified in PONDERFUL pondscapes in the DEMO site, and may thus not be present in other pondscapes of the country. Legend: Belgium (BEL), Switzerland (CHE), Denmark, (DNK), Spain (ESP), Great Britain (GBR), Germany (GER), Turkey (TUR), Uruguay (URY). A light green background indicates that a corresponding enabling factor exists in min. 1 DEMO site, while a light red background indicates that no such enabling factor exists elsewhere. A grey background denotes that stakeholders 'wish' for the potentially enabling factor. A purple background denotes that the potentially enabling factor is found in policies. Both colours suggest that the potentially enabling factor occurs in both data sources.*

Category	Coding level I	Coding level II	Country where enabling factor exists (#)
Goals, Objectives, & Targets	Goals	Abandoning the economic growth paradigm	ESP, GER (2)
		Appreciating natural capital	BEL, GBR, TUR (3)
	Objectives	Maintaining or restoring habitats	BEL, CHE, GBR, GER (4)
		Using pond(scapes) to achieve NBS co-benefits	BEL, ESP, GBR, GRE (4)
	Targets	Maintaining or restoring habitats	DNK, GBR, GER (3)
		Using pond(scapes) to achieve NBS co-benefits	BEL, CHE, GBR, GER (4)
Legislation & Regulations	Land tenure	Private landowners provide land for pond(scapes)	GBR, TUR (2)
	Legal status	Legal classifications for the protection of pond(scapes)	ESP, CHE, GER (3)
		Statutory designations for the protection of pond(scapes)	CHE, DNK, ESP*, GBR, GER, TUR, URY (7)
		Zoning	GER, TUR*, URY (3)
	Better regulations	Focus on agricultural areas	DNK, GER, URY (3)
		Focus on non-protected areas	BEL (1)
Financing	Costs of NBS	Low costs of NBS as an opportunity	ESP, GBR (2)
	Financing priorities	Focus on larger scales	BEL (1)
		Focus on long-term financing for management	ESP*, GBR, GER*, URY (4)
	Institutional funding	Higher baseline funding for public institutions	GBR, GER*, URY (3)
	Private finance	More donations and foundations	DNK (1)
		More biodiversity offsetting funds and CSR	BEL, CHE, GBR, TUR (4)

Category	Coding level I	Coding level II	Country where enabling factor exists (#)
Financing (ctd.)	Public finance	More international project financing	URY (1)
		More non-international project financing	BEL, GER, TUR (3)
		Higher subsidies to landowners	BEL, DNK, GBR, GER, URY (5)
	Better use of existing funds	Simplification of bureaucracy	GBR, GER (2)
Management Approaches & Tools	Day-to-day management	Improved biophysical monitoring	BEL, DNK, ESP, GBR, GER, TUR, URY (7)
		Restrictive permitting/surveillance for harmful land uses	BEL, GBR, GER, TUR, URY (5)
	Strategic planning	Plans shall provide clarity and specificity	BEL, ESP*, GER (3)
		Holistic approach in planning is needed	BEL, ESP, GER (3)
		Plans function as overarching steering tool	BEL*, CHE, DNK, ESP (4)
Institutional Capacities & Cooperation	Interpersonal factors	Bolder leadership	GER (1)
	Structural factors	Higher capacities	URY (1)
		Improved cooperation between key actors	BEL, GBR, GER, TUR, URY (5)
Stakeholder Awareness & Engagement	Stakeholder engagement	Improved stakeholder cooperation and consultation	BEL, ESP, GBR, GER, TUR*, URY (6)
		Making use of stewardship agreements	TUR (1)
	Stakeholder awareness	Heightened awareness of pond benefits	BEL, DNK*, GBR*, GER*, TUR*, URY (6)
		Using citizen science, env. education, and info campaigns	BEL, ESP*, GBR, GER, TUR*, URY (6)
		Increasing identification with local pondscape	BEL, GBR, URY (3)
Knowledge Production & Dissemination	Research	Research for optimised management	BEL, ESP, GBR, GER*, TUR, URY (6)
		Research in support of policies	BEL, ESP, GBR, TUR, URY (5)
		Research on specific benefits	BEL, CHE, DNK, ESP, GBR (5)
	Knowledge dissemination	Improved advisory services	GBR, GER*, URY (3)
		Improved technical guidelines	GER, URY (2)

5.2.1. Goals, Objectives, and Targets[7]

Barriers: In half of the DEMO sites, policy goals are focused on extracting economic value from nature (and/or ponds specifically) rather than protecting it. This focus on extraction also expresses itself in policy objectives. Intensive agriculture with associated impacts (e.g., excessive chemical inputs or drainage) is often prioritised over the sustainability of the biophysical systems, including through policy targets focused on agricultural intensification (DNK). Likewise, in cities, pollution is often tolerated and in-filling even desired to enable housing and industrial developments (e.g. GBR, TUR). Other targets, such as the expansion of renewable energy, can impact ponds in places where such infrastructure would be useful (see e.g. Albera, ESP[8]). Meanwhile, in two DEMO sites (BEL, GER), biodiversity targets are barely in line with associated EU nature restoration targets.

Moreover, it seems that NBS generally are still not widely considered to achieve policy objectives, and particularly ponds are often ignored. Specifically, some key institutions have never formulated any policies for ponds (CHE), or had not done so until recently (GBR). Also, some policies never consider ponds for their fulfilment, despite potential benefits - may it be for carbon sequestration (CHE, GBR, URY), flood protection (GER), or water supply for agriculture (GER). If at all, the focus is still on other ecosystems as NBS (mostly afforestation) (CHE; GBR; URY). Also, scales for which policy objectives are formulated, do not support pondscape NBS. This can, for example, be related to an emphasis on the development of a nearby city (Schöneiche, GER), or a concentration on only small parts of or areas much larger than a pondscape (BEL).

If ponds or pondscapes are considered as NBS, conflicting objectives for their use are often a challenge. For example, it is difficult to reconcile public access with biodiversity concerns. At La Pletera (ESP), stakeholders were concerned that the pondscape may ‘die of its success’, with increased number of visitors. Meanwhile, in Lystrup (DNK), a peri-urban area, local retention ponds are purposed for climate change adaptation but suboptimal for biodiversity.

[7] This category describes policy statements that guide action and set the general direction in which a society or system shall be developed. Goals are higher level statements than objectives. Objectives describe a measurable contribution to achieving the goals. Targets are specific desired outcomes that support objectives.

[8] If the pondscape is mentioned specifically, it means that the information is specific to the pondscape and not necessarily applicable to the country of the DEMO site as a whole.

Enabling factors: In La Pletera (ESP) and Schöneiche (GER), local policy-makers were guided by their ambition to harmonise economic development with the protection of natural and cultural heritage, and changed policy goals accordingly.

In the majority of DEMO sites (but predominantly in PONDERFUL pondscapes), policy objectives focus on improving the habitat quality of ponds or types of habitats that include ponds (e.g. amphibian habitats, wetlands). In some cases (also mostly in PONDERFUL pondscapes), policies even emphasise improving habitat connectivity within and through pondscapes. Specific targets relevant for ponds are rare though (Pikhakendonk, BEL; DNK; Albera, ESP). One example is that DNK intends to restore ponds in Natura 2000 areas to favourable conservation status.

Beyond that, some decision-makers do consider (non-biodiversity) benefits of ponds to achieve their policy objectives (again mostly in PONDERFUL pondscapes). These co-benefits included ponds as an eco-tourism attraction (La Pletera, ESP), as a NWRM (BEL; Albera, ESP; Gölbaşı, TUR), and as a source for irrigation (URY).

Potentially enabling factors: Abandoning the goal of extracting as much economic value from nature as possible is unlikely to happen, although in two DEMO sites (La Pletera, ESP; GER) stakeholders express that hope. Yet, there might be an increasing appreciation of a sustainable use of natural capital to achieve policy goals (BEL, GBR), or at least the ambition to incorporate it into policies moving forward (TUR).

Specific objectives that could be relevant for maintaining or restoring ponds are mostly found in regional or national policies. At the moment, they merely articulate a future focus on maintaining or improving types of habitats that *may* include ponds (e.g., amphibian habitats, salt marshes, wetlands), often with a concentration on areas with some kind of statutory designation or other legal status. Explicit policy targets were identified especially in relation to land use change in the agricultural sector and an extensification of agricultural practices (DNK, GBR, GER). Only DNK has a target immediately relevant for ponds however (improve biodiversity in biotopes smaller than 1 ha). Generally, for EU Member States, the CAP Strategic Plans seem to be relevant policies to establish specific targets (see e.g., DNK, GER).

5.2.2. Legislation & Regulations

Barriers: One of the most prevalent barriers across DEMO-sites is linked to the legal status of ponds and pondscapes, meaning their protection by law or ordinances.

This includes statutory designations as protected areas as well as classifications and zoning[9] of territories, habitats, or ecosystems that affect their management.

International designations are considered to be ineffective, as they are too high-level to have an impact on the ground (Albera, ESP; GBR; GER; URY). In addition, pond restoration may actually be impeded due to restrictions on allowed measures (Schöneiche, GER). Lower-level designations, meanwhile, may theoretically prevent deterioration but often do not require restoration (CHE; DNK) - also, the protection of individual ponds does not mitigate land use pressures (DNK; GBR). Moreover, designations are often simply ineffective, and may yet hinder cooperation with farmers worried about having operations on their land restricted (CHE; DNK; GBR; TUR). At the same time, stakeholders are concerned about policies focusing on protected areas only (esp. Natura 2000), leaving non-designated areas without land use regulations and monitoring regimes (BEL; CHE; DNK; ESP; Schöneiche, GER; Imrahor Valley, TUR).

Legal classifications categorise aquatic habitats, prescribing management practices and/or biophysical quality standards. The data shows that lower-level authorities struggle to translate higher-level classifications into actions on the ground (e.g., HNV farmlands in BEL; HD Annex IV species in DNK). Also, in Albera, ESP, Mediterranean temporary ponds (which are priority habitats according to the BHD) are catalogued as agricultural land, as they are dry most of the time. Outside Natura 2000 areas, this makes them ineligible for CAP support though. Additionally, in a number of DEMO-sites, a variety of classifications that determine, for example, water quality standards, omit ponds altogether (CHE; ESP; GER; TUR; URY).

Zoning in itself was not considered a widespread barrier, but for some of PONDERFUL pondscapes associated regulations were simply seen as an ineffective or underutilised tool for the protection of ponds and pondscapes (Tommelen, BEL; Albera, ESP; generally, in URY). Sometimes zoning is even used to open up previously intact habitats to other (potentially ecologically damaging) economic activities (PONDERFUL pondscapes in CHE and TUR; Albera, ESP).

Meanwhile, land tenure was identified as another barrier. In some DEMO-sites (BEL; CHE; GBR) it is difficult to work with private landowners on pond and pondscape NBS. Also, for Pikhakendonk, BEL and for DNK generally it is considered difficult to obtain financing for (large-scale) projects on private land. In addition, fragmented land ownership can inhibit implementing NBS at landscape scale (BEL, DNK, ESP).

[9] Zoning could also be coded under “Management Approaches & Tools”, as it pertains to strategic planning. However, as zoning statuses can in themselves also have legally-binding implications, we categorised it here.

Enabling factors: Outright improved protection due to international statutory designations (Natura 2000) may be rare (only seen in PONDERFUL pondscapes in BEL; La Pletera, ESP). However, the status seems to be correlated with better planning (Pikhakendonk, BEL; Schöneiche, GER), better access to financing (BEL; DNK; La Pletera, ESP; GER), better monitoring (ESP), and stronger institutions (La Pletera, ESP). Further, international designations can strengthen stakeholder awareness for pond importance (GBR). National or local designations carry many of the same benefits as international ones. Stakeholders felt that they are sometimes even more relevant, as they are more specific in terms of land use restrictions (e.g., BEL; GER; URY).

In terms of legal classifications, local adaptations of EU classifications can be helpful to attract funding (e.g. Getevallei, BEL; Fyn Islands, DNK; La Pletera, ESP regarding Annex IV species or Annex II habitats). Also, a couple countries consider some ponds in their RBMPs (DNK; ESP). In La Pletera, ESP and Gölbaşı, TUR, a classification as a natural area/people's garden has allowed for additional protections and (may) constitute an intermediate step toward a designation as a protected area.

Zoning as an enabling factor was not widespread, but useful in some PONDERFUL pondscapes (e.g., Rhône genevois, CHE, La Pletera, ESP, Schöneiche, GER). Zoning is used to declare non-urbanizable land or water protection areas, and the delineation of pondscapes as valuable environmental areas has been a 'stepping stone' toward the inclusion into protected areas and important strategic planning documents.

Lastly, in the Canton of Geneva (CHE), implementing pond and pondscape NBS is enabled through the ownership of forested land or nature reserves by public entities or large CSOs. In DNK, it is also reportedly easier to find funding for NBS on public rather than private property. However, if private landowners are willing to engage, it might actually be advantageous (e.g., due to less bureaucracy) (BEL, CHE, GBR).

Potentially enabling factors: In some DEMO-sites, policies contain information relevant but non-specific to pond and pondscape NBS in protected areas (e.g., the intent to reduce land use intensity in important wetlands in URY and Natura 2000 areas in GER, or the prioritisation of the rehabilitation of protected areas in CHE). Only DNK, intends to improve specifically the monitoring of ponds in Natura 2000 areas.

Other than that, the implementation of NBS as management will depend on whether a) existing or planned statutory designations are (better) enforced (Albera, ESP, GER, TUR, URY), b) planned measures for limiting land use impacts (esp. in

agriculture) are implemented (DNK, GER, URY), ponds will be defined as a lake (GER) or wetland (ESP) (as it would entail better protections or monitoring), c) responsible institutions make use of zoning plans to restrict land use in environmentally-sensitive areas (URY) or prescribe the creation and restoration of ponds as NBS (e.g., NWRMs) (GER; TUR), or d) private landowners can be engaged effectively (GBR, TUR).

5.2.3. Financing

Barriers: Barriers related to financing pond and pondscape NBS are manifold. Firstly, in comparison to the creation and restoration of ponds, the management of ponds and pondscapes is perceived as especially costly (BEL; Bois de Jussy, CHE; DNK; La Pletera, ESP; GBR; URY). Yet, even the creation/restoration can pose a barrier: In BEL and URY, costs are high for farmers, esp. compared to other environmentally-friendly measures (e.g., hedges on farms). Also, in the majority of DEMO sites (BEL, CHE, DNK, GBR, GER, URY) the opportunity costs are too high for private landowners (in the sense of foregoing other land uses for a pond).

Secondly, public institutions similarly struggle with funding. In DNK, ESP, GBR, and URY, esp. day-to-day management is considered insufficient due to a shortage of baseline funding. Small municipalities likewise may struggle to finance restoration measures (La Pletera, ESP; Schöneiche, GER). In addition, for example in GER, maintaining small water bodies is optional for water user associations, and the financial risk for associated measures is carried by these small institutions. This risk is particularly high when county administrations, with which the associations cooperate, do not have a drainage plan. Then any pond-related NBS would be a ‘shot in the dark’.

Thirdly, in a number of DEMO sites (BEL; GBR; Lake Mogan, TUR; URY), it is reportedly very difficult to find long-term financing for the management and monitoring of ponds and pondscapes. The stakeholders lamented that the priorities of funders or even CSOs themselves (BEL) lay on the creation/restoration of ponds. If at all, financing for NBS focuses on individual ponds rather than the pondscape scale (DNK; GBR; URY), and/or in some DEMO sites predominantly for protected areas (CHE; DNK).

Fourthly, it appears as if current environmental financing schemes do not consider benefits of ponds and pondscapes. For example, the German CAP Strategic Plan only prescribes buffer strips along watercourses, and a criterion for state-level funding mechanisms is the alignment with the WFD (through which ponds are not covered).

Likewise, in GBR, the rollout of biodiversity net gain programs is under way and selection criteria for projects currently do not favour ponds.

Lastly, sometimes funding for pond(scape) NBS already exists, but various stakeholders feel that bureaucracy is in the way to access or make good use of the funds, mostly related to complex communication and funding application structures (BEL; CHE; La Pletera and Albera, ESP; GER).

Enabling factors: As mentioned under barriers, obtaining long-term financing is difficult. In some of the PONDERFUL pondscapes (Pikhakendonk and Tommelen, BEL; Fyn Islands, DNK; La Pletera, ESP; Gölbaşı, TUR) and CHE generally, there has though been a continuous stream of public funding for pondscape NBS in areas with a protective legal status (e.g. Natura 2000 or lower-level statutory designations). Outside protected areas, financing opportunities are rare and usually linked to the policies of single public institutions or CSOs (Lystrup, DNK; England, GBR).

Stewardship agreements entered by public institutions with landowners usually focus on protected areas (CHE; GBR), while agreements between CSOs and landowners may also encompass other areas (BEL; CHE; WFF, GBR). Sufficient financial support has contributed to motivating farmers to implement pond and pondscape NBS.

Potentially enabling factors: Stakeholders indicate that a shift toward larger landscape scales (BEL) and, especially, long-term financing (La Pletera, ESP; GBR; Schöneiche, GER; URY) could be a lever for pondscape NBS. In GBR and CHE, there are some (planned) financing schemes that will finance NBS over 20-30 years to make large-scale land use changes. It is unclear at this stage, however, how beneficial these will be for ponds. Also, in some DEMO sites (GBR; Schöneiche, GER; URY), a higher baseline funding for institutions responsible for ponds would be key for measures to be implemented over a sustained period of time.

When it comes to ad-hoc project-based financing, plans of the Flemish (BEL) and German governments to create more flooding zones by increasing the number of water bodies and restoring natural water flows are promising. In BEL, small municipal grants for the creation of landscape elements could potentially help. In GER, key actors (landowners, county administrations, water user associations, etc.) shall be financially supported to plan the creation and/or management of high-diversity landscape elements. However, stakeholders believe that first bureaucratic processes need to be simplified, so public and private actors would be willing to seek financing.

To motivate landowners (esp. farmers) for implementing pond and pondscape NBS higher public subsidies are needed. In a number of the European DEMO sites, there are public agricultural schemes that are not specific to ponds but shall support buffer

strips along (BEL, DNK) or generally the maintenance of landscape elements (GER), water retention in wetlands (GER), measures to reduce carbon emissions from wetlands and peatlands (GBR, GER), and reductions in nutrient and pesticide inputs into wetlands (DNK, GBR). In addition, in URY, stakeholders want to see past state-financed programs for the creation of ponds (aimed to support cattle production) to be brought back.

Meanwhile, regarding private financing, there is a hope that CSR (BEL; CHE; GBR) and biodiversity offsetting regulations will fuel NBS implementation (GBR; CHE; TUR). In GBR, biodiversity net gain programs have already shown first positive results (incl. for pond habitats) and municipalities are developing strategies to attract associated funds. Stakeholders in TUR also expressed the hope that regulations for offsetting impacts of housing developments would actually be applied strictly and could be used to advance, for example, NWRMs. For other biodiversity offsetting policies, it would be crucial that the benefits of ponds are recognized. For example, the Swiss government obligates fossil fuel importers to offset CO_2 emissions. It is planned that soon these projects shall also finance NBS as carbon sinks, with sustained payments over thirty years. Ponds are not considered here, yet.

5.2.4. Management Approaches & Tools

Barriers: Firstly, planning for pond and pondscape NBS or integrating them into larger plans seems to be difficult. Sometimes, strategic plans are rather focused on too large a scale, so that ponds as small habitats are overlooked. Therefore, high-level strategies are not practical for translation into action on the ground even if they generally support NBS (BEL; GBR; GER; URY). Toward the other extreme are planning processes that focus on individual ponds or only small parts of pondscapes, neglecting interactions at or beyond the pondscape scale (BEL; GER).

Occasionally, strategic plans may also not exist or be ignored. In three DEMO-sites (BEL; Albera, ESP; GER), missing strategic plans for the pondscape itself or landscapes that may be impacted by new pondscape NBS were a problem. Meanwhile, sometimes plans are produced, but they are then not applied in the field. Reportedly, actions on the ground often contradict the management plans for protected areas (BEL; Lake Mogan and Gölbaşı, TUR). Also, stakeholders think that higher-level strategies will not translate into actions on the ground as long as binding laws are not aligned with the strategies (‘people do not take it seriously’) (Albera, ESP; Schöneiche, GER; URY).

Secondly, poor monitoring of ponds and pondscapes affects their state negatively. The resources of the institutions in charge are limited in the majority of DEMO sites

(BEL; DNK; GBR; GER_Schöneiche; URY), or authorities may simply have no interest and only gather monitoring data in case of emergencies (Lake Mogan, TUR). Additionally, current biophysical quality indicators are inadequate for ponds (ESP).

Thirdly, permitting procedures are delaying pond and pondscapes NBS. In a number of DEMO sites (BEL; GBR; GER; URY), obtaining a permit, for the creation or restoration of ponds, can be tedious (in BEL esp. for places outside protected areas) or there are simply no functioning structures altogether (Gölbaşı, TUR). Meanwhile, in many DEMO sites, the perception was that land uses damaging ponds and pondscapes are too easily permitted; or, at least, there is no political desire to contain them. In some DEMO sites, responsible authorities usually do not go after farmers who pollute, empty, or remove ponds (Getevallei, BEL; Catalonia, ESP; Brandenburg, GER; URY). In TUR, urban infrastructure is allowed to be built in close proximity to ponds.

Enabling factors: Firstly, strategic planning is identified as an enabling factor in multiple ways. Management plans are considered useful to identify specific actions to manage and restore pondscapes (Pikhakendonk, BEL; CHE; DNK; URY), and make best use of available funds (GBR). Moreover, the implementation of NBS in the PONDERFUL pondscapes benefits from an integration into other plans (e.g. for municipal wastewater, Natura 2000 site, river basin, urban development), creating a holistic approach and addressing the scalar challenges mentioned above. In addition, in some DEMO sites (DNK; La Pletera, ESP; Lake Mogan, TUR), overarching policy objectives command the inclusion of ponds and pondscapes into planning processes. In DNK, restoring ponds has been a priority of the national Natura 2000 plan and some ponds (>1ha) have been included in RBMPs. Similar policies exist in Catalonia, ESP. In La Pletera, ESP, a political decision on making urban planning more sustainable has led to parts of coastlines and salt marshes being declared as non-urbanizable. At Lake Mogan (TUR), the objective to protect bird nesting places, such as ponds, was inscribed in the protected area's management plan. Importantly though, all in all, examples of pondscapes being integrated in strategic plans are almost exclusively limited to the PONDERFUL pondscapes and/or areas with statutory designations.

Secondly, analogous to strategic planning, monitoring is successful in PONDERFUL pondscapes or where ponds are integrated into larger, overarching efforts. Four reported reasons why biophysical monitoring goes well are: 1) the local CSOs take charge of it (e.g., Bois de Jussy and Rhone genevois, CHE; Lake Mogan; TUR), 2) the clustering of ponds and subsequent monitoring of only some representative ponds (Albera, ESP), 3) the inclusion of ponds into wetland inventories or river basin

management plans (CHE; Catalonia, ESP; GBR), and 4) the kick-starting of sustained monitoring through pond-dedicated projects (Lystrup, DNK; WFF, GBR).

Thirdly, permitting for the creation of ponds as well as for regulating surrounding land uses seems to function best when ponds have been integrated into zoning regulations (e.g., DNK, GER) and/or are linked to protected areas (URY). Additionally, in GBR, stakeholders mentioned that some financing programs (e.g., offsetting funds) can help with acquiring permits for the creation of ponds.

Potentially enabling factors: Firstly, some planning processes have promising foci. Embedded in higher-level strategies are specific actions that shall be supported and could result in pond and pondscape NBS (e.g., voluntary buffer strips along landscape features (BEL), the rewetting of moorland and peatland (GER), the extensification of agricultural practices (GER) in CAP strategic plans; NWRMs for flood and drought management in regional policies (Brandenburg, GER). Other overarching strategic plans set general priorities, which may be relevant for pond and pondscape NBS (e.g., NBS for adaptation (Catalonia, ESP); conservation of protected areas and priority species, CHE; improving biodiversity in biotopes <1ha, DNK). In fact, there is even some indication that policy-makers are starting to consider interlinkages between water bodies. According to the RBMPs for the Catalonian, the Schelde (Pikhakendonk, BEL), and Elbe (Schöneiche, GER) river basins, streams shall be reconnected with floodplains and small adjacent water bodies. Also, Brandenburg (GER) is planning to decrease drought risks through integrated management of aquifers, lakes, and wetlands (incl. explicitly pondscapes). However, overall, stakeholders worried that high-level strategies are not translated into actionable local plans.

Secondly, there are some intentions to improve monitoring of ponds (e.g., in Natura 2000 areas, DNK; in connection to drought risks, GER) or systems relevant to ponds (soils in Flanders). Mostly though, stakeholders merely expressed the hope for better monitoring (ESP; GBR; Schöneiche, GER; URY). Participatory monitoring to save costs and improve stakeholder awareness is recommended (Schöneiche, GER; URY). Additionally, the view of stakeholders is that any approach needs to be scalable, gather baseline data, and be implemented over an extended period of time.

Thirdly, regarding permitting processes, stakeholders in GBR emphasise that it would be important to accelerate permitting processes, so that landowners are not risking fines when constructing a pond. In terms of pondscape NBS in the form of improved management, existing or envisaged land use regulations (e.g., reduction of fertiliser and pesticide inputs; halting of housing developments near ponds) will only yield positive results if surveillance is improved (BEL; GER; TUR; URY).

5.2.5. Institutional Capacities & Cooperation

Barriers: By and large, barriers related to institutional capacities and cooperation can be separated into structural and interpersonal factors, with the former being more common across DEMO sites than the latter.

On a structural level, barriers can be further broken down into a lack of capacities, non-cooperation, and historic legacies. Firstly, many stakeholders perceive the labour force at key institutions as too small and unskilled. This has negative effects for pondscape management and monitoring as well as inhibits the possibility of providing support to third parties interested in pond and pondscape NBS (BEL; GBR; GER; TUR; URY). In addition, in some DEMO sites (Albera, ESP; GBR; URY), planning processes are an administrative burden for local institutions, which is seen as one reason why national strategies are not translated to the local level.

Secondly, cooperation often breaks down across both governance levels and sectors. In terms of governance levels, conflicts between higher-level and local authorities are observed (BEL; ESP; GER; URY), with local actors usually feeling that higher-level authorities impose impractical regulations. In terms of governance sectors, in BEL, integrated management of natural reserves is hindered by a lack of cooperation among authorities who prioritise their own sectors. In Schöneiche (GER), non-cooperation contributes to a lack of integration in water management.

Thirdly, in a small number of DEMO sites (CHE; GBR; Schöneiche, GER), a historic focus on rivers and lakes is considered inhibiting pond and pondscape NBS. For example, in Schöneiche (GER), the municipal infrastructure was designed to prevent floods instead of droughts (which are more prevalent today), and ponds adjacent to the town's principal stream are continuously dry. However, the responsible institution does not show the flexibility to shift approaches.

On an interpersonal level, missing rapport of representatives of key institutions with landowners hampers pond and pondscape NBS. Often there is a distrust toward public authorities (BEL) or non-local 'experts' (GER). This interlinks with stakeholders complaining about the lack of local leaders who would take charge and responsibility implementing NBS or convince third parties of associated benefits.

Enabling factors: Sufficient institutional capacities usually emanate either from a sustained and stable budget or through historically grown structures that are particular to a given context. Sometimes there is an overlap between the two. Generally, the enabling factors found here were tied to local contexts of the PONDERFUL pondscapes (La Pletera, ESP; Pinkhill Meadows, GBR).

In terms of well-working institutional cooperation, stakeholders report a successful collaboration between local authorities and CSOs (Pikhakendonk, BEL; Geneva, CHE; Albera, ESP; Schöneiche, GER). In La Pletera (ESP), additionally, it has been the local government's policy for decades to include a wide range of actors into the urban development planning as well as, more recently, sustainable tourism policies. Again, enabling factors are almost exclusively found in PONDERFUL pondscapes.

In addition, analogous to the interpersonal factors that pose a barrier, effective leadership (La Pletera, ESP) and rapport with landowners are enabling factors (BEL; WFF, GBR). The relationships with landowners are upheld by CSOs who take on responsibilities of public institutions, as landowners are still suspicious of the implications of any official paperwork.

Potentially enabling factors: The greatest potential is seen in improving cooperation between key actors. However, specific suggestions are rare, with the following exceptions: A dedicated process in which all relevant institutions come together to define management objectives and good practices for protected areas (BEL; TUR), common working groups to translate higher-level strategies into local action plans (GER), or joint activities (e.g., monitoring of ponds) to break down silos (GER).

In regard to other structural and interpersonal factors, only stakeholders in URY advocate for improving capacities in institutions concerned with ponds, and stakeholders in GER emphasise the need for enthusing local decision-makers, so they become champions for pond and pondscape NBS.

5.2.6. Stakeholder Awareness & Engagement

Barriers: A barrier to implementing pond and pondscape NBS is the low stakeholder awareness of pond and pondscape benefits (PONDERFUL pondscapes in BEL; GBR; GER). As a result, ponds are often not deemed worthy of conservation efforts (Tommelen, BEL; GER). In general, efforts to educate the public and decision-makers of the value of ponds are seen as failing (GBR; URY).

The low interest in or awareness of pond and pondscape benefits translates to neglect of or active resistance against ponds. In La Pletera, ESP, the public first opposed the restoration project because it interfered with both housing development projects and agriculture. Stakeholders note that farmers often push back on the idea to create ponds, as they are concerned with limitations for their farming operations, especially if the site becomes protected (BEL, DNK, GBR). Also, often farmers have no interest in or insufficient knowledge of how to maintain ponds (BEL, DNK; Albera, ESP; GBR; Schöneiche, GER; TUR; URY). It is ostensibly difficult to motivate farmers to implement pond and pondscape NBS without the necessary rapport (BEL, GER,

GBR), especially to work in groups to achieve an effect at landscape scale (GBR); and farmers prioritise other high-diversity landscape elements (BEL; DNK).

In some places, locals also impact ponds through littering or stealth dumping (BEL; La Pletera, ESP; GBR; TUR) and illegal water abstractions (Schöneiche, GER; TUR).

Enabling factors: Awareness of pond and pondscape benefits is mostly reported directly in relation to PONDERFUL pondscapes. In Albera (ESP) and Pikhakendonk (BEL), the public has been experiencing positive effects of nature protection for biodiversity over an extended period. Moreover, in parts of BEL and GBR as well as Schöneiche, GER, ponds have been part of the cultural landscape for a long time, which is why people identify with them. A status as a protected area (La Pletera, ESP; Pinkhill Meadows, GBR; WFF, GBR), environmental education (BEL; Geneva, CHE; Schöneiche, GER, Gölbaşı, TUR), information campaigns (La Pletera, ESP; Schöneiche, GER), and guided tours (Pinkhill, GBR; Schöneiche, GER) can further increase local identification with the pondscape. To some extent, PONDERFUL itself has also had a positive effect on awareness already, as in Sierra de los Caracoles (S.d.l.C, URY), one livestock farmer is especially interested in the potential function of ponds as a carbon sink in order to market meat as climate-friendly.

It also appears as if positive experiences with pond and pondscape NBS strengthen public support for existing and future measures. Meanwhile, stakeholders of the WFF project in GBR report that farmers get a ‘nice feeling’ from participating in the project and motivate their peers to implement pond and pondscape NBS. In two DEMO sites (Tommelen, BEL; La Pletera, ESP), the mere access to the pondscape allowed people to enjoy benefits for well-being, and, additionally, La Pletera’s function to mitigate flood risks has proven useful during a storm in 2020. Stakeholders there now support similar NBS elsewhere in their respective regions.

Civil society often also plays a large role in advancing pond and pondscape NBS. Either civil society actors do advocacy work - raising awareness (TUR) and/or instigating policy changes for pond protection (CHE, ESP) - or even implement pond and pondscape NBS themselves (esp. management). To do so, they enter management agreements with various landowners (Tommelen, BEL, Schöneiche, GER, and PONDERFUL pondscapes in CHE with local government; Pikhakendonk and Gete Vallei, BEL and WFF, GBR with farmers; Pinkhill Meadows, GBR with a private company). Where CSOs do not implement pond and pondscape NBS themselves, they often enter informal stewardship agreements with the respective landowners (BEL; CHE; Albera, ESP; WFF, GBR; S.d.l.C, URY), often including monetary compensation for landowners. Stakeholders in BEL and GBR actually underlined that it is often easier for CSOs to work with farmers than it is for public

actors, as those are perceived as punitive and bureaucratic. In fact, stewardship agreements between public institutions and landowners are rare (CHE, GBR).

Other forms of stakeholder engagement are considered to be generally at a satisfactory level (BEL, GBR, URY). Detailed reports of successful engagement for pond and pondscape NBS, however, are tied to projects in which stakeholders were involved from the outset and could influence the design of the site (Lystrup, DNK; Schöneiche, GER), the management regime (Lystrup, DNK), or how to integrate the pondscape at landscape scale (La Pletera, ESP; Schöneiche, GER).

Potentially enabling factors: Moving forward, raising stakeholder awareness for pond and pondscape benefits is considered a vital step toward the implementation of associated NBS. Specifically, awareness-raising is contextualised with statutory designations. On the one hand, some stakeholders feel that *awareness-raising is key until a pond or pondscape has a statutory designation* (BEL; DNK). On the other hand, other stakeholders view a *statutory designation as a first step toward raising awareness* for the importance of ponds (GBR; URY).

Either way, there are some suggestions on how to raise awareness, although none of them is embedded in policies yet. Stakeholders see a need to address farmers and local policy-makers through research outputs, outreach campaigns, or environmental education to give pond and pondscape NBS a positive standing (BEL; GBR; GER; URY). In URY, stakeholders also call for a water management approach at river basin rather than departmental level, so that the identification with the resources as well as other riparian landowners is increased. Likewise, in URY, one departmental government awards plaques of recognition to farmers who participate in agroforestry (to solve the ´loss of native endemic palms´); the suggestion is to apply something similar for ponds.

In general, stakeholders feel that more engagement of the public, and especially landowners, is desirable to implement NBS (esp. at larger scales). In BEL, stakeholders specifically see a need for landscape-level strategies that are developed by all relevant actors. In Schöneiche (GER), stakeholders felt that collaborations between local authorities and landowners are key to translate high-level strategies into local actions.

5.2.7. Knowledge Production & Dissemination

Barriers: In regard to knowledge production and dissemination several barriers hinder progress, including significant gaps in baseline data. There is a concern that there is no build-up of baseline data through, for example, standardised biophysical quality indicators (Albera, ESP) or research projects that track the before-and-after of NBS

(GBR; ESP; URY). Impacts of data gaps are visible in, for example, URY, where environmental flows are not observed due to absent data. Also, more research into the benefits of ponds as NBS is needed before an argument for their use will 'stick' with policy-makers (BEL and URY regarding biodiversity; CHE and GBR regarding climate change mitigation). The same applies to climate change impacts on ponds themselves and associated necessary changes in management regimes (GBR; URY).

The other major challenges are insufficient technical guidelines and support, as well as limited knowledge sharing. In GBR, farmers are missing high-quality advice on how and why they would create ponds. Similar problems exist in URY, only that farmers create ponds anyway, but not always with the best outcomes for biodiversity - not least because technical guidelines are outdated and focused mostly on the agronomic performance of ponds, as they miss design parameters for ponds located within protected areas or generally parameters to guarantee a satisfactory water quality while biodiversity parameters are ignored. Meanwhile, in Brandenburg (GER), the state government has intended to design and disseminate guidelines for how to implement NBS for drought risk management, but lower-level authorities pointed out that they are delayed by several years. This may also be an indication of why higher-level strategies are not translated into actions at the local level.

Enabling factors: Research addressing data gaps can advance pond and pondscape NBS in three ways: Firstly, it can provide supportive evidence for policies. Stakeholders in La Pletera (ESP) viewed research as a key factor in the design and support of key policies. Here, the technical knowledge gathered decades ago informed stronger protection for the salt marsh and helped obtain funding. Decision-makers in Albera (ESP) are convinced that PONDERFUL will play a similar role in a desired expansion of the local Natura 2000 site. Positive impacts of research on policies are strongly expected (URY) or recalled (Lystrup, DNK; Pinkhill Meadows, GBR) also at other DEMO sites. Secondly, research has helped to ascertain specific pond benefits (Lystrup, DNK; La Pletera, ESP). Thirdly, research can increase the public willingness to implement pond and pondscape NBS (Albera, ESP; URY).

Corresponding with the respective barriers of knowledge dissemination, there is also evidence of successful advisory services and useful technical guidelines. In the Canton of Geneva (CHE), the local government is receiving advice from an expert panel for the appropriate management of the protected areas on agricultural land. In Lystrup (DNK), the municipality is advising the grazer association on the management of the local pondscape. In URY, a currently suspended governmental program used to couple monetary support with advisory services for farmers regarding the creation of ponds. In terms of technical guidelines, positive examples

concern a recommendation for the local municipality on how to increase habitat connectivity (Tommelen, BEL), the desire to collaborate with PONDERFUL researchers on how to revise monitoring guidelines for ponds for Catalonian RBAs (Albera, ESP), or the desire for a manual for pond creation that includes biodiversity and ES dimensions (URY).[10]

Potentially enabling factors: The ways that research could potentially support the implementation of pond and pondscape NBS are similar to current enabling factors.

Research could play a role in understanding of how NBS can be employed to achieve policy goals (BEL and GBR for sustainable agriculture; BEL and ESP for climate change adaptation; CHE, DNK, ESP, GBR, and URY for climate change mitigation; TUR for water quality management). Furthermore, stakeholders speculated about accompanying specific NBS actions with research projects, for example related to: delineations and management of existing new protected areas (BEL; TUR), design of carbon sinks (GBR), and erection of farm ponds (URY).

One notable difference compared to existing enabling factors is that there is especially a demand for research that informs management practices. There is deemed to be value in research on how to optimise pond management for whatever benefits are desired in a given context (BEL; GBR; GER; URY). Also, some stakeholders (Albera/ESP) and policies (GBR) emphasised that an increased attention toward how to manage especially pondscapes at landscape scale is necessary.

Regarding knowledge dissemination, more high-quality advisory services and useful technical guidelines are deemed vital. Subsidy schemes coupled with advisory services could incentivize pond creation (GBR; URY). Moreover, future/updated guidelines on how drought risks can be mitigated through NWRMs (Brandenburg, GER) as well as the creation of farm ponds (URY) could prove beneficial.

5.2.8. Interlinkages between categories

The interlinkages below occur in the majority of investigated DEMO sites (presented in descending order from most common to less common). Therefore, they depict the larger trends in terms of how barriers and enabling factors interlink and yield opportunities and limitations[11] for the implementation of pond and pondscape NBS[12].

[10] This manual is now outdated (see 'barriers'). It is still seen as something that 'put ponds on the map'.

[11] For an explanation of 'opportunities' and 'limitations' see the methods section on the EU policy analysis (Section 4.3.1.).

[12] We present those interlinkages between categories that are prevalent in more than half of the DEMO sites - focusing therefore on the most prevalent ones. A dedicated presentation of each type of interlinkages would

Legal Status and Management Approaches & Tools: The legal status, i.e. the protection of pond or pondscape through statutory designations or legal classifications, also affects their management. The status of ponds affects how they are incorporated into strategic plans as well as their day-to-day management.

Firstly, if a pondscape is (part of) a Natura 2000 site, its development and maintenance is usually planned for in strategic plans - both in plans dedicated to the site as well as, on a more abstract level, in overarching national plans. In Pikhakendonk (BEL), for example, the local management plan lays out a vision for maximising habitat space and quality for the great crested newt, which includes the creation and restoration of ponds. In DNK, the restoration of ponds in Natura 2000 areas is a priority (as laid out in its national Natura 2000 plan) and municipalities with Natura 2000 sites need to design their local management plans accordingly. Other statutory designations or legal classifications of ponds, national or local ones, can likewise contribute to better incorporation into strategic planning. This can concern the inclusion in RBMPs (DNK; ESP) or the development of local management plans that define permitted land uses and pathways toward improving habitat connectivity (CHE; Schöneiche, GER).

Secondly, in terms of day-to-day management, statutory designations or other legal classifications can be grounds for local authorities to define permissible land uses and monitor the adherence of landowners to these standards. In some of the DEMO sites this is already applied to protect ponds (CHE; Schöneiche, GER; URY). Furthermore, the monitoring of the biophysical state of ponds is usually better in protected areas. CHE, through the respective cantonal governments, closely monitors ponds in alluvial zones and wetlands of national importance. Meanwhile, DNK and ESP are expanding their efforts to monitor ponds within Natura 2000 sites

However, the opposite of the opportunities described above is often true for ponds and pondscapes without a legal status. For example, in GER and TUR, where the legal classification of the WFD is followed in terms of what constitutes surface water to be kept in good status (i.e. only water bodies >50 ha), ponds are often not included in RBMPs or monitored generally. In addition, they are not the focus of key strategic plans, such as the CAP Strategic Plan which may set land use restrictions for the protection of ponds and pondscapes (GER). Likewise, in DNK, very little is known about the biophysical state of ponds outside compared to the one within Natura 2000 sites.

go beyond the scope of this Deliverable. The interlinkages therefore do not provide an exhaustive picture, however.

Also, importantly, a legal status alone does not guarantee the opportunities indicated above. In several DEMO sites (Schöneiche, GER; Lake Mogan, TUR; URY), plans for the development and maintenance of a protected area may exist, but they can be insufficiently detailed to promote the implementation of pond and pondscape NBS or simply be ignored. Likewise, the surveillance of land uses and continuous monitoring of protected areas can also be deficient (GBR; TUR; URY).

Legal Status and Financing: Statutory designations and other legal classifications can help public institutions and CSOs with accessing funding for pond and pondscape NBS (DNK; La Pletera, ESP; GBR). In several DEMO sites in EU Member States it appears as if the protection of a pondscape through Natura 2000 is a substantial reason for the access to LIFE financing, and therefore for the implementation of NBS (Pikhakendonk, BEL; Fyn Islands, DNK; La Pletera, ESP). In fact, even the prospect of potentially being a Natura 2000 site - for example, because a pondscape may inhabit priority species or a pond be a priority habitat - can substantially improve the chances to access funding from the EU. Importantly, in the PONDERFUL pondscapes, LIFE funding has been renewed multiple times and thereby contributed to institutionalisation and sustained monitoring in the respective pondscapes.

Private landowners may also receive support for improved management to guarantee a high-diversity landscape - with there often being a premium paid for Natura 2000 areas (GER), HNV farmlands (BEL), or other protected sites (CHE; GBR). However, it seems landowners are occasionally hesitant to seek associated funding due to possible restrictions for their operations (BEL; GBR). Positive experiences are reported only from CHE, where cantonal governments (with financial support from the central government) are obliged to enter into stewardship agreements with private persons, if a protected area extends onto private land. These agreements are important, as it is difficult for public actors to implement NBS on private land (BEL; DNK).

Financing - Management Approaches & Tools: The inclusion of pond and pondscape NBS in strategic plans facilitates the access to financing, as many planning processes also have funding schemes associated with them. In Flanders (BEL) and GER, the maintenance of high-diversity landscape elements shall be improved; and some types of ponds are recognized as such landscape elements, as per the CAP Strategic Plans. Similar support is planned for voluntary buffer strips around ponds in DNK.

At the same time, in GBR, the availability of biodiversity offsetting schemes actually has motivated local public institutions to develop strategic plans for the use of such funds. Hence, the prospect of funding propelled planning.

Inversely, if ponds are not considered in key strategic planning processes, this can also affect the financing available for NBS. In Brandenburg (GER), for example, NWRM shall be promoted, but one of the funding criteria is to be in alignment with the WFD and associated RBMPs. Since ponds are usually not considered in RBMPs, it is difficult to access financing for pond and pondscape NBS.

The most widespread risk, however, is the lack of long-term financing to support monitoring efforts (esp. outside protected areas). Stakeholders in a number of DEMO sites (BEL; DNK; ESP; TUR; URY) report funding shortages, which complicates assessing the state of ponds and pondscapes over longer time frames.

Goals, Objectives, & Targets and Management Approaches & Tools: Strategic plans define and are defined by policy goals, objectives, and targets. In EU Member States, the CAP Strategic Plans are the main policy documents charting the development path forward for rural areas. The CAP Strategic Plans contain policy objectives and targets relevant for ponds and pondscapes (e.g., extensification of agriculture, reducing nutrient and pesticide levels in wetlands, improving biodiversity in small biotopes, and reducing carbon emissions from wetlands and peatlands), and, at the same time, identify specific actions that shall be taken to achieve them (e.g., conversion of arable land to grassland or wetlands; buffer strips, etc.) (BEL; DNK; GER).

National planning policies are also of relevance for setting biodiversity-related policy objectives in general - not only in rural areas. In both CHE and DNK, identify biodiversity enhancement in ponds as a priority and put forward measures to ameliorate current shortcomings.

Furthermore, strategic plans can also outline desired monitoring regimes based on the policy objectives contained in them (BEL; GER). For example, the Low Water Concept of Brandenburg (GER) promotes water retention in natural reservoirs, and puts forward the better monitoring of hydrologic data to anticipate future water needs - including those related to ponds and pondscapes.

In contrast, if pond biodiversity is not considered in policy objectives and targets it can negatively affect their standing in strategic planning processes. In ESP, requirements for EIAs have been relaxed to enable the expansion of renewable energy capacities (even in protected areas), potentially negatively affecting, for example, Albera (ESP). Policy objectives are focused on a large scale, so that ponds are overlooked.

Stakeholder Awareness & Engagement and Knowledge Production & Dissemination: In La Pletera (ESP) and Lystrup (DNK), past research projects laid

the foundation in the past for stakeholder engagement and heightened stakeholder awareness, so that stakeholders became and are still keen on implementing pond and pondscape NBS. Meanwhile, in URY, one farmer is interested in the performance of ponds as carbon sinks and associated management needs, as it may help them market their products.

Furthermore, in a few DEMO sites (BEL; ESP; GBR; TUR; URY), stakeholders expect research outputs on ponds to be a means to influence public and private stakeholders - granted that they are already involved during the respective research project.

That there is need for knowledge dissemination is also evidenced by the current limitation that emerges out of the combination of a lack of interest in and knowledge of pond benefits and management amongst many farmers (BEL, DNK; Albera, ESP; GBR; Schöneiche, GER; TUR; URY).

6. Concluding discussion and recommendations

In this Deliverable, we explored how EU-level policies and local, regional, and national policies in the DEMO-sites (can) affect the implementation of multi-functional pond and pondscape NBS. Below we first summarise the key insights - also drawing linkages between the EU and lower-level policy contexts, if applicable - and discuss them in light of existing literature. We conclude thereafter with recommendations to facilitate the implementation of pond and pondscape NBS moving forward.

6.1. Key insights from the policy analyses

6.1.1. Support for NBS, but implementation limitations persist

Overall, while pond and pondscape NBS specifically are not yet acknowledged in many policies, we find considerable support for NBS as such across EU policies. Although explicit mentions of NBS mostly refer to the creation and restoration of ecosystems, there are also policies (e.g.; BS; NRL) that indicate that the EU also considers management and protection of ecosystems. Management actions to reduce impacts on biodiversity (e.g. pollutant input reductions and set-aside landscape features) are envisaged particularly for rural areas - actions that are also found in lower-level policies.

Importantly, EU policies not only show support for different NBS types, but also an awareness of employing them for habitat connectivity. The EU seems to move from 'piecemeal approaches' (Kabisch et al. 2016) toward NBS networks with ecosystems of 'different maturity and complexity' (Krauze & Wagner 2019). The DEMO site policy context also occasionally reflects this priority, although mostly in terms that are not specifically prioritising ponds. For example, various RBMPs emphasise reconnecting streams with floodplains and small adjacent water bodies.

The EU calls on authorities to adopt the net-gain principle for biodiversity, finances strategies to manage urban-rural linkages, and supports lower-level authorities in integrating NBS into planning through research projects and guidelines. However, the ambitions to improve habitat connectivity miss 'legal teeth' (Borgström & Kistenkas 2014). Eventually, the responsibility and choice to implement NBS rests with local planners and decision-makers. Unfortunately, in this context, the DEMO site analysis shows that strategic plans, even if they support NBS generally, are rather focused on too large a scale, so that ponds and pondscapes are overlooked.

Positive examples of pondscapes being integrated in strategic plans are almost exclusively limited to the PONDERFUL pondscapes and/or areas with statutory designations. Also, if at all, financing for NBS focuses on individual ponds rather than the pondscape scale.

In rural areas, the responsibility is even upon individual landowners, who are hesitant to implement pond NBS in many of the DEMO sites, especially in collaboration with public institutions if measures are voluntary. Recent assessments of some national CAP Strategic Plans support our findings that the current level of payments for environmental and climate-friendly measures are too low to offset opportunity costs and incentivise bold and effective action (Midler et al. 2023). In addition, landowners would need to join forces to implement measures at landscape scales. This can further limit opportunities, as, for example, the CAP recognises the added value of jointly implemented environmental measures, but does not mandate any specific mechanisms to facilitate coordination between individual farmers (Leventon et al. 2017). In addition, private and/or fragmented land tenure may then also complicate the implementation of pondscape-level monitoring - an approach that is applied successfully in some PONDERFUL pondscapes, but may dash against a lack of cooperation from landowners.

6.1.2. Path dependency between legal status and implementation opportunities

By far, the most refined policy framework exists around the implementation of NBS in areas with a distinct legal status. In the EU, binding targets and regulations, financing and planning tools, as well as monitoring and stakeholder engagement strategies focus on habitats and habitats of species listed in the BHD Annexes (i.e. existing and prospective Natura 2000 sites).[13] Outright improved protection due to Natura 2000 may, in fact, be rare, as the designation alone usually does not have positive effects. However, as our DEMO site analysis shows, the status seems to correlate with better planning, better monitoring, and stronger institutions. In fact, the PONDERFUL pondscapes that are part of the Natura 2000 network (and other designated sites in non-Member States) were even supported through long-term financing for management and monitoring, which is particularly challenging to sustain elsewhere, as our DEMO site analysis and existing literature show (Deely et al. 2020; Sarabi et al. 2019; 2020; Seddon et al. 2020).

[13] Importantly, merely being a priority habitat, but not being a Natura 2000 site, does not result automatically in better protection. In the Albera pondscape (Spain), those Mediterranean temporary ponds not included in the Natura 2000 site are declared agricultural land, as they are dry most of the year. This has led to a deterioration of their state.

While there are intentions to restore all ecosystems to good health, regulatory, managerial, and financial tools for non-BHD habitats are not as 'sharp'. Therefore, many opportunities for NBS, specifically restoration and management, may only apply to a small subset of habitats - and, in fact, not very many types of ponds. At the PONDERFUL workshops, stakeholders expressed concerns about policies focusing too much on protected areas, leaving non-designated areas without regulations for land uses or opportunities to create or restore ponds (unless on public land). For rural areas, for example, this may mean that HNV farmlands should also find consideration in planning and as landscape features, but so far non-Natura 2000 sites have been poorly monitored and at a higher risk of conversion to arable land (Anderson & Mammides 2020; Lomba et al. 2014).[14]

Similar to statutory designations, classifications of ecosystems that define quality standards are also a legal status of heightened relevance. With regard to water quality management, much of the protection awarded to water bodies is organised through the WFD and its implementing authorities. Unfortunately, ponds are rarely considered here, as most of them are smaller than fifty hectares (Kristensen & Globevnik 2014). Consequently, they do not have to be in a 'good status' and may not benefit from regulatory (e.g. pollutant input limits), managerial (e.g. emissions monitoring), or financial (e.g. control measures financed through CAP) measures. In fact, the WFD has relevance even in non-Member States, as TUR also applies the same classifications to their surface waters. On the other hand, as our analysis shows, some EU Member States (DNK, ESP) choose to monitor some ponds, especially those in protected areas, which has successfully informed their management.

All in all, there is a path dependency between the legal status of ecosystems and opportunities for NBS implementation.

6.1.3. NBS for climate change adaptation and mitigation

Another relevant emphasis of both EU and DEMO site policies is the one on climate change adaptation and mitigation co-benefits of NBS. As of now, ponds are not strongly considered for these purposes yet, however. Some policies support the use of NWRMs generally, but whether ponds will be applied as such NBS in the short-term will likely depend both on whether they will be considered (part of) wetlands and/or peatlands. The intention to rewet wetlands and peatlands to create net carbon sinks, as well as to make use of wetlands as NWRM, is widespread across policies.

[14] Yet, Świtek et al. (2019) suggest that HNV farmlands have more high-diversity landscape features, including ponds.

In the assessed DEMO sites, ponds are still rarely used as NWRMs; and, in fact, the design parameters have not been fine-tuned yet to serve both climate change adaptation and biodiversity purposes.

Also, importantly, previous experiences outside PONDERFUL have shown that authorities are slow to adopt NWRM for drought and flood management due to institutional silos, uncertainty about costs and benefits, and disagreements over who pays for them when benefits may accrue in another place than the location of the NBS (Collentine & Futter 2018; Linnerooth-Bayer et al. 2015).

Another point that neither came up throughout our document analysis nor at the stakeholder workshops, but is nonetheless important to discuss is that there are concerns that more NWRM will supposedly equal more mosquitoes and therefore water-borne diseases. Expert feedback to a draft of this Deliverable underlined that decision-makers may therefore be hesitant to adopt NWRM. In fact, according to the feedback received, climate and health sector policies may limit the implementation of NWRM, as they aim to prevent the spread of water-borne diseases. While we cannot support or refute that claim based on our data, we would like to underline that some voices even argue that a well-managed wetland or pond will not come along with higher mosquito population numbers (Jackson et al. 2009) - and may actually reduce them in the respective areas, as predators will control populations (Sentell et al. 2020). If at all, new ponds, where fauna has not matured and predatory not settled yet, may lead to more mosquitoes, but only for the first few months of a pond's existence (Williams 2023: pers. comm). Ultimately, there is still little evidence regarding the matter at hand and it warrants more investigation.

6.2. Recommendations for enabling pond and pondscape NBS

Based on the insights from our analyses and the review of existing literature, we outline the following recommendations to facilitate better implementation of pond and pondscape NBS in the future:

1. *Award a legal status to more ponds/pondscapes*: Different types of statutory designations and legal classifications are often the foundation for other enabling factors such as financing, monitoring, and planning. Therefore, ponds/pondscapes valuable for biodiversity and other benefits need to be awarded such a status. For this purpose, it is key to amend regulations on an EU level such as the WFD or the annexes of the BHD. For outright protection from detrimental land uses it is further helpful if lower-level authorities supplement or complement international designations with national or local ones.

2. *Define ponds and pondscapes in relation to wetlands, moorlands, and peatlands*: Many potential opportunities for the implementation of NBS for climate change adaptation and mitigation are reserved for wetlands, moorlands, and peatlands. It is important to raise the profile and potential of ponds and pondscapes for the same benefits in this context. Therefore, we recommend more closely defining in relevant policies what constitutes the respective land types mentioned above and that ponds and pondscapes may often be included in or constitute them. Also, it is important that high-level bodies, such as the secretariat of the Ramsar Convention, recognize the importance of ponds and pondscapes as components of, or types of, wetlands.
3. *Assist with the translation of high-level policies into local actions*: National (e.g., CAP Strategic Plans) or regional (e.g., RBMPs) policies have often already incorporated NBS into their set of possible measures to achieve their objectives. However, translation into local action is still deficient. Therefore, policies need to promote and (financially) support joint working groups of higher-level and local institutions to holistically plan the implementation of NBS - from the design all the way to the long-term management and monitoring regime. For measures at landscape scale, it would further be important to amend and make use of key local policies, such as zoning plans.
4. *Improve the knowledge base on pond status*: Currently, the monitoring of ponds is spotty, at best. So far, for some pond types there are not even standardised indicators to judge their condition. Positive experiences from DEMO sites show that major progress can be achieved if pond monitoring is integrated into larger monitoring efforts, such as national/regional wetland inventories or RBMPs.
5. *Determine pond benefits in pilot projects*: Determining the benefits of potential NBS is key for their long-term consideration. Therefore, we recommend that new pond and pondscape NBS measures are integrated with research projects to track before-and-after effects. This needs to consider that NBS often need a longer time frame compared to grey infrastructure to develop their full potential and thus deliver relevant benefits. Importantly, this may also include investigating potential risks of ponds (e.g., a heightened risk for water-borne diseases) and how to manage them.
6. *Nurture local pond champions*: Research efforts should feed into identifying and nurturing potential pond champions amongst local policy-

makers and landowners, to promote good practices. In this context, EU-financed Horizon Europe Missions (and other knowledge broker platforms) will likely be of outstanding importance, as they are supposed to bring together scientists with policy-makers and other stakeholders. Further the research could be coupled with citizen science and environmental education to raise awareness and nurture a sense of stewardship.

7. *Support broad-based collaborations*: We find in our DEMO site analysis that private landowners are hesitant to cooperate with public institutions, as they are perceived as punitive and bureaucratic. Financial and institutional support should be directed toward collaborations that bring together a large stakeholder base from the private, public, and civil society sectors. In fact, CSOs can possibly function as a convenor to provide a safe space for relationship-building. Positive examples from our DEMO site analysis show that such relationships, and possibly their institutionalisation, build over extended time periods. These relationships are important, however, to implement NBS over longer time-periods and at larger scales to overcome landscape fragmentation.
8. *Couple long-term financial support with advisory services*: Local institutions need to build up capacities regarding pond and pondscape NBS over time so that they can give high-quality advice to other actors. Ideally, these advisory services would also be coupled with sustained long-term financing for the implementing actors, to ensure that NBS can be implemented over an extended period of time.
9. *Make NBS without a business case attractive*: Not all NBS immediately 'pay for themselves' (e.g. through tourism income or payment-for-ecosystem services schemes). Therefore, funders need to step in and steer investments toward NBS that are not economically viable at first. Currently, opportunity costs for, for example, farmers are still perceived to be too high, so subsidies for such measures need to be increased. Also, in the public sectors, public procurement criteria need to be adjusted to account for benefits that are not (easily) amenable to monetization.

While strengthening the role of ponds and pondscapes NBS and facilitating their broader uptake is a long term-process that requires removing substantial barriers/limitations, our DEMO-site analysis shows many positive examples and outline opportunities. Building on identified opportunities and utilising the recommendations above should enable broader implementation of ponds and pondscapes as NBS in the European Union and beyond.

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8. Annexes

8.1. Background information

Table A1: Overview of ES/NCPs of ponds.

Benefit	Description
Water quality improvement	• Reduction of pollution through sedimentation, flotation, infiltration, adsorption, biological uptake, biological conversion, or pollutant degradation (Carpenter et al. 2014) • Interception of agricultural runoff, thereby mitigating nitrate, phosphorus and pesticide pollution (Díaz et al. 2012; Jia et al. 2019) • Wastewater treatment in waste stabilisation ponds and use of pond-wetland complexes as processors (Díaz et al. 2012; Kumar & Kumar 2020; Wang et al. 2016)
Water source	• Storage of water for agricultural irrigation (Chen et al. 2019), providing an alternative to aquifer exploitation and reducing energy use of irrigation (López-Felices et al. 2020; Sikka et al. 2018; Vico et al. 2020; Villanueva & Glenk 2021) • Drinking water source for livestock (Chen et al. 2019) • Natural/artificial retention ponds as reservoirs for extinguishing water (Kaulfuß 2011)
Flood management	• Postponement and decrease of flood peaks (Linnerooth-Bayer et al. 2015) • Stormwater detention and retention ponds as part of urban drainage systems, which can also manage water quality of runoff (Blicharska & Johansson 2016; Nayeb Yazdi et al. 2021; Oertli & Parris 2019; Morales & Oswald 2019)
Groundwater recharge	• Recharge of aquifers from ponds through permeable sand and rocks (Healy 2010) or man-made infiltration ponds (Dillon et al. 2020)
Habitat provision	• Habitat for fauna and flora (Hill et al. 2016; Oertli et al. 2010; Williams et al. 2020) • Habitat for pollinating insects, thus increasing the quantity and quality of pollinator-dependent crops (Stewart et al. 2017; Walton et al. 2021) • Stepping-stone habitats for enhanced habitat connectivity (Oertli et al. 2009; Simaika et al. 2016; Watts et al. 2015) • Biodiversity hotspots in ecologically poor areas such as cities or agricultural land (Biggs et al. 2017; Blicharska & Johansson 2016; Céreghino et al. 2014; Sayer 2014)
Cooling	• Mitigation of urban heat island effect (Jacobs et al. 2020; Manteghi et al. 2015) • Improvement to thermal comfort in urban areas due to trees and natural ventilation (Coutts et al. 2013; Jacobs et al. 2020)
GHG sequestration	• GHG sequestration and storage, but also release of carbon dioxide, nitrous oxide and methane (Downing 2010; Peacock et al. 2019; 2021; Taylor et al. 2019; van Bergen et al. 2019)
Erosion control	• Sediment trapping from run-off water (Chen et al. 2019; Fiener et al. 2005)
Recreation and well-being	• Recreational pursuits (Giampaoli et al. 2014; Ghermandi & Fichtman 2015; Moore & Hunt 2012) • Support to physical and mental health in nearby residents and visitors (Blicharska & Johansson 2016; Pedersen et al. 2019; Völker & Kistemann 2013; White et al. 2021) • Aesthetic scenery (Moore & Hunt 2012; Oertli & Parris 2019; Zhou et al. 2020)
Education and research	• Opportunities for research and environmental education (Ghermandi & Fichtman 2015; Oertli & Parris 2019; Sousa et al. 2016; Welker et al. 2010; Zhou et al. 2020)
Food and materials	• Food e.g. fish, watercress, and materials e.g. reeds (Hill et al. 2018; Nicholas 1991) • Aquaculture production (Bostock et al. 2016; Tucker & Hargreaves 2012)
Conservation value	• Opportunity for future generations to know and experience ponds as they are now (Davenport et al. 2010; Hassall 2014; Zhou et al. 2020)

Table A2: Pond and pondscape NBS actions: type and description.

Pond and pondscape NBS actions: type and description
1) Pond or pondscape creation • Creating a pond or pondscape in a site where there was formerly no waterbody
2) Pond or pondscape restoration • Creating or restoring a pond/pondscape in a site where formerly a pond/pondscape was existing, e.g. excavating a pond that had been filled in • Significant alterations to an existing pond or pondscape, e.g. depth, morphometry, slopes, shoreline design, flora or fauna
3A) Pond infrastructure and management actions On-site infrastructure measures *(acting on areas surrounding a pond)*: • Access restrictions, e.g. fencing to prevent access or allow access for animals and/or humans; • Development of trails or wildlife observatories; • Management of riparian vegetation and wetland plants; • Removing invasive alien plant species; • Implementing (or enlarging) the buffer area immediately surrounding the pond; • Creation of terrestrial habitats in the vicinity of the pond (e.g. for reptiles or amphibians); • Removing hard infrastructure (e.g. concrete edge); • … Pond management measures *(actions within a pond)*: • Removing invasive alien plant and animal species; • Reintroducing or protecting threatened plant and animal species; • Pond water management, e.g. manage input, output (e.g. sluice adjustments, lining), drying rate; • Routine management measures for pond design and depth (e.g. re-profiling of banks, sediment removal, creation/removal of islands, scraping edges to maintain populations of pioneer species); • Mowing and removal of submerged, floating or emergent plants; • Regular monitoring of physical, chemical or biological indicators; • Planting or introducing structured vegetation into ponds (e.g. planted coil rolls); • Shade management (e.g. a few trees or large % of cover); • Partial desilting; • ….
3B) Pondscape-scale land use and management actions • Placing (part of) the pondscape under protective status (e.g. protected areas regulations); • Changing land use in the pondscape area (e.g. convert arable land or intensive livestock grazing area to extensive grassland; decrease impervious surfaces e.g. asphalt in neighbouring areas); • Enhancing the connectivity between ponds or pondscapes. This involves the creation of terrestrial or aquatic corridors, removing obstacles, or active transport of propagules; • …. Specific management measures (*at pondscape scale*), depending on landscape: • In agricultural land, 1) Soil Management (e.g. allow drainage systems to deteriorate or reinstate/increase infiltration to decrease sediment load), 2) Livestock Management (e.g. reduce the length of the grazing day or grazing season), 3) Fertiliser Management (e.g. reduce fertiliser application rates), 4) Manure Management (e.g. change from slurry to a solid manure handling system) and 5) Farm infrastructure (e.g. Fence off pondscape from livestock) • In urban land, 1) Manage water quality (e.g. inputs of nutrient, salt, other pollutants); 2) Increase good quality terrestrial habitats in neighbouring areas (e.g. other green/blue spaces); 3) Promote natural hydroperiods, 4) Encourage water harvesting from buildings (rainwater) • …

Table A3: List of publications assessed to identify the main categories of barriers and enabling factors.

Policy context	Authors	Title of the publication	Year
Pond-specific	Boix et al.	Pond research and management in Europe: ''Small is Beautiful''	2012
	Biggs et al.	The importance of small waterbodies for biodiversity and ecosystem services: implications for policy makers	2017
	Blicharska & Johansson	Urban ponds for people and by people	2016
	Boothby	Framing a Strategy for Pond Landscape Conservation: aims, objectives and issues	1999
	Giampaoli et al.	Regulations concerning natural swimming ponds in Europe: considerations on public health issues	2014
	Gozlan et al.	Status, trends, and future dynamics of freshwater ecosystems in Europe and Central Asia	2019
	Hassall et al.	The ecology and management of urban pondscapes	2016
	Hill et al.	New policy directions for global pond conservation	2018
	Indermuehle et al.	Pond conservation in Europe: the European Pond Conservation Network (EPCN)	2008
	Kati & Jari	Bottom-up thinking–Identifying socio-cultural values of ecosystem services in local blue-green infrastructure planning in Helsinki, Finland	2016
	Linnerooth-Bayer et al.	Challenges for mainstreaming climate change into EU flood and drought policy: Water retention measures in the Warta River Basin, Poland	2015
	Oertli	Freshwater biodiversity conservation: The role of artificial ponds in the 21st century	2018
	Oertli et al.	Pond conservation: from science to practice	2009
	Oertli & Parris	Toward management of urban ponds for freshwater biodiversity	2019
	Osti	The Anti-Flood Detention Basin Projects in Northern Italy. New Wine in Old Bottles?	2017
	Sawadgo et al.	What drives landowners' conservation decisions? Evidence from Iowa	2021
	Sayer & Greaves	Making an impact on UK farmland pond conservation	2020
	Sayer	Conservation of aquatic landscapes: ponds, lakes, and rivers as integrated systems	2014
	Sousa et al.	Can Environmental Education Actions Change Public Attitudes? An Example Using the Pond Habitat and Associated Biodiversity	2016
	Trepel	Towards ecohydrological nutrient management for river basin districts	2016
	Villanueva & Glenk	Irrigators' preferences for policy instruments to improve water supply reliability	2021

Policy context	Authors	Title of the publication	Year
NBS generally	Deely et al.	Barrier identification framework for the implementation of blue and green infrastructures	2020
	Nelson et al.	Challenges to realizing the potential of nature-based solutions	2020
	Ramírez-Agudelo et al.	Nature-Based Solutions for Water Management in Peri-Urban Areas: Barriers and Lessons Learned from Implementation Experiences	2020
	Sarabi et al.	Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review	2019
	Sarabi et al.	Uptake and implementation of Nature-Based Solutions: An analysis of barriers using Interpretive Structural Modeling	2020

List A1: Decision criteria for which EU policies to include into the analysis.

To limit the scope of the study, we established the following criteria for the inclusion of a given policy into the data set:

1. Must be a *Directive* or *Regulation* passed by the European Parliament and the Council of the European Union; OR
2. A *Recommendation* or *Decision* adopted by the above-mentioned institutions, IF:
    a. There is no *Directive* or *Regulation* regulating a given policy issue, OR
    b. It outlines key aspects of the policy agenda relevant to NBS implementation for the future; OR
3. A *Communication* drafted by the European Commission, IF:
    a. There is no *Directive, Regulation, Decision*, or *Recommendation* regulating a given policy issue, OR
    b. It provides details regarding the status or future pathways of implementation of one or more *Directive*, *Regulation, Decision*, or *Recommendation,* AND/OR
    c. It outlines key aspects of the policy agenda relevant to NBS implementation for the future; AND
4. Must be the latest amendment or iteration of a policy; AND
5. Must be in force OR will likely enter into force (applies to *Directives, Regulations, and Decisions*).

8.2. Templates

8.2.1. Mapping the socio-economic and political context

Step I: Mapping the socio-economic and political context of PONDERFUL pondscapes

To focus the policy analysis on the most salient issues, it is important to map the context that policy-makers are operating in. Also, policies can sometimes use encoded, generic, or vague language. Therefore, it is indispensable to gather information before the analysis that helps us researchers to 'read between the lines'. Therefore, we intend to collect short 'background stories' on each pondscape. If necessary, we return to these stories during the subsequent analysis and collect supplementary information.

The following aspects could be of relevance:

- Type of pondscape (surrounding land use, origin, purpose, protection status);
- Current ecological state of pondscape and biodiversity features;
- Current and potential future threats to the pondscape;
- NCPs/ ES delivered by pondscape;
- Management measures carried out in the past 30 years;
- Main stakeholders (roles, influence, interests, and potential conflict between them);
- Political context (leading parties, changes in government);
- Points of contention or sources of conflict around pondscape;
- Cultural significance (attitude of local population, attachment to pondscape);
- Links to further valuable information.

Table A4: Template for mapping the socio-economic and political context of PONDERFUL pondscapes.

Imagine that somebody is interested in your pondscape, but there is only limited time to share your knowledge with them? What is there to tell about your pondscape? What do they really need to know when wanting to understand the local context? *The list above serves as a suggestion of potentially relevant aspects. Feel free to consider those that are most relevant in your pondscape, and add additional ones, if necessary.*
…

Step II: Overview of Key Policies for PONDERFUL Pondscapes

This section provides guidance for identifying policies influencing the implementation of pond(scape) NBS and describing in some detail the most relevant policies. An in-depth analysis will be carried out at a later stage.

Policies are highly diverse and may be of regulatory nature (e.g. laws, strategies, environmental impact assessments) or economic (e.g. agri-environment schemes, funds). Moreover, policies can but do not necessarily have the formal status of a law, but could also, for example, be a research programme or take the form of an awareness-raising campaign. Accordingly, in this analysis we are applying a broad definition of policy, and are consequently interested in all policies that influence pondscape NBS. The following list should serve as a guidance in identifying policies that are relevant:

- Policy is presumably significant for pond creation, restoration, or management in the pondscape in question (e.g. biodiversity conservation strategy, climate change adaptation plan; etc.);
- Policy focuses on NBS or related concepts;
- Policy is presumably of significant relevance for the general development of the area the pondscape is situated in (e.g. municipal/regional development strategy);
- Policy is associated with conflict (potential) amongst stakeholders (e.g. 'greening' guidelines for agricultural areas; spatial development plan/zoning laws; etc.);
- Policy faces obstacles during the implementation phase or is particularly successfully implemented);
- Policy links to corresponding EU policies (e.g. RBMPs for the WFD, Rural Development Programme for the CAP, Integrated Pest Management Plan for the Pesticide Directive, etc.).

Table A5: Template to list potentially relevant policies for pond(scape) NBS in PONDERFUL pondscapes.

List all potentially relevant policies that are presumed to influence pond(scape) NBS. In the second column, briefly present the objectives of the policy and the assumed influence on ponds. In the third column, indicate if the policy is linked to any European policies. In the last column select the 5-10 most relevant policies to be assessed in more detail.			
Name	Objectives	Link to EU policy	Selected
Policy 1	*...*	*Y/N, which one*	*Y/N*

8.2.2. Options for qualitative content analysis of key policies at DEMO site level

Table A6: Template I to assess key policies for pond(scape) NBS in PONDERFUL pondscapes in detail.

Use the fields below to describe each selected policy. If you are unsure about any information, just leave it out and make a comment. Please create a new table for each selected policy.
Name of pondscape
Name of policy
Adoption/entry into force/revisions *When did the policy enter into force? Please include revisions, if applicable.*
Administrative body in charge *Which authorities primarily deal with the implementation (incl. planning and monitoring) of this policy? Does the body work independently or jointly with other authorities?*
Relevance for pondscape NBS *Why is this policy relevant to the implementation of pondscape NBS?*
Linkages with other policies, esp. EU
Legally binding Y/N, because…
Type of policy
Main objectives *What are the relevant broad objectives of the policy?*
Key target(s) *What are relevant specific (quantitative/qualitative) goals?*
Implementation of policy *How successfully has the policy been implemented? Has it achieved its desired outcomes? Are there obstacles to its implementation? Describe what you base your judgement on.*
Spatial scope *What geographical and management units does the policy concern?*
Key stakeholders *Which stakeholders are involved in the implementation of the policy? Which stakeholders support/oppose thepolicy? How do they engage in discussions around the policy?*
Key instruments and/or management measures *Which are important measures or instruments to achieve the policy's objectives and targets?*
Funding *Is there any funding supporting the implementation? Who/what decides over funding allocations?*
Interaction with other policies *Does this policy interact with other policies (creating synergies or inhibiting each other)?*

Table A7: Template II to assess key policies for pond(scape) NBS in PONDERFUL pondscapes in detail (example for category 'Goals, Objectives, and Targets').

	Dimensions for category 'Goals, Objectives, and Targets'									
	Definition: Objectives are the overarching statements that provide the general direction of what a policy or policy element shall achieve, whereas targets oftentimes define how 'success' or progress is defined and measured.									
	Time	Scope	Type	Roles & Responsibility	Causes	Aim	Effects	Source	Comments	Questions
Values	*Since when has this policy existed?*	*To which political unit or area does the policy apply to?*	*Is it a goal, objective, or target?*	*Who sets the goals/objectives/targets? Who is expected to achieve them?*	*What triggered or what is the rationale for the goal, objective, or target?*	*What is the overarching aim?*	*What are the specific intended or actual outcomes?*	*Ref. to relevant text segment*	*Valuations or things to highlight, esp. regarding pondscape NBS.*	*Things that remain unclear or warrant further inquiry.*

8.2.3. Stakeholder workshop data collection

Table A8: Template for group work at stakeholder workshops (example for Uruguayan DEMO site and enabling factors).

	How important do you consider the listed aspects for the Uruguayan pondscapes to provide value for both nature and people? (1=not important at all; 5=very important)				
Statutory designations as protected areas	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Land-use designations (e.g. zoning as farming land)	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Management plans at national/local level (e.g. for river basins, protected areas)	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Monitoring of biophysical status of pondscape	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Financing for public/private actors (e.g. project-based funding; payments for landowners)	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Research into pondscape benefits (e.g. for biodiversity, adaptation, mitigation, and well-being)	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Awareness-raising for pondscape benefits (e.g. citizen science; environmental education; etc.)	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Cooperation amongst stakeholders	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					
Civil society activism	1	2	3	4	5
Comment: Feel free to describe in one or two sentences why your group assigned a given score.					

Ponderful

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