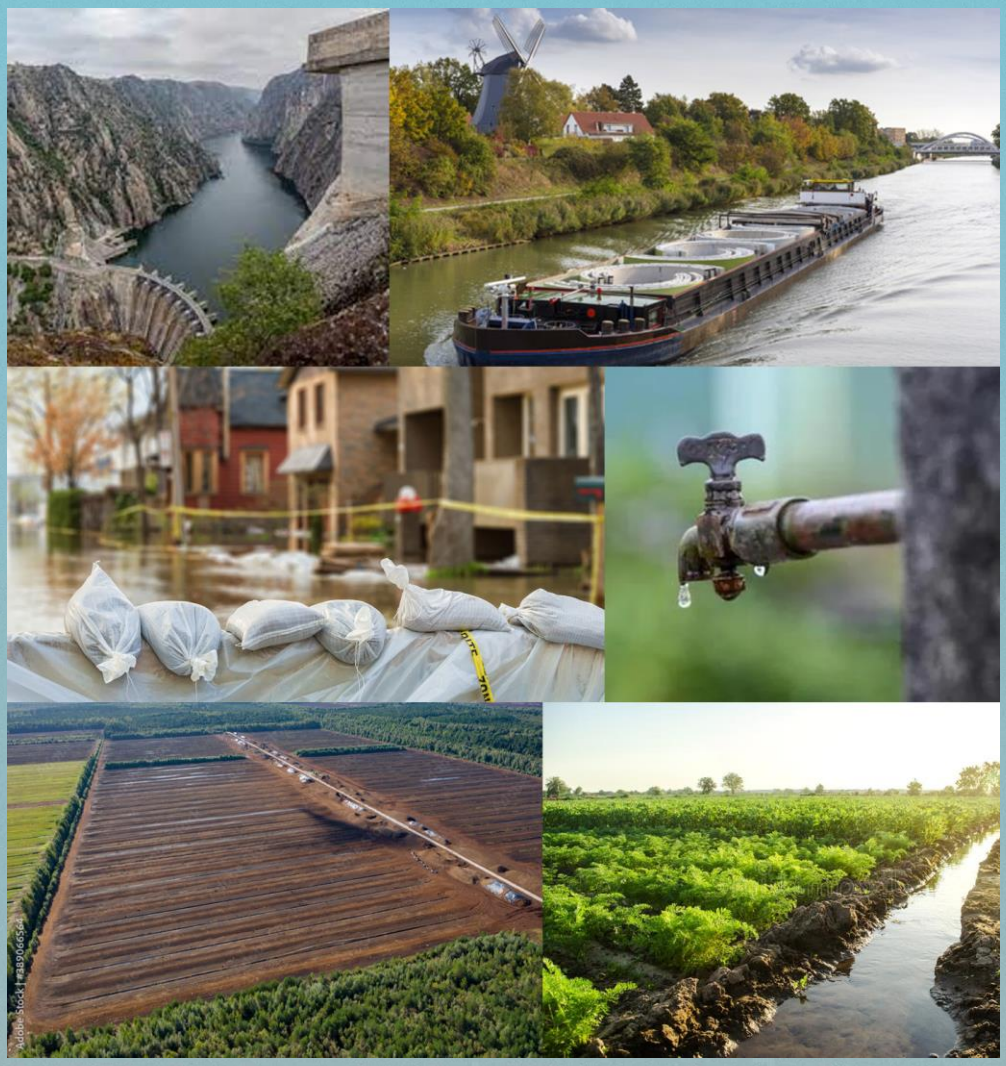

Deliverable D4.1: Mainstreaming aquatic restoration using Nature-based Solutions

Briefing on national / EU sector perceptions, workshops, and tailored briefings per sector

MEDLiN

Imprint

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MERLIN Key messages

1. Mainstreaming aquatic restoration using Nature-based Solutions (NbS) requires involving all relevant stakeholders and understanding their connection with rivers and wetlands. We work with six economic 'MERLIN' sectors (Agriculture, Hydropower, Insurance, Navigation, Peat Extraction and Water Supply and Sanitation).

2. Our data suggests these sector actors are aware of the environmental and socio-economic challenges arising from degraded freshwater ecosystems and are aware of the types of NbS that MERLIN will demonstrate and implement. However, not all sector actors were convinced of the need for radical change/transformation or that they could rely on NbS to deliver their sector needs.

3. The language of NbS is not well embedded (yet) with these sectors, however concepts of sustainability and working with nature are well understood. With its focus on meeting societal goals, NbS can address the sectors' concerns about balancing environment, social and economic objectives.

4. The sectors are seeking evidence regarding the benefits of NbS to their sector, concrete examples of NbS at the catchment scale and assistance to integrate sectoral concerns into spatial catchment management.

5. There are strong interdependencies and synergies between the MERLIN sectors. However, there are also potential trade-offs and challenges. We are building a Community of Practice to support an understanding of NbS, how we can enable mainstreaming of NbS in the six MERLIN sectors, and most importantly, how the sectors can work together.

MERLIN Executive Summary

Our research has highlighted that there is a shared awareness that the freshwater environment is under threat and that the European Green Deal provides a supportive agenda to address these threats.

In MERLIN we focus on how to mainstream freshwater restoration through Nature-based Solutions (NbS) in order to develop solutions for both nature and society, in the spirit of the Green Deal.

NbS require the engagement of all relevant stakeholders including the economic sectors that affect, and are affected by, interventions in our freshwater ecosystems. We focus on Agriculture, Hydropower, Insurance, Navigation, Peat Extraction and Water Supply and Sanitation Sectors, but other sectors, including the finance sector, are also important.

Our data suggests these sector actors are aware of the environmental and socio-economic challenges arising from degraded freshwater ecosystems and are aware of the types of NbS that MERLIN will demonstrate and implement.

However, not all sector actors were convinced of the need for radical change or that they could rely on NbS to deliver their sector needs. Our challenge is to illustrate how using NbS can advance the Green Deal goals, given that most actors were supportive of the overall vision.

Roles and responsibilities remain unclear and some sectors (Agriculture, Hydropower, Peat Extraction) are more involved in implementing NbS within their own properties than others that mainly rely on the 'downstream' benefits (Insurance, Navigation, Water Supply and Sanitation). Some intra- and inter-sectoral tensions were identified; and there are still questions about how to support collective action at the catchment scale to coordinate different actors involved in water management and use.

Sectors were concerned about how NbS will balance economic, environmental and social objectives and how 'burden-sharing' of restoring nature will be governed. There were concerns about impacts on business profitability but also about wider trade-offs e.g. with food or energy security.

These are opportunities to show how true NbS address societal goals over the longer term, in ways that should help businesses become more resilient to the pressure of climate and other changes. Policies can play a stronger role in supporting NbS and integrated water management. There are also opportunities to value working with nature through certification and value chains; and to harness innovative finance to work at scale and at pace.

The approach in MERLIN aligns with the IUCN principles for NbS but there is still a long way to go, due to the challenges outlined above.

This is our baseline from which we will engage representatives from the six MERLIN sectors on some prioritised areas for cooperation around provision of evidence, policy and value chain recommendations, implications for social justice and networking. The MERLIN Academy can support this with resources to respond to concerns over information and training.

Most importantly, we are building a Community of Practice to try to address the tensions, trade-offs and burden-sharing questions. The robust debates experienced in the development of this briefing illustrates the benefits of such a cross-sectoral and trans-disciplinary forum.

Table of Contents

The MERLIN project (https://project-merlin.eu) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

Acronyms

CAP	Common Agricultural Policy
EIA	Environmental Impact Assessment
EIP-AGRI	Agricultural European Innovation Partnership
EU	European Union
EUWMA	European Water Managers Association
GAEC	Good Agricultural and Environmental Conditions
GEMAPI	Gestion des milieux aquatiques et prévention des inondations (French Law)
H2020	Horizon 2020
IUCN	International Union for Conservation of Nature
IPCC	Intergovernmental Panel on Climate Change
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
MERLIN	Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling and transformation
NbS	Nature-based Solutions
PSI	Principles for Sustainable Investment
RPP	Responsibly Produced Peat
RTD	Round Table Discussion
SEA	Strategic Environmental Assessment
TNFD	Task force on Nature-related Financial Disclosure
UNEP	United Nations Environment Programme
WFD	Water Framework Directive
WP	Work Package
WSS	Water Supply and Sanitation

List of Figures

List of Tables

1 Introduction

Mainstreaming aquatic restoration using Nature-based Solutions: supporting transformation with six economic sectors

This deliverable provides our baseline for working towards transformation with the six MERLIN economic sectors (Agriculture, Hydropower, Insurance, Navigation, Peat Extraction and Water Supply and Sanitation) over the rest of the MERLIN project.

The deliverable summarises our understanding of the MERLIN sectors' current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sectors at the start of our collaboration. Building on these insights, it proposes how MERLIN can support the sectors to implement and mainstream freshwater restoration as NbS.

The deliverable comprises seven briefings. The first 'cross-sectoral briefing' (Section 2) is based on an analysis of the commonalities and differences across our six economic 'MERLIN' sectors. The specific challenges, opportunities and proposed cooperation points for each sector are described in the remaining tailored briefings (sections 3 – 8) making up D4.1.

These seven briefings are designed to be read on their own, without need to read D4.1 from top to bottom. Therefore, there is some repetition regarding the description of MERLIN project, definition of NbS and next steps in the sectoral briefings.

2 Cross Sectoral Briefing

Mainstreaming aquatic restoration using Nature-based Solutions: supporting transformation with six economic sectors

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at the landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].*

2.1 How can MERLIN support transformation

The H2020 MERLIN (Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling and transformation) project aims to support the implementation of the European Green Deal, particularly the goals on climate action and biodiversity restoration, whilst not retarding the remaining goals. The project focuses on restoration approached as a Nature-based Solution (NbS), working with nature for the benefits of nature and people. Transformation means working at scale and MERLIN seeks to complement small scale urban NbS with large(r) scale interventions in rivers, streams and wetlands[2].

Figure 1: Illustration of large and small-scale Nature-based Solutions (NbS). Large-scale NBS A in mountainous regions (e.g. afforestation) B along river corridors (e.g. retention basins) and C in coastal regions (sand dunes) to complement small-scale NbS like green roofs etc.[2]

NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (see also Section 8.) This reframes restoration (defined as measures to restore or renew the environment) by focussing on working with nature to tackle societal goals, working at scale and involving all the relevant actors, including the economic sectors. Over the course of the project, we seek to mainstream and upscale freshwater restoration as NbS across

Europe. This is crucial given the current state of the freshwater environment where only 40% of European surface waters reach good ecological status, often associated with impeding the natural processes of rivers, wetlands and streams[3]. These pressures on water quality are being further exacerbated by water stress and climate change[4]. Responding requires a transformation – maintaining existing good practice where it exists, creating new opportunities and disrupting existing practices that damage our freshwater environments.

This briefing is based on an analysis of the commonalities and differences across our six economic 'MERLIN' sectors that are summarised in the remaining briefings making up D4.1 (Agriculture, Hydropower, Insurance, Navigation, Peat Extraction and Water Supply and Sanitation). These briefings drew on interviews, online 'Round Table' discussions (RTDs), document reviews and insights from our MERLIN sectoral partners. This cross-sectoral briefing also draws on a questionnaire implemented with sectoral experts from across the European Union over the summer of 2022[5] (n=172, of which 65 responses belonged to individuals who identified themselves as experts on the six MERLIN sectors whilst others came from complementary water, conservation and policy sectors). The combined data provide an overview of the main opportunities and challenges across the six sectors.

An important difference to the sectoral summaries that follow is that this cross-sectoral briefing has not been developed with sectoral or policy experts. It is our evaluation of how representatives of the six MERLIN sectors currently think about mainstreaming freshwater restoration through NbS. The cross-sectoral briefing implements the integration aspect of NbS as we introduce our target audience (Community of Practice) to the commonalities, differences, synergies and interlinkages between the six MERLIN sectors. Our Community of Practice concerns EU and Member State level policy and commercial actors who share a common interest in improving their practices better through regular interaction and sharing information. The briefing forms an important baseline by highlighting areas where we can engage the important economic sectors that rely on Europe's freshwaters.

2.2 Description of the six sectors

In the MERLIN project we have focussed on economic sectors that affect, and are affected by, freshwater NbS and have links to the 17 demonstration cases with which MERLIN works. To develop collaborative relationships, we have prioritised six sectors to work with during the project.

The Agricultural sector is highly heterogeneous but consists of businesses that grow crops, raise animals or harvest fibre – in MERLIN we are focussed on crop and livestock farming. Farm sizes range considerably from small farms with lower standard outputs to large farms that produce the majority of the EU's agricultural output. The sector is focussed on food production for European food security and is concerned with its social and economic as well as environmental sustainability.

The Hydropower sector involves the generation of low carbon electricity by the flow of water through turbines. This can be in closed systems (pumped storage) or by utilising the flow of water in river systems. Hydropower plants can vary greatly in size, age and energy efficiency. In MERLIN our focus is on the Hydropower being produced by in-river barriers that can obstruct natural ecosystem functions. The sector is focussed on providing renewable energy and reliability of energy supply, which is seen to be particularly important with current geo-political tensions and the cost-of-living crisis.

The Insurance sector provides risk management products and services through insurance contracts. The basic concept of insurance is that one party, the insurer, guarantees payments for potential future events (like floods or injuries) that would have produced a financial loss for the policyholder. Meanwhile, another party, the insured or the policyholder, pays an insurance premium to the insurer in exchange for that protection on that potential future risk occurrence. In MERLIN we will concentrate mainly on (direct) non-life insurance companies that compensate the insured/policyholder for damages incurred by water related events such as floods or droughts to the insured assets.

The Navigation sector involves the use and management of water for the movement of goods (freight) and people. In MERLIN we will focus on inland navigation on rivers. Inland navigation needs a waterborne transport infrastructure including fairway dimensions that guarantee and maintain the ease and safety of navigation of vessels using these river stretches. These vessels can range from small recreational boats to large ships and river cruisers. Whilst the Navigation interests are diverse, most of the water infrastructure is provided through public, often, statutory responsible authorities.

The Peat Extraction sector dries and mechanically removes peat to provide resources for horticulture and energy production. Current licences are only granted to already degraded peatlands where mire vegetation may already be missing, and the extent of peat extraction sites is a fraction of the total area of degraded peatlands across Europe. However, there is an urgent need to rewet and revegetate degraded peat habitats and the sector has an important role to play through appropriate after-use of extraction sites.

The Water Supply and Sanitation sector (WSS) involves drinking water and wastewater activities (including wastewater treatment) for households, industrial, agriculture and commercial customers. In Europe public utilities and private operators are in charge of Water Supply and Sanitation and sewage networks and wastewater treatment plants. MERLIN's focus is on upstream restoration to preserve water supply and will therefore entail working together with the sector on the availability of drinking water in a landscape context, mainly in rural areas.

More details about the specific sectors and their perceptions of freshwater NbS can be found in the six sector briefings within this document.

There are other economic sectors that are also linked to freshwater restoration and NbS as they use water resources or rely on the water environment for their businesses. Our data highlighted sectors including aquaculture, freshwater fisheries, forestry, tourism, recreation, sand and gravel extraction, housing and urban development; hunting; food and drink processing; water management; education, policy and outreach; and the conservation sector. MERLIN also recognises the importance of financing the transformation analysis (see section 6), with a separate workstream addressing how to leverage private investment.

2.3 Societal challenges for NbS to address

Conservationists sound the alarm for freshwater ecosystems[6] and reports highlight the need for NbS[7] but these challenges and risks need to be understood by all society if transformation is going to be supported. Questionnaire responses highlighted four top challenges (Figure 5). These were 'pollution and degraded water quality (70 times, 57%), 'too little water (which poses flood risks' (67, 54%), 'loss of connectivity between various elements in the water environment (52, 42%), and 'too much water (which poses flood risks)' (50, 41%). Roundtable and interview participants also highlighted similar awareness of environmental issues.

However, while sectoral respondents also selected many of the same challenges; there was diversity in their answers. Agricultural respondents prioritised flooding and droughts; Hydropower respondents highlighted issues of connectivity and pollution; Insurance highlighted flooding; Navigation highlighted, sediments/erosion and structures in the rivers; Peat Extraction highlighted, connectivity and pollution; and WSS, highlighted drought and pollution. This illustrates that whilst NbS can be multi-functional, different sectors have different priorities to solve with NbS.

Non-environmental challenges were also identified. Questionnaire responses included several that can be summarised as pressures coming from existing land use and land use change; concerns about rising costs in their business and squeeze on revenues; the need to adapt to climate change and the lack of awareness and knowledge in their sector and finally; social or political pressures on water and riparian managers to manage freshwater ecosystems in specific ways (both positive and negative for nature). These challenges are confirmed through sectoral document reviews and Round Table Discussions (RTDs). These challenges were seen by many respondents as affecting their business. Of the 111 respondents answering this question, most selected 'to a high extent' (52, 47%) or to some extent (43, 39%). This suggests that the challenges are important, the sectors are aware of the pressures on the freshwater environment and are directly affected by these societal challenges.

2.4 The need for NbS

2.4.1 NbS approaches in MERLIN

Although there are clear societal challenges, there is less agreement about whether and how restoration measures implemented as NbS can be used to address these challenges.

Overall, revegetation of peatlands; riparian, channel and floodplain restoration were most popular across the questionnaire respondents. At least one respondent from every sector felt that every proposed restoration measure being implemented in MERLIN was relevant to their sector. Riparian restoration was most popular for

Agriculture and Insurance; rewetting or revegetation was most popular for Peat Extraction; channel restoration for WSS and floodplain restoration for Navigation; with Hydropower equally split across all suggested interventions. Conversely, removal of small or obsolete dams seemed to be the least popular intervention for all the sectoral questionnaire respondents. Other interventions were suggested, including a focus on soil management to improve percolation in rural and urban settings.

Although most respondents were positive about the need for restoration and NbS, some questionnaire respondents from the Hydropower and Peat sectors disagreed that restoration or NbS were needed to address their sectoral challenges. The roundtables and interviews also suggested that whilst sectoral actors were interested in discussing the challenges to their sector and the opportunities available, some individuals also believed that their sectors were already applying good practice. Therefore, some of our sectoral participants resisted the need for radical change. There was also discussion of the need to continue to use 'grey' infrastructure and traditional engineering approaches like dredging[8] alongside NbS due to uncertainty about how NbS could deliver the sectoral objectives.

While over half (61%) of the sectoral respondents to the questionnaire were confident that the NbS interventions proposed within MERLIN would be able to address the environmental challenges; a quarter of the respondents were unsure; and some (particularly in the Navigation, Hydropower, and Agricultural sectors) were not confident that these interventions would address their specific sectoral challenges. For example, the navigation sector respondent was concerned that the NbS may increase sedimentation and reduce fairway capacity. The lack of confidence may be related to whether the concept of NbS and the suggested measures are familiar to these sectoral actors; compared to experience and skills in more traditional approaches as discussed in the RTDs and identified in the reviews. However, other relevant concerns, such as how measures might perform under climate change, were also shared.

2.4.2 How the sectors relate to NbS

The document reviews identified a range of experiences of participating in restoration or NbS projects – the questionnaire data also suggested that around half of the respondents answering had been involved in restoration or NbS projects, but this result was much lower for the Agriculture respondents. Our literature review also found few examples of peat extraction site restoration projects, instead the good practice tends to be focussed on wider peatland restoration which may not involve the extraction sector actors directly. Therefore, whilst there is understanding of the need for solutions to societal challenges, there may be less understanding of how NbS relates to the specific sectoral practices and motivations – the gap that MERLIN hopes to help fill.

It appears that MERLIN has a significant challenge ahead in this regard. The questionnaire respondents were not very positive about the current motivation of economic sectors to mainstream NbS. Out of the 48 responses from the MERLIN economic sectors, only 15 (31%) perceive economic sectors as 'very motivated' or 'motivated' (14), while the rest indicated that sectors were indifferent (16, 33%), or not motivated (16, 33%) or not motivated at all (2). Of the 10 of those who selected 'motivated', six were from the Peat Extraction sector and four from the Water Supply and Sanitation Sector. These findings on motivations reinforces the discussion in some roundtables where not all sectoral actors felt that their sector needed to go beyond current good practice (see Section 4.1 above). Interviews with policy experts reinforced the importance of involving the economic sectors. Therefore, the challenge for MERLIN is to persuade the sectors to adopt NbS as a response to the Green Deal.

Part of the reason for low motivation might be that the language of NbS is not common in the sectors' reports and briefings we reviewed. Instead, the sectors tend to use the language of sustainability, particularly alignment with the UN's Sustainable Development Goals and the concept of 'working with nature'. However, given the opportunity to better understand how NbS can support economic sectors during interviews and RTDs, sector actors tended to agree that NbS could be relevant. The discussions were able to move from terminology to questions focusing more on who, where and how such actions should be pursued (the aim of our cooperation opportunities, see Section 7).

2.4.3 Relationship between the sectors

Based on the reviews of relevant sector literature, the questionnaire responses and interactions with sector experts through interviews or roundtables, different economic sectors could have different roles in implementing large scale NbS, as shown in Figure 2.

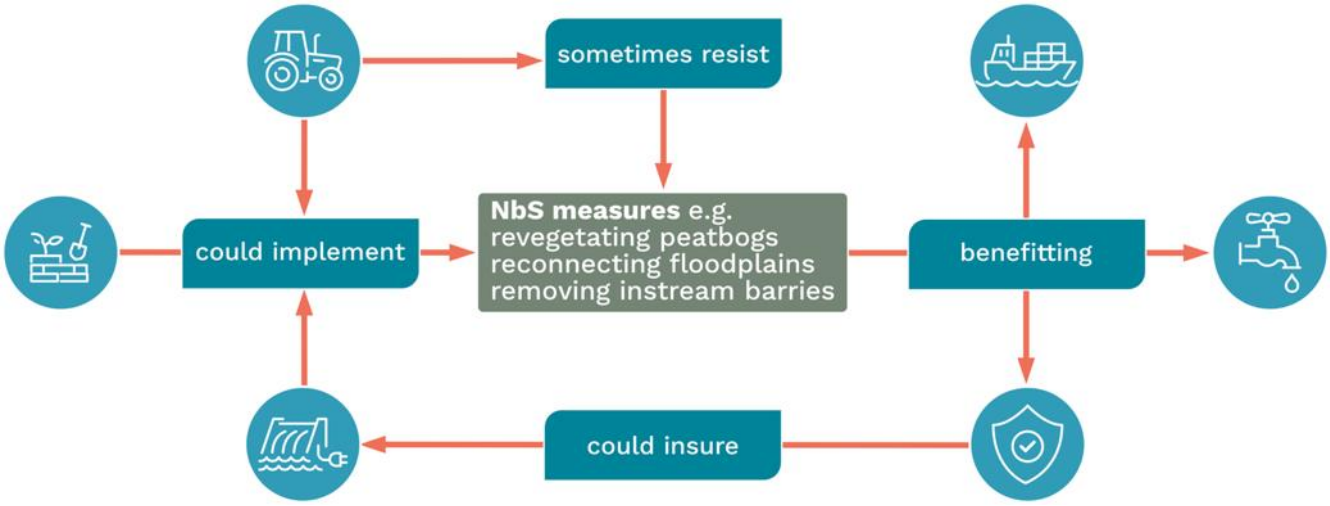

Figure 2: How the MERLIN economic sectors interact[9].

As shown in Figure 2, the sectors interact due to their different roles. Implementing actual restoration measures such as restoring peatlands and wetlands, riparian restoration, floodplain restoration or removing barriers are most likely to involve land and water managed by Agriculture, Hydropower and Peat extraction actors. Other sectors, such as Insurance, Navigation and WSS can support adoption of these NbS measures but rarely have direct access to these interventions themselves. Regulation of water levels through adoption of NbS by Agriculture, Peat Extraction and Hydropower businesses could benefit downstream Agriculture, Hydropower, Navigation, Water Supply and Sanitation and Insurance companies directly. There are also further potential interactions between Agriculture and Peat Extraction sectors, e.g. extensive paludiculture could provide a form of Peat Extraction after-use that is compatible with revegetation[9], whilst horticulture is one of the main users of extracted peat. Finally, insurance can be used to support sectors coping with extreme events and illustrate how NbS can benefit the sector through reducing their risks and therefore their premiums.

Although this shows the potential for positive interaction, in some cases, there were concerns from sectoral actors that NbS measures proposed in MERLIN could negatively impact several sectors, e.g. restoring the natural rivers and increasing upland water retention can affect the navigability of rivers and decrease the water availability that can be used by Agriculture and Water Supply and Sanitation companies. There were also concerns that renewable energy objectives were overriding environmental objectives within the hydropower sector, resulting in lower downstream flows with potential knock-on impacts on Water Supply, Irrigation Agriculture and Navigation. These concerns will be amplified by the increased risk of extreme events due to climate change, including water scarcity[4].

This last point relates to burden sharing and whether the sectors feel they have a responsibility to help address environmental challenges faced by Europe's freshwater ecosystems. For example, many sectors recognised the need for action on the environmental challenges but pointed out that their sector was not the main or only source of negative pressure on the environment. In roundtable discussions for example, sector actors highlighted how Peat Extraction sites cover a small area of Europe compared to Agricultural or Forestry use of peat soils. This concern about the burden sharing is related to which businesses should bear any additional costs and responsibilities associated with restoration and NbS.

2.5 Challenges to mainstreaming NbS

Initial reviews and interviews highlight challenges such as lack of knowledge, inadequate capacity, and financial cost of undertaking NbS. The main challenge preventing mainstreaming NbS selected by questionnaire respondents was the need to balance economic, social, and environmental needs (80, 73%), something particularly emphasised by Agriculture and Peat Extraction participants. Questionnaire respondents also raised concerns about 'additional costs and responsibilities for my business'. Indeed, many sector actors did not associate restoration projects with delivery of 'multiple benefits' beyond those for nature. This may explain why they were concerned about how NbS would deliver for both biodiversity and societal well-being.

The issues are not only about commercial profitability however, as sectors also talked about trade-offs between making space for nature and food production (Agriculture, Peat Extraction for horticulture) or climate mitigation (Hydropower as a renewable electricity source or Navigation as an alternative to road transport). The sectors highlighted tensions and trade-offs between these different Green Deal goals. Many of the goals are essential for social cohesion within Europe – the ongoing war in Ukraine has highlighted the importance of energy and food security and these were highlighted as trade-offs with some of the NbS approaches such as reclamation of flood plains or removal of older hydro-power dams. There were also concerns about impacts on jobs or on cultural heritage if existing grey infrastructure were removed.

These debates are closely related to another challenge 'inadequate (lack of) knowledge, experience, data and uncertainties about the outcomes (of NbS) selected by the majority of the sectoral questionnaire respondents. Again, this mirrors the request by sectoral respondents (n=22) to have 'adequate data and information to support investment [in NbS]'. Whilst there is a growing literature and evidence base for NbS across Europe, further effort is needed to package the information in ways that are meaningful to the economic sectors and their objectives. For example, converting environmental data into financial planning metrics such as return on investment, or risk reductions.

Other challenges identified by sector actors was a lack of coordination and collaboration between different actors within a sector, for example in the navigation sector between fleet operators and waterway managers. Furthermore, the challenge of 'capturing the needs of all stakeholders and addressing conflicts' was also highlighted by questionnaire respondents (63, 57%). Questionnaire respondents selected Agriculture, Hydropower, Peat Extraction and Water Supply and Sanitation as having potential inter-sectoral conflicts. There were also responses that indicated conflicts within economic sectors (such as between different types of agricultural production); and with other sectors (e.g., Forestry, Mining) beyond the six MERLIN sectors.

Regarding conflicts with the Agriculture sector, there was concern over water allocation between irrigated agriculture and other users such as aquaculture; or how farm drainage might make it difficult for peat extraction sites to be restored. Likewise, peatland revegetation and rewetting might make it difficult to practise conventional Agriculture if restoration results in a raised water table. Where drinking water supply depends on reservoirs, this can impede downstream flows and availability of water resources for Hydropower, Navigation and Agriculture. In contrast, there were virtually no conflicts identified with the Insurance sector.

Working at scale is difficult when there are a variety of actors working within a catchment, with different property regimes and business objectives. Findings also illustrated that fragmented land ownership and how to access private land to implement NbS was a challenge perceived by Agriculture, Hydropower, Navigation, Peat Extraction and Water Supply and Sanitation sector actors. The need for coordinated or collaborative action is at the heart of NbS and sustainability[10]. However, concerns over 'free-riding' when not all beneficiaries from the services provided by Nature bear the costs of implementing NbS were voiced by members of our roundtables, for example by the Insurance sector. This concern about retaining competitive advantage explains why there is more interest in measures focussed on individual sites (farms, hydro plants, after use of peat extraction sites, WSS infrastructure) than wider landscape or catchment scale interventions.

There is also a temporal dimension, as working with nature may require several years if not decades to show results, which is problematic for sectors with shorter business planning cycles (Agriculture, Risk Insurance). Grey infrastructure investments can take a long time to plan and build, but actors feel more certain about when and what outcomes will be achieved. Thus, many of our sectors (Hydropower, Navigation, Water Supply and Sanitation) are used for long-term planning[8]. This suggests the challenge is more about lack of certainty about effectiveness and returns on investment, or how the NbS might relate to business risks. Therefore, effort is needed to integrate knowledge of NbS options into the long-term business planning practices of each sector.

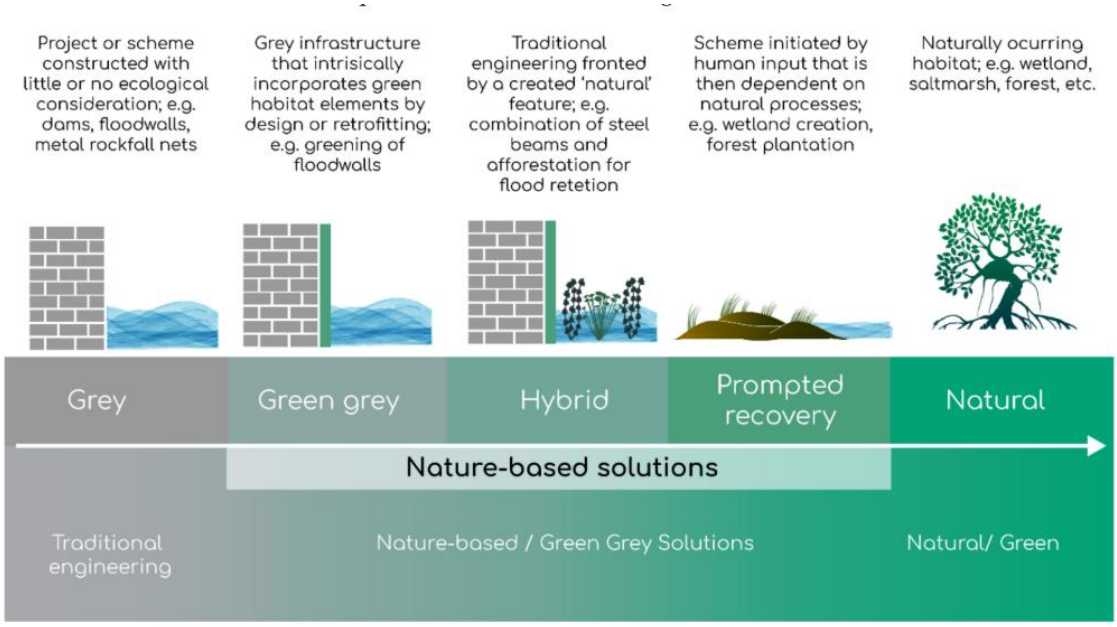

Figure 3: How NbS compares to traditional grey solutions [8]

Policy is often seen as providing the basis for long-term planning by providing clear objectives, obligations, and incentives for positive behaviour. However, our data suggest that sectoral respondents believe that existing policies do not support an NbS approach and there remain tensions between the implementation of the Common Agricultural Policy and Water Framework Directive (WFD) for example. Whilst there are positive signs of a shift in thinking towards working with nature, particularly with the Green Deal objectives and the proposed Nature Restoration Law, the economic sectors are seeking more evidence on how these policies balance environmental, economic, and social objectives.

2.6 Opportunities for mainstreaming NbS

Challenges can become opportunities when addressed. For example, the concerns about balancing economic, social, and environmental considerations are central to a true NbS which addresses societal challenges, whilst being economically viable and socially just (see Table 2 below). This is related to the fact that sectoral questionnaire respondents identified 'increasing economic outcome (profits)' (n=24) as the main way to motivate the sector to support NbS. Therefore, the opportunity is to illustrate how investing in NbS is not a cost but an asset to the resilience of a business (particularly under conditions of climate change). Furthermore, round table participants were mindful of the reputation of a sector in terms of societies shifting expectations in relation to sustainability (e.g., within Hydropower and Peat Extraction). Additionally, the sector actors were seeking more information of the costs and benefits of NbS. Furthermore, as highlighted in Section 7 below, there is potential for the risk insurance sector to incentivise NbS uptake as part of Agriculture, Hydropower, Navigation, and Water Supply and Sanitation management of the risk of flood and drought damage to their assets.

There is interest in how existing efforts to work with nature and contribute to NbS can be valorised by the market through certification and/or obtaining a product premium. Within Agriculture, there is a strong policy push towards organic or restorative Agriculture, but the sector is seeking evidence that these farming systems are recognised and rewarded by consumers. With the Peat Extraction sector, the Responsibly Produced Peat (RPP) certification process is being used to ensure that where peat is extracted for horticulture, the sites are restored to a suitable standard and there are opportunities to strengthen these standards. Within Navigation, there was discussion of whether the reduction in greenhouse gases from water borne transport could be signalled in marketing to incentivise the shift from road to river; and green tourism standards for river cruises could also be used to incentivise investments in river restoration. There is an opportunity to explore having certification for NbS with IUCN[11] and to use public procurement processes to reinforce the uptake of NbS by economic sectors.

Furthermore, there was a keen interest in more information about funding and financing (raised by 52 respondents) to increase the different routes to pay for NbS implementation. Grants and subsidies remain popular means of financing restoration measures, particularly with Agriculture and Peat Extraction sector

respondents. However, there was considerable interest in payment for ecosystem services and carbon credits across all the economic sectors. One of the ongoing aspects of financing the transformation to working with nature is not only financing the capital costs of measures but financing the operational costs and ongoing maintenance to ensure delivery of ecosystem services and benefits over the investment time frame. Furthermore, ensuring there are sufficient 'bankable' projects means working at scale – this can be a challenge where there is fragmented land ownership requiring intermediaries to parcel up multiple holdings but conversely some of our sectors already have strong coordinated networks delivering large scale infrastructure e.g. Rhine and Danube conventions to maintain international navigation routes, or large-scale hydropower providers that could lend themselves to working at such scales.

The need for more evidence was clearly signalled and other parts of the MERLIN project are working on this including providing evidence of how interventions create Green Deal outcomes (through monitoring processes) and the estimation of costs and benefits of ecosystem service provision created by restoration interventions. Section 9 (Implications for the Academy) highlights some ideas including how we can share insights from other research projects and existing data. There are also opportunities for data -driven industries, such as the risk insurance companies, to share how they estimate flood vulnerability and incorporate the impact of upstream NbS on downstream risks. However, we need more than provision of information but knowledge exchange and increased mutual understanding. Questionnaire respondents, and participants in our RTDs were keen to pursue building of networks to link researchers, industry experts and water managers, which is the motivation to build up the MERLIN Community of Practice. Respondents were seeking guidelines for NbS. However, many roundtable participants felt there were already industry guidelines, so the best approach might be to bring a strong NbS freshwater lens to those already in use by sectors.

The issue of trade-offs, conflict and burden sharing is difficult to resolve. Policy has a role to play in ensuring a level playing field for businesses within Europe; and respondents suggested many issues where policy coherence or implementation could be improved. For example, swapping biomass grown on rewetted peat extraction sites for peat as sources of heat and power. However, it is also possible to overcome conflicts through building networks and mutual understanding, whereby opportunities for common ground can be found as evidenced by the benefits of integrated catchment or watershed institutions[12]. Again, this is the purpose of building a Community of Practice and it is heartening that despite robust debate and strongly held views, a core of high-level sector experts has engaged with, and educated the MERLIN project team about their sector and potential ways to work together.

2.7 Reviewing our sectoral cooperation opportunities

Interviews and questionnaire responses show that NbS is not just about technical solutions as there are administrative, governance and policy dimensions that can constrain or facilitate the application of NbS. Hence, the individual sector briefings identify the following 'cooperation' opportunities that we will focus upon over the next year (see Table 1).

Table 1: Summary of Proposed Cooperation Opportunities

Sector	Cooperation Opportunities
Agriculture	Enhancing the enabling environment to get more uptake of NbS on farm land through identifying and sharing: ➔ Benefits of NbS ➔ Evidence of impact on farm resilience ➔ Capacity building and networking opportunities ➔ New policies or products (e.g. insurance, certification and CAP implementation)
Hydropower	Facilitation of dam removals where the dams are no longer economically viable through identifying and sharing:

	➔ Evidence on cost-benefits ➔ Tools to screen potential dams for removal ➔ Existing examples ➔ Finance mechanisms ➔ Catchment partnerships for strategic planning
Insurance	Better defining NbS benefits to use in new products through ➔ Adapting risk models to include NbS benefits ➔ Addressing alternative risk transfer models ➔ Meetings and workshops ➔ Revised regulatory frameworks to support investment in NbS
Navigation	Integrated project delivery including Navigation through: ➔ Evidence of how NbS can sustain fairways ➔ Engage other sectors involved in water infrastructure and management ➔ Raise awareness of NbS including training events
Peat Extraction	Ensuring licences require revegetation if possible, and require appropriate after-use through improving planning and licence processes and/or certification Linking restoration of peat extraction sites with wider peatland restoration approaches (as a business opportunity) through engagement in wider partnerships and sharing funding mechanisms
Water Supply & Sanitation	Raising awareness of the importance of working upstream using large-scale NbS through: ➔ Providing more opportunities to work in catchment partnerships ➔ Identifying policy levers to help with upstream coordination of multiple landowners ➔ Providing more information on finance mechanisms

Table 1 shows that for many, it is not yet possible to work directly with the sectors on implementing NbS, as there is still a need to provide more information about the benefits of NbS and to enable more financing, collective action and resolve policy coherence problems.

Therefore, the overall cross-sectoral implications of these cooperation opportunities are that often they are seeking evidence that may span multiple economic sectors; they need more information and concrete examples of NbS in action that again may relate to multiple economic sectors; and they seek further engagement with networks or partnerships to integrate their sectoral objectives into spatial catchment planning. The cooperation opportunities also respond to the questionnaire results that respondents were seeking more information about NbS to resolve conflict and balance trade-offs.

2.8 Alignment with IUCN criteria for NbS

Our MERLIN project proposes to develop a 'route-map' of different ways to get from our starting cooperation points with the six economic sectors to the end point of cross-sectoral working to deliver NbS at scale and at pace across Europe. In this section, we summarise to what extent we are already mainstreaming 'NbS' within these sectors. The criteria in Table 2 are adapted from the IUCN Global Standard for Nature-based Solutions™.

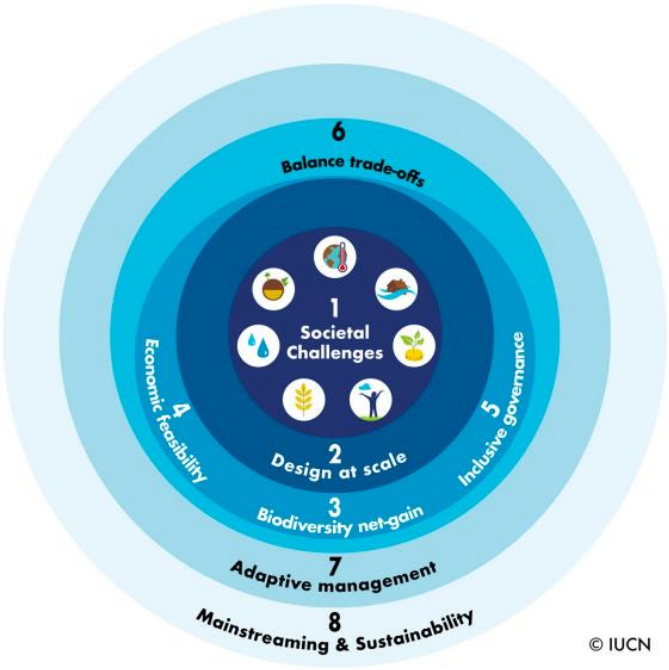

Figure 4: IUCN Global Standards on NbS[13]

Table 2: Evaluation against IUCN criteria

IUCN criterion	Evaluation from our sectoral engagement
NbS address societal challenges as identified by beneficiaries; these agreed challenges are documented and the outcomes are assessed.	The impact of negative environmental change on society is recognised but it has been harder to agree on the specific challenges to prioritise. The findings reported in this briefing draw intentionally on organised stakeholder voices active within the economic sectors and freshwater management at the European Union, supra-national regions or national scale and therefore do not include the views of local populations.[14] Impacts are being assessed for the 17 MERLIN case studies.
NBS is informed by geographic, economic and institutional scales; synergies across sectors are sought and impacts beyond the intervention site are considered.	The process has deliberately targeted the scale(s) relevant to the sectors rather than the biophysical approaches; and we seek to find synergies between the MERLIN sectors as well as within catchments. However, it has proved challenging to handle the multi-level aspects of how many sectors are organised (businesses; networks; member states and pan-EU or global). Furthermore, we are mindful that many other sectors are involved in NbS and the MERLIN case studies.
NbS result in a net gain to biodiversity and ecosystem integrity; these outcomes are measured including ensuring there are no unanticipated adverse effects.	The responsibility of sectors to deliver biodiversity net gain is disputed and there is uncertainty about how NbS generates ecological benefits, including some sector respondents suggesting that some MERLIN interventions might degrade some habitats (e.g. the claim that removing dams can destroy upland wader habitats). Other respondents felt economic priorities still overrode environmental concerns. Therefore more knowledge sharing is needed about restoring functioning ecosystems and the benefits restoration in MERLIN can bring to the sectors.

NbS should be economically viable, including estimating costs and benefits over time.	This principle is well accepted but currently difficult to implement, with the sectors seeking more information about costs and benefits, return on investments and the ability to balance economic and environmental benefits. Many sectoral respondents were also seeking more certainty about how NbS could be evaluated against more conventional interventions. The interest in a range of financing options is encouraging.
NbS use inclusive and transparent governance processes that allow for conflict resolution and document the discussions.	The participants in the interviews and roundtables were identified through stakeholder analyses to represent a particular set of stakeholders often missing in discussions about NbS. (Potential) conflicts have been identified and interactions documented but we have yet to resolve fundamental differences of opinion.
NbS manage trade-offs in an equitable manner; respecting different rights and responsibilities and providing safeguards to avoid inequality.	The process has started to identify rights and responsibilities within the sectors and identified some trade-offs to be resolved. However, it is not easy to find mechanisms to resolve these trade-offs and attention to inequality is part of further work planned.
NbS are managed adaptively based on evidence but allowing for innovation and experimentation	The process so far has clearly highlighted the need for more evidence before the sectors will engage with large scale NbS. However, there seems limited appetite to experiment with NbS and adapt as evidence is obtained, as most sectoral respondents were seeking certainty before adopting NbS as common practice.
NbS are mainstreamed within appropriate national and international frameworks	Our approach in developing the community of practice is precisely to share lessons with economic sectors in ways that align with relevant policies and programmes. The process has clearly identified some policy issues to resolve. Part of our next steps is to consider how to best align with IPCC/IPBES/IUCN frameworks.

2.9 Implications for the MERLIN Academy

The data suggests that there is a need to explain the benefits of restoration and how it could become a NbS (see Table 2 above); which also reflects findings from the roundtables and interviews reported in the sectoral briefings. This has already been partially addressed by the inaugural MERLIN webinar[15], but further dissemination of this information would be useful; and targeted information per sector will be the most compelling.

Explaining what restoration and NbS are, and how these concepts interact, could also be helpful. Our research suggests that NbS is not (yet) a common term for many sectors, although they understand the principle of sustainability and working with nature. The discussions around the proposed Nature Restoration Law[16] might provide a useful way to introduce these terms and explain why they are relevant to the sectoral practices.

There remains a conceptual shift to be made for some sectors to move from benefiting from restoration measures or NbS implemented by other sectors to investing in these measures directly. However, understanding how to do this requires more analysis of the policy and market conditions that impede the insurance sector, navigation and Water Supply and Sanitation sector investing directly in large-scale upstream NbS. The issues around financing will be tackled through a workflow to build capacity in how to tap into private finance for NbS including planned briefings on 'off-the-shelf' financial instruments as part of WP3. As our findings become available, the Academy can provide further information about potential ways to transform these blockages into opportunities.

It is always helpful for those running businesses that depend on, and/or affect, freshwater resources, to learn from demonstration projects and hence it would be useful to host visits of sectoral representatives to the

MERLIN, twin partner, or other relevant demonstration sites. Again, addressing the specific needs of the sector (e.g. shipping firms to understand how opening sidearms can work or farmers understanding floodplain reconnection) is more powerful than a general field visit for all sectors. This is because, for some actors, awareness of their role in restoration as NbS is needed before we can move into cross-sectoral working. When individuals are aware of, and comfortable discussing the concepts of restoration and NbS, it is then appropriate to move towards more cross-sectoral working to generate networks of aligned economic champions working together in specific basins or catchments (as anticipated by MERLIN's regional and EU wide upscaling plans). These cross-sectoral discussions are planned to begin during 2023-4.

2.10 Next Steps

Our findings, particularly regarding the challenges in bringing the 'MERLIN' sectors with us on a journey of transformation, resonate with other findings[17]. However, the continued engagement by members of our sectors with our work provides hope for the future.

Further roundtables are planned in 2023, to deepen discussions within each of the six economic sectors; bring the sectors together to discuss interactions and to also involve other important supporting sectors such as tourism, forestry, or gravel extraction. The next RTDs will focus on the cooperation opportunities to advance these ideas in ways that understand their needs, challenges, and opportunities.

We will examine the relevant EU policies, particularly in light of the policy issues highlighted in Section 5, to identify how existing and potential policies (e.g. the proposed Nature Restoration Law) could be used to mainstream NbS across Europe. In particular, how policy can provide a foundation to motivate and support economic sectors to become more involved in NbS implementation. Alongside policy analysis, we will start to consider how the market could reward protection or enhanced natural capital and ecosystem services as part of the sectors' value chains, potentially through enhanced accreditation processes. Finally, we will Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector so that the transformation tries to 'leave no-one behind'.

There is no better way to end this briefing than with the words of a questionnaire respondent:

> *"In the current uncertainty of climate conditions and patterns, water becomes more than ever a valued resource. Many economic activities depend on it. Therefore, to ensure sustainable businesses, a healthy environment and human development, we need to ensure that water is maintained, used, and preserved in an optimal balance."*

2.11 References

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3 Briefing for Agriculture Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Sectoral Transformation

Climate change and biodiversity crises are posing new challenges for sectors across Europe, demanding new solutions. A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change that can help people, nature and the economy. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS) for their challenges. Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, health, and wellbeing and sustainable food systems).

NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].

This briefing focuses on the Agriculture sector. It summarises our understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of our collaboration. The briefing proposes how MERLIN can support the Agriculture sector to implement NbS across catchments (more information about the MERLIN project can be found here).

How can MERLIN support transformation?

The Agriculture sector can play a crucial role in contributing to reach Europe's Green Deal objectives, besides contributing to sustainable food systems. In particular, responding to extreme events such as recent floods, droughts, and heat waves. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets and citizens. MERLIN will support this through understanding how and why the Agriculture sector is already making positive changes, sharing good practice between European countries and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from involving individuals actively engaged in the Agriculture sector (using questionnaires, interviews, and participating in sector meetings) and a desktop review of formal documents. We are very grateful for the insights shared to date, which have helped us understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within our developing Community of Practice. Our Community of Practice concerns EU and Member State level policy and commercial actors of the Agriculture sector who share a common interest in improving their practices through regular interaction and sharing information.

3.1 Relationship of the Agriculture sector with freshwater restoration and NbS

3.1.1 Brief description of the sector

The Agriculture sector is a highly heterogeneous sector across the EU. It consists of establishments primarily engaged in growing crops, raising animals, and harvesting food or fibre from a farm, ranch, or their natural habitats. The Agriculture sector and its major activities are dependent on the geographical context, including the climate and the various forms of land uses and farm structures. The Agriculture sector comprises sub sectors that include arable farming, livestock, agroforestry-forestry, fishing and aquaculture - in MERLIN we are focussed on crop and livestock farming. Food production, and thus EU food security, is important for the sector.

Almost 40% of EU land, 173 million hectares, were used for agricultural production in 2016, Of the EU's 10.5 million farms, the majority are small (under 5 hectares) with relatively low standard outputs and covering only about 25% of the total agricultural area. In contrast, 304,000 large farms (3% of the EU total) each produced a standard output of EUR 250,000 per year or more in 2016 and were responsible for a majority (55.6%) of the EU's total agricultural economic output. This diversity has to be considered when encouraging uptake of NbS at scale. The number of farms in the EU has been in steep decline, but the amount of land used for production has remained steady. Agriculture remains a big employer within the EU; 9.7 million people worked in Agriculture in 2016. However, as the number of farms in the EU has declined, so has the number of farmers and those employed in Agriculture, falling from 5.7 % of total EU employment in 2005 to 4.4 % in 2016 [3]. The sector has to

face market competition that further threatens small-scale farmers[4], as global market competition tends to favour large scale production and cheap labour[5]. Concerns over rural depopulation and the need to safeguard food security explains why successive Common Agricultural Policy reforms still contain elements of income support to maintain rural populations as well as competitive food export conditions.

The sector faces various economic, social and environmental challenges that undermine food systems and increase the pressures on natural resources: Copa-Cogeca[6] warns of the "difficult debates" coming up on "generation renewal, low farm income, market volatility and climate change".

Climate change is intrinsically linked to water, a resource the sector is highly dependent on: soil, ground and surface water for rain fed or mechanical irrigation. It is the second main source of water extraction in the EU[7]. accounting for 24% of water use on average in Europe, with some catchments in Southern Europe reaching 90%[8]. To provide agricultural land with sufficient water, using dams, or to reclaim land using drainage, farmers have altered the hydromorphology of wetlands, streams, peatlands, rivers and floodplains, which can reduce resilience to extreme weather events on farm and downstream. Agricultural production also affects water quality. Despite the increasing shift of the sector towards more sustainable practices, Agriculture is still the largest contributor of nutrient pollution to groundwater[6]. It generates diffuse pollution from nutrients and pesticides as well as sediments[9]. The effects of Agriculture on water quality obviously depend on the geographical context, farming system and management practices, e.g., extensive VS intensive management, organic VS conventional cultivation[10].

Coupled with climate change, Agriculture's pressure on natural resources leads to the degradation of the (agro)-ecosystems, affecting agricultural production and productivity and the sector's adaptation capacity. Changes in climatic conditions and extreme events related to climate change have affected crop yields and livestock productivity in Europe, with regional variations. For instance, droughts and heat waves have increasingly affected costs and caused economic losses in Agriculture[11] . Future climate projections reveal potential increase in yield loss, in some European regions 12. Crop productivity has also been affected by changes in plant phenology and the time of flowering induced by climate change, as it has disturbed interactions between plants and pollinators[13]. Agriculture, at the same time, also contributes to climate change, e.g., through the release of greenhouse gases[14].

The greening of the Common Agricultural Policy and several European strategies, e.g. the Green Deal, Farm to Fork and Biodiversity strategies, are increasingly supporting the transition towards sustainable food systems by aiming at improving the environmental and climate performance of European Agriculture. The Farm to Fork Strategy aims at having 25% organic land by 2030, from around 9% of total utilised agricultural area in 2020[15] - this is one strategy to combat the negative impacts of some farming practices on water bodies and their biodiversity. Measures also exist at the Member States level, e.g. farm-level nutrient planning, setting aside buffer strips or fertiliser standards, leading to a general improvement of water quality in the European rivers. Whilst the sector seeks to improve its environmental standards, they are also seeking more funding to do it.

3.1.2 NbS and their potential for supporting the sector

In MERLIN, we understand NbS as working at the landscape or basin scale, to connect farmed land to the natural wetlands, floodplains and natural channels that provide many ecosystem services (from downstream provision of drinking water, regulation of flood peak speeds, supporting biodiverse food webs and cultural or health benefits from recreation). This understanding shows that NbS can be used to achieve different goals within the Agriculture landscape.[16] (1) Sustainable production practices such as agroforestry and windshields can be used to increase food production, while reducing the conventional Agriculture practices. (2) Measures such as wetlands, riparian buffers and grass strips could regulate water, control soil erosion and stabilise slopes. (3) NbS could enable the removal of pollutants and rehabilitation of degraded lands. This process helps agricultural lands to function as carbon sinks, pollinators or pollution control. (4) Finally, as a conservation function, NbS can enable the sector to improve biodiversity and ecological connectivity across landscapes. Overall, it offers the opportunity for the Agriculture sector to use nature to rehabilitate landscapes affected by agricultural activities.

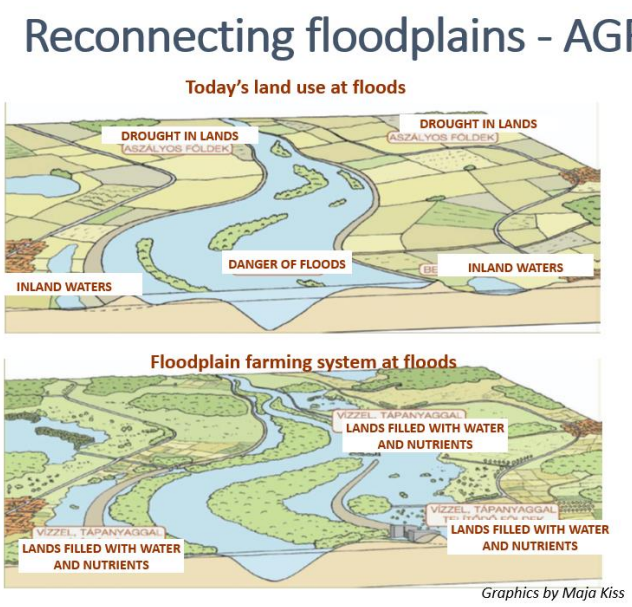
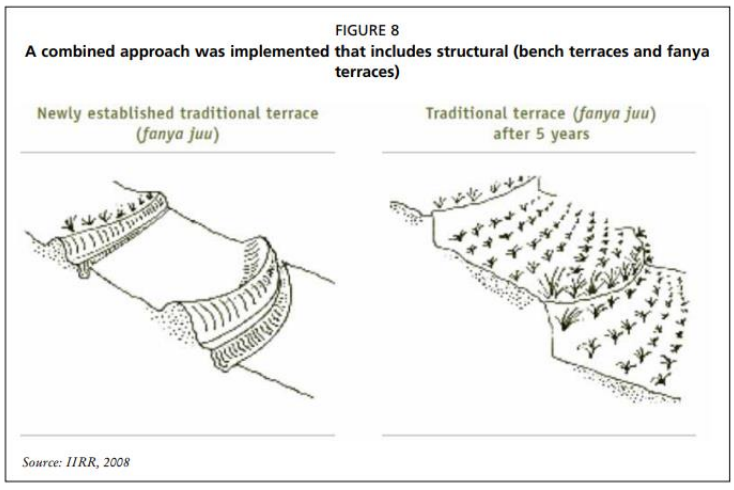
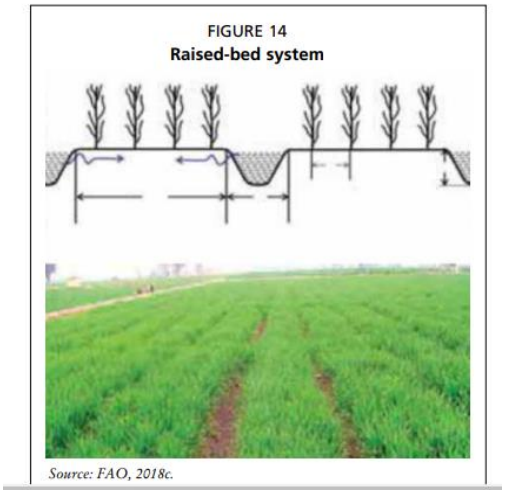


Figure 1: NbS for reconnecting floodplains[17]

As shown in Figure 4, a coordinated approach across multiple farms is needed to generate landscape, or basin scale, outcomes to reduce diffuse pollution, mitigate floods and help protect against droughts. These linked aquatic habitats also provide blue carbon benefits for climate sequestration and biodiversity, helping to meet Green Deal Goals. Innovations like paludiculture may allow farming and floodplains or peatland to co-exist. Paludiculture helps to productively sustainably use drained agricultural lands.

However, much of the discussion of NbS to date has focussed on farm measures aiming to improve soil water and fertility, as shown in Figures 2 and 3. These are important, but NbS need to consider the complex ecosystems that extend beyond the farm boundaries illustrated in Figure 1.





Figures 2 and 3: Farm-scale interventions[18]

3.1.3 How the sector currently understands NbS

Both in interviews and in sectoral agricultural meetings, most of the participants said to be aware of the meaning of NbS, however, a diverse set of understandings was put on the table (e.g. NbS as a new terminology that reflects traditional practices, such as agroforestry, intercropping, crop rotation, cover cropping, and traditional organic composting, that have less impact on the environment than modern intensive practices; or NbS as a very abstract concept.) Most of the participants connected NbS to, e.g., the concept of sustainability, or to circularity, resilience, sustainable intensification, by linking the terminology to improved human-nature

relations. The agricultural stakeholders that were more familiar with the NbS approach were able to present a formal definition by FAO. NbS was also literally understood as engineering with nature. Some stakeholders did not feel comfortable with the IUCN and EU Commission definitions as they did not suit the needs of the sector and proposed to come up with a new one that better suited their needs. Something in which most of them agreed was that there was resistance towards NbS with the sector. This was because NbS was seen as something for nature but not solving farmers' problems.

3.1.4 Good examples of NbS for the Agriculture sector

- Dutch example[19] the room for the river program rewets the floodplain to slow the flow from extreme weather events and is already contributing to climate adaptation. Lands are flooded in the winter but allow grazing activity the rest of the year. Those programs are combined with agri-environmental measures (e.g. conservation of water salamanders) to give extra financial support to the farmers. The project works with groups of farmers to work at scale. See more about it Case study 04 - MERLIN project
- Spanish example[20] shows a successful system of ditches that promote biodiversity and allows watering of areas for livestock production. The water filters along the ditches creating small wetlands and meadows. In areas of high permeability, the water from the ditches is deliberately dumped to recharge semi-artificial aquifers whose water flows in springs at the level of the villages or flows into the main river. The system of water sowing and harvesting that guarantees water security, which provides food security to local communities It serves to regulate water resources with effects in the watershed and downstream. They have become a cultural landscape and are a tourist attraction.
- Slovakian example[21] Intercropping different agricultural production affects water resources on farms and in the water catchment. A rolled cover crop mulch can shade the soil, keeping moisture in it and protecting it against water erosion and overheating. No ploughing implies that soil capillaries are not destroyed, and the water infiltrates well in the soil, even in heavy rain. Additionally, some legume cover crops can fix Nitrogen, maintaining or improving water quality on farms and in larger areas. The cover crops also help biological activity in the soil, creating a good environment for microorganisms and pest predators. To be most effective, these practices need to be taken up widely by farmers to generate downstream positive benefits.

3.2 Challenges and Opportunities of the Agriculture sector

Rural areas face the dual challenge of meeting the demand for food, and to reduce the negative impact of agricultural production practices on the environment. Globally to meet a diverse selection of human needs by 2050, the agricultural sector needs to provide food for a projected world's population of about 9.6 billion. The agricultural sector in Europe is overall dealing with a number of environmental, social, and economic challenges including biodiversity loss, and the decrease of pollinators, unreliable and polluted water supplies, soil erosion, and flood damage that impact their ability to produce food within the safe operating space of the planetary boundaries. In particular, climate change is at the core of a number of environmental, social, and economic challenges that the agricultural sector faces, which is projected to have considerable effect on food production and livelihoods. While areas suitable for food production might change across Europe, increasing in some areas and decreasing land capability (due to saturation or aridity) in others. Climate change increases temperature and alters the supply and demand of water regionally, increasing the competition between the agricultural sector and other sectors.

Agriculture is one driver of land and soil degradation and of the depletion of natural resources and biodiversity[22]. These dynamics lead to the decline of the provision of several ecosystem services, including pollination[23] and soil erosion control[24]. Yet, those services are critical for food production and the rural stakeholders. Rural areas face the dual challenge of meeting the demand for food, and to reduce the negative impact of agricultural production practices on the environment. Therefore, the sector needs solutions, ideally NbS to respond to these challenges and maximise the global opportunities. In particular, where farmers are managing their environments well, they believe they are not receiving due market value for these actions. Therefore, the whole food value chain - determined by the market, demands and cost - can play a significant role in valorising NbS. As business strategy is key to farmers, alternative solutions should be provided to ensure continuous production of food at affordable prices.

NbS in farming systems can lead to the maintenance and enhancement of several environmental conditions and parameters, which in turn would be beneficial for resilient and stable agricultural outputs. For instance, NbS could contribute to healthier soils, that are critical components of resilient agricultural production, e.g., through its importance in control on microbial activity and nutrient recycling. NbS could play an important role in restoring

soil quality, with increased carbon content and high infiltrability rates and water available for plants, that would lead to enhanced agricultural productivity and sustainability. Feedback loops might occur when enhancing one environmental condition, positively impacting others and being highly beneficial for the agricultural yields.

3.2.1 Challenges

- Lack of common terminology. The term 'NbS' may be understood at some governance level, e.g., the policy level, but not necessarily at all levels, e.g. the practical level. This misunderstanding results from the diverse terminology that is adopted among the different stakeholders. Other terminology might be used by farmers and (existing) farming practices might achieve the same goals as envisaged by policymakers and aimed by NbS, but under a different label (e.g., agroecology, biodynamic agriculture, organic farming).
- Lack of environmental awareness, incl. water related issues and lack of knowledge on NbS that can lead to the opposition to the NbS of the farmers, and a lack of willingness to change. Although most farmers know about their land and are aware of some practices that aims at improving natural resources and of the importance of managing water in a sustainable manner for business sustainability and resilience, their knowledge in all potential benefits provided by NbS and in all alternative practices that could maintain or enhance the environmental conditions might be limited.
- Uncertainties of the results of NbS /water restoration. The actual benefits of NbS/ water restoration, especially under climate change, at the farm level are unknown, and therefore the NbS may be unattractive for risk-averse farmers.
- Lack of an enabling environment, i.e. of institutional and financial support to locally implement new practices and NBS on a large scale and in a collaborative way.
- Mismatch in time and spatial scales of application of NbS: mismatch between changes in local farming practices and their long-term impact on broader (neighbouring) water systems. The location of NbS at the watershed does not fully overlap with the farm spatial extent, which implies the need of connecting farmers among themselves, and with the stakeholders responsible for the management of the watershed, and with stakeholders from other sectors. However, policies are sectoral and might prevent such collaboration across sectors.
- Monitoring and performance assessment: the indicators used for the monitoring, the identity of people conducting the monitoring, the way performance should be rewarded -are often not properly defined.
- Land tenure: some farmers are tenants and their decisions on the land they use are limited. Further, NbS being long term solutions, the benefits of their implantation might take longer than the duration of the lease.
- Scarcity of agricultural land that is oftentimes rented or hired. This is a barrier to implementing NbS as with experimental fields for NbS, a stakeholder loses a certain plot of field to produce foods, reducing areas for food production while paying for the land they are renting.
- Farming practices and NbS are context-specific (environmental and socio-economic characteristics): this poses the problem of up - and out-scaling of locally-though solutions and applicability of regionally-though solutions.

3.2.2 Opportunities

The main opportunities from NbS are as follows:

- NbS can be implemented through the adoption of already existing agricultural practices. For instance, the reduction or absence of tillage and an increase in soil cover, can contribute to achieve the goals of the NbS and meet some of the EU policy goals. Carbon farming can support high carbon stocks in soil, while protecting biodiversity and enhancing soil quality. It also helps to retain water in soil and prevent flooding. These are already being implemented. The adoption and implementation of alternative farming practices and of NbS can be facilitated by Eco Schemes and agri-environmental and climatic measures.
- Development of the climate resilience of the Agriculture sector strongly depends on the landscape-scale transformation of the land use system, providing space for NBSs preventing further soil degradation and fostering recovery, mitigating water scarcity and floods, stabilising the micro climate, etc. To reach this goal there is a strong need to integrate land use and water management strategies, aiming the optimization of resource management and the regenerative development at scale.
- NbS could support the emergence of new value chains particularly making more market value from good environmental stewardship of water on farms and across the basin - including using existing certification to increase visibility or gain premiums from the buyers[25].

- Investment in NbS would support the maintenance or regeneration of several ecosystem services, promoting multifunctionality of agricultural areas, and support the resilience of farms over time, especially preventing soil loss from flooding and holding water on the land for use in summer droughts.
- The carbon benefits of some NbS measures, including restoring degraded organic soils, can be financed through carbon credits and help deliver the targets for the agricultural sector.
- Increasingly, public funding for Agriculture is being justified through delivery of public goods, such as the Green Deal goals of climate action and biodiversity restoration so adopting NbS as part of a farming business model will enable farmers to align themselves with CAP strategic plans and benefit from relevant eco schemes.

3.3 Cooperation (MERLIN & the Agriculture sector)

Whilst many different aspects of how the Agriculture sector might mainstream NbS were discussed, we would like to focus on the enabling environment that can support coordinated or collective action across farms and help farmers benefit from adopting NbS. To mainstream such an NbS approach, several issues were identified and are listed here for discussion and lead into the route map and sectoral strategies. In the MERLIN project we will focus our work with the sector on the issues in bold:

3.3.1 Illustrate the benefits of NbS

- By supporting the implementation of a consistent terminology and link the current and potential farming practices to the framework of NbS
- To transform the belief that farmers bear the costs of implementing NbS but wider society gains the benefits rather than farmers. To change these perceptions, Illustrate the multiple benefits of NbS, e.g. by making use of Cost-Benefit Analyses;
- Mapping/modelling how NbS impacts the agricultural business models in a landscape context (e.g. risk reduction, effects on yield change)
    - A number of online tools exist that can help illustrate the benefits of interventions (e.g. CAPRI[26]) that can be used to inform policy discussions but to get impact on the ground, these need to be employed in a participatory fashion with the land managers. Screening restoration needs by farm type could be a first step to see how MERLIN NbS interact with business objectives.
- Provide evidence of NbS for delivering ecosystem services and enhancing farms' resilience, in the short and long term.
- Share successful case studies (learn from MERLIN case studies, their twins, and others), covering different realities (and challenges for the sector) across Europe
    - Including alternatives to current production in wetlands and peatlands - more case studies and knowledge sharing about paludiculture might be beneficial to address the issue of Agriculture on restored peatlands.

3.3.2 Build capacity and knowledge sharing opportunities

- Build on the Agricultural European Innovation Partnership (EIP-AGRI) NbS focus group to maintain a Community of Practice were the sector feels well represented, a safe environment where trust among the different participants can be developed, to speak freely and confidently
- Develop consortia models to bring together stakeholders often working separately, e.g., resource managers, farmers, value-chain operators, policymakers.
    - These require an integrated landscape-based or watershed-based approach to bridge mismatches between farm and basin scale to address landscape multifunctionality and resilience (not only related to water issues).
- Share information about the practical / technical and decision-making aspects of NbS implementation from MERLIN case studies. Ensure this takes account of the socio-economic and ecological context to consider how it can be transferred to other farm systems and weather patterns.
    - Involve farmers in the (re)design, implementation, and monitoring of NbS could transform the perception society has of the farmers (not to be the polluters anymore).

3.3.3 Adapt or create policies and products

- Explore insurance schemes that would cover farmers for loss due to allowing their land to absorb water during extreme climate events occurring as part of the NbS

- ➔ Explore the implementation of eco-schemes to organise collective action to implement NbS in a group of farms
- ➔ Explore a NbS certification as an add-on module to organic certification or stand-alone certification. The use of certification would allow for the farmers to be acknowledged for adopting NbS
- ➔ Support NbS is well integrated into the CAP and related Country Strategic Plans:
  - ◆ Via conditionalities for direct payments under the first pillar. For example, by using NBS to meet Good Agricultural and Environmental Conditions (GAEC) 2, which requires protection of wetlands and peatlands
  - ◆ Strengthen and promote relevant CAP eco-schemes
  - ◆ Ensuring that funds available under the second pillar of the CAP for rural development are used to mainstream NBS solutions e.g. through Agri-environment climate measure and knowledge sharing activities.
  - ◆ consider the role of Agriculture in protected organic soils through integrating peatland restoration better into CAP and agricultural policies

This will allow us to move from a broad understanding of the sector to a more focussed and therefore in-depth engagement with the sector regarding which barriers to remove and which opportunities to exploit.

Cross sectoral: NbS relying on certified nature-inclusive Agriculture would be beneficial for nature conservation. It will support the regulation of several biophysical cycles and therefore contribute to better water quality, and could also contribute to the regulation of water levels, which would be favourable for Hydropower, Navigation, Water Supply but also Insurance sectors (also by increasing the resilience of the farming systems). As many degraded peatlands are used for agricultural production, adopting NbS will complement efforts by the Peat Extraction sector to revegetate and improve the peatland functions. Furthermore, the horticulture part of the sector can continue to work with the Peat Extraction sector to find alternatives to peat based growing media. As above, MERLIN will consider if agricultural insurance can help farmers manage extreme events using NbS.

3.4 Next Steps

Overall, we are building a Community of Practice to support an understanding of NbS and how we can enable mainstreaming of NbS in the agricultural sector; as well as how the agricultural sector can work with other sectors.

Together with participants from the six sectors, in the next year we will:

- ➔ Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS.
- ➔ Examine the EU policy context and how in the future policy could better enable NbS.
- ➔ Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term, we will:

- ➔ Identify opportunities for cross sector partnerships by applying a value chain approach.
- ➔ Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how we will collaborate with the sectors‘ representatives or to discuss how you can help MERLIN please contact: Anna.Berczi-siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk.

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4 Briefing for Hydropower Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Transformation

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].*

This briefing focuses on the Hydropower sector. It summarises MERLIN's understanding of the sector's current connection with rivers and wetlands, and how NbS are viewed within the sector at the start of the collaboration. The briefing proposes how MERLIN (more information about the MERLIN project can be found here) can support the Hydropower sector to implement NbS.

How can MERLIN support transformation?

The Hydropower sector can play a crucial role in responding to Europe's Green Deal objectives, as the Biodiversity Strategy 2030 aims to restore at least 25,000 km of rivers to free-flowing by 2030. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets, and citizens. MERLIN will support this through understanding how and why the Hydropower sector is already making positive changes, sharing good practices between European countries, and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from involving individuals actively engaged in the Hydropower sector (using Round Table Discussions (RTDs), questionnaires, interviews) and a desktop review of formal documents. The MERLIN team is very grateful for the insights shared to date, which have helped to understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within the developing Community of Practice of MERLIN. The Community of Practice concerns EU and Member State level policy and commercial actors of the Hydropower sector who share a common interest in improving their practices better through regular interaction and sharing information.

4.1 Relationship of the Hydropower sector with freshwater restoration and NbS

4.1.1 Brief description of the sector

Hydropower is one of the largest and oldest sources of renewable energy, involving the generation of electricity from the flow of water through turbines. Types of hydroelectric generation plants are reservoir power plants, run-of-river hydropower, pumped storage hydropower and hidden hydropower in conveyance networks (drinking water, wastewater, agricultural channels). Currently, Hydropower contributes 13.8% to overall net electricity generation.[2] There are 21,387 hydropower plants in the EU, while 8785 additional plants have been proposed or are under construction (Figure 1).

The efficiency of hydropower dams is an important factor for the sector (i.e. that may decrease as dams age) that has helped lead to their removal of large dams, as they become less reliable and costly to upgrade by age[5]. It must be noted that there are many other in-river dams across catchments that are not directly linked to hydropower generation, but to Agriculture, Water Supply and Sanitation, or Navigation. Hydropower-related dams represent less than 2% of the approximately 1.2 million obstacles built in waterways[10]. However, the sector has an important role to play in river restoration. Firstly, because the sector as a whole is at a turning point now, due to a large number of ageing dams[11]. In Europe, an average hydropower plant is 45 years old, which requires a structural transformation. This is a unique opportunity to conduct this transformation in line with the Green Deal objectives. Secondly, the removal of these ageing and no longer economically viable dams would have relatively less negative socio-economic consequences compared to other dams that provide water supply or irrigation for example. Moreover, removing dams that are no longer economically viable is beneficial for the sector, not only cost-wise, but because hydropower plants have a more and more negative reputation in several parts of Europe.

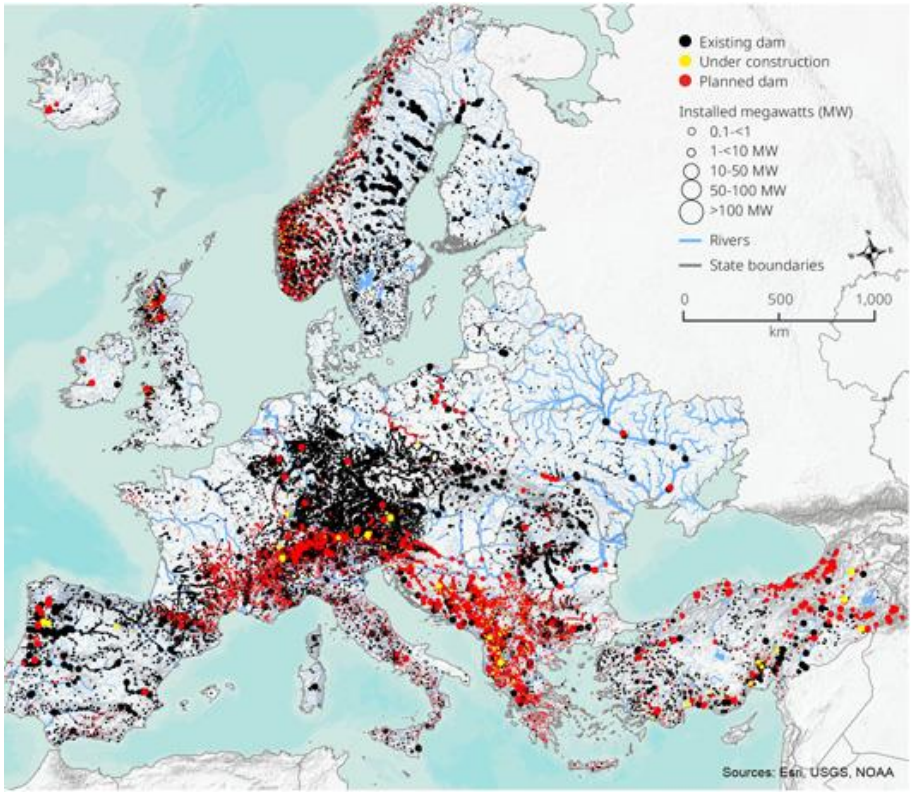

Figure 1. Distribution of recorded hydropower plants in Europe3

4.1.2 NbS and their potential for supporting the sector

Ecological requirements (e.g. flow requirements attached to licences), technological improvements and sustainability standards mean the sector is moving towards reducing negative social and ecological impacts[12]. However, these practices are far from being mainstreamed and many social, environmental, and economic challenges remain for the sector. Therefore, NbS could help address a range of their challenges, while the sector itself can be instrumental in enabling the implementation of catchment scale NbS.

NbS in the sector include the implementation of turbines, which enhances hydropower efficiency, but not restricting the free flow of water. Upstream river restoration and maintaining the river's environmental flow - which preserves freshwater ecosystems while satisfying human consumption - are also mentioned as NbS practices. The most efficient practice is dam removal, when in line with NbS, as dams have a significant ecological and environmental impact, while it could strategically address socio-economic challenges as well. For example, it could contribute to the better management of potential impacts from extreme weather events, whilst also increasing the resilience of local communities and restoring local biodiversity[13]. Mainstreaming NbS within the sector could also help strengthen sustainability practice within the sector. It would also open up space to discuss social values of freshwater ecosystems to incorporate local stakeholders who may feel marginalised by traditional restoration processes[6]. Dam removal can restore natural flows and has catalysed further action within a catchment towards freshwater ecosystem restoration[14] which can also help address socio-economic challenges (i.e. providing NbS). Achieving this to also provide benefits for the sector will be transformative and will involve greater cross sector collaboration.

4.1.3 How the sector currently understands NbS

Nature-based solutions is not a widely understood concept within the sector. The current relationship to restoration in the Hydropower sector involves three broad views:

- ➔ Ecosystem restoration through dam removal is seen as a threat to meeting climate mitigation objectives through Hydropower, thus dam removal at scale needs to be resisted[15]. The sector stresses that there are other dams and obstacles in rivers that are not Hydropower and could be removed instead of hydropower dams.
- ➔ Negative ecological consequences of Hydropower are an issue and need to be reduced or mitigated[16]. These impacts are often narrowly viewed in terms of fish migration, and fish passages seem to be the preferred

option before dam removal for the sector[17, 18], forgetting water, sediments, and nutrients flow, as well as restoring ecosystem functionality. Policy frameworks exist which the sector needs to comply with.

- ➔ Ecosystems have been degraded by sector activities and more widely, and the sector needs to make a positive contribution to biodiversity and ecosystem services [19, 20].

The second view seems to be the most prevalent to understand the sector's current relationship with restoration. However, in relation to dam removal social dimensions (if considered) are often narrowly defined in terms of local livelihoods (tourism sector, subsistence). Human wellbeing considerations of ecosystem restorations are often overlooked. This is despite the sector recognising its reliance on and role in shaping a range of ecosystem services (e.g. reliance on water and changes to water quality and fisheries). Dam removal has to be inspected through the NbS lens with the consideration of specific societal challenges. IUCN currently refers to seven societal challenges -climate change adaptation and mitigation, disaster risk reduction, reversing ecosystem degradation and biodiversity loss, human health, socio-economic development, food security and water security) and follow the NbS process accordingly, using the Global standard on NbS.[7]

4.1.4 Good examples of NbS for the Hydropower sector

As mentioned above in section 4.1.2, several NbS practices are already applied in the sector, yet the most efficient one is considered to be dam removal, when in line with NbS. Therefore, in this briefing, we selected four examples of hydropower barrier removals from different parts of Europe (listed in Table 1), where this solution proves to be an NbS.

Table 1: Examples of NbS for Hydropower - Dam Removal

Initiative (name, locations, date)	Key driver highlighted	Lead stakeholders/funders	Retrieved from (link)
UNIPER plant on the Mörrum River, Sweden, 2020	➔ Fish migration ➔ River connectivity	UNIPER funded the plant's removal with financial support from several other stakeholders, including the Baltic Salmon Fund and Life Connects.	http://www.fiskmarknad.org/images/Presentationer/FM2016-Dag-2-1450-Johan_Tielman-Dam_removal.pdf
Molló Dam Removal in Catalonia, Spain, 2020	➔ Located in a Natura 2000 site and considered a trout genetic reserve	Coordinated by the Department of Territory and Sustainability, and the Catalan Water Agency.	https://damremoval.eu/mollo-dam-removal-in-catalonia-spain/
La Roche-qui-boit and Vezins on the Sélune, Normand, France, 2019 & 2021	➔ Fish migration ➔ Water quality problems ➔ Low energy productivity of dams ➔ Regulatory obligations (e.g. make safe for local community)	Environmental Defense Fund, supported by Patagonia (similar to other schemes)	https://www.ern.org/en/selune-libre/
Fåvang, Innlandet, east Norway - Old dam (not used in 50 years)	➔ Fish migration ➔ Safety (the dam was blown up as there was a rack in the middle)	Norwegian angling club Gudbrandsdal Sportsfiskeforening Public funding	https://damremoval.eu/explosive-dam-removal/

4.2 Challenges and Opportunities of the Hydropower sector

4.2.1 Challenges

- ➔ Water availability: Climate change on the one hand increases water scarcity risk and decreases water availability. On the other hand, it induces more severe natural hazards, such as floods and landslides, which contests the resilience of dams.[4]

- Negative reputation of Hydropower: The sector is increasingly recognised as holding some responsibility for the decline in freshwater biodiversity [12].
- Economic viability: Hydropower increasingly may not be the cheapest renewable energy option because of decreasing costs of alternative technologies, such as solar and wind. This could hinder new development, and for refurbishment, it is a factor that needs to be considered [21].
- Operational costs: Ageing of hydropower plants can incur higher maintenance costs (e.g. to maintain structural integrity or capacity, and to meet shifting legal and/ or societal expectations) [21].

4.2.2 Opportunities

- Enhancing localised climate resilience: hydropower dams can hinder local community's climate resilience with a changing climate requiring both mitigation and adaptive action5, 13. The focus on climate adaptation and aspects of social justice could provide entry points into a discussion about how NbS could complement and strengthen the sector.
- Targeting less viable dams: Some hydropower schemes can be adapted and modernised to increase capacity and cost effectiveness, while there is also recognition that some hydropower structures will be retired. There are also many dams not in use that could be removed. This represents 'low-hanging fruit', and could be considered as part of a transformation strategy, if approached in terms of NbS (i.e. as part of a catchment scale strategic plan).
- Linking to the EU taxonomy: As for financial opportunities, the EU taxonomy could be used to support investment in dam removal as part of a NBS approach with its principal goal is to help the EU scale up sustainable investment and implement the European Green Deal. The Taxonomy regulation's main objectives include climate change mitigation, adaptation, sustainable use and protection of water and marine resources, and protection and restoration of biodiversity and ecosystems8. However, currently there are concerns regarding how the delegated acts are defined, and the Taxonomy needs to include NbS more specifically.
- Drawing on diverse finance mechanisms: Green finance mechanisms could incentivize NbS application in the sector. The Climate Bonds Standard is also helpful in providing guidance for developers, banks, governments and others for direct investment on ensuring climate change resilience, improving environmental and social sustainability9.
- Working at scale with other sectors: Dams may be linked to other uses (now or in the past) such as Agricultural Irrigation, Navigation and Water Supply and Sanitation, and achieving the EU Green Deal needs to involve all such sectors. Across a catchment, opportunities for multisector NbS could be identified, potentially opening up additional finance options.

4.3 Cooperation (MERLIN & the Hydropower sector)

MERLIN needs to base suggestions on transformation and mainstreaming on practical experience. There are many different aspects of how the Hydropower sector may connect to NbS. In order to be the most effective and reach low-hanging fruits, MERLIN would like to facilitate dam removal where dams are no longer economically viable and are more beneficial to society when removed. In the MERLIN project we will focus our work with the sector on the issues in bold:

- Help to prepare cost-benefit analysis about hydropower plants which includes externalities as well, such as biodiversity degradation and socio-economic impacts.
- Offer tools to the sector based on cost-benefit analysis on where to remove or refurbish economically no longer viable dams.
- Draw on existing examples of dam removal (such as the La Roche qui Boit example above) to develop understanding of NbS and dam removal across the sector.
- Work to support the development of cross sector partnerships involving hydropower organisations for more holistic approaches and large catchment scale NbS for restoration through dam removal.
- Develop an understanding about key entry points into decision making processes about future economic viability of dams to ensure consideration of NbS as an option.
- Develop an understanding and awareness of different finance mechanisms for supporting dam removal and NbS as a financially feasible path for the sector.

For cross sectoral cooperation the relationship between the Hydropower sector and freshwater NbS has to be understood. In general all the MERLIN sectors (Hydropower, Navigation, Peat Extraction, Agriculture, Insurance)

rely on the others to manage water resources better to avoid floods and droughts that mean that their sectors can continue to operate profitably. If not well managed Hydropower barriers and regulation of water can be in conflict with Water Supply and Sanitation, and Navigation; although in the past barriers were used to regulate water to help Navigation, Water Supply and Sanitation, and protect against flooding (therefore helping Insurance). Impoundments can be also used for agricultural irrigation but sediments from upstream land use including farming can silt up dams. Therefore, the implications across sectors will be considered.

4.4 Next Steps

Overall, MERLIN is building a Community of Practice to support an understanding of NbS and how MERLIN can enable mainstreaming of NbS in the Hydropower sector; as well as how Hydropower can work with other sectors.

Together with participants from the six sectors, in the next year MERLIN will:

- ➔ Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS
- ➔ Examine the EU policy context and how in the future policy could better enable NbS.
- ➔ Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term, MERLIN will:

- ➔ Identify opportunities for cross sector partnerships by applying a value chain approach.
- ➔ Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how MERLIN will collaborate with the sectors' representatives or to discuss how you can help MERLIN please contact Anna.Berczi-siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk.

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5 Briefing for Insurance Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Transformation

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].*

This briefing focuses on the Insurance sector. It summarises our understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of our collaboration. The briefing proposes how MERLIN (more information about the MERLIN project can be found here) can support the Insurance sector to implement NbS.

How can MERLIN support transformation?

The Insurance sector can play a crucial role in responding to Europe's Green Deal objectives, particularly climate action. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, the private sector, and citizens. MERLIN will support this through understanding why, how, and where the Insurance sector is already making or can lead positive changes, sharing good practice between European countries and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from individuals actively engaged in the Insurance sector from a series of Round Table Discussions (RTDs), questionnaires, structured interviews, and a desktop review of relevant literature. We are very grateful for the insights shared to date, which have helped us understand the different roles and the main potential entry points for transformation. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within our developing Community of Practice. Our Community of Practice concerns EU and Member State level policy and commercial actors of the Insurance sector who share a common interest in improving their practices better through regular interaction and sharing information.

5.1 Relationship of the Insurance sector with freshwater restoration and NbS

5.1.1 Brief description of the sector

The Insurance sector provides risk management products and services through insurance contracts. The basic concept of insurance is that one party, the insurer, guarantees payments for potential future events (like floods or injuries) that would have produced a financial loss for the policyholder. Meanwhile, another party, the insured or the policyholder, pays an insurance premium to the insurer in exchange for that protection on that potential future risk occurrence. There are two main types of insurance: life and non-life. Life and health insurance companies focus on legacy planning and replacing human capital value, and medical costs[15]. Non-life covers property, casualty, or accident insurance and is aimed at replacing the value of homes, cars, or valuables[16]. For example, (direct) non-life insurance companies compensate the insured/policyholder for losses (as defined in the insurance contract) due to damage to the insured assets, such as private and commercial buildings/homes, cars etc. MERLIN for example will look at damages incurred by water related events such as floods or droughts. The Insurance sector also offers insurance to cover losses due to business interruption, 3rd party liability and personal injury. The contract (and premium) is normally limited for a one-year-period but can be multi-year if agreed between the policyholder and the insurance company.

5.1.2 How the sector currently understands NbS

The Insurance sector is more aware of the term NbS than just 2-3 years ago, when a sector survey confirmed it was not a well-known or understood concept[2]. Since then, the sector has become much more aware and active in this area, partly due to the work of global insurance (and financial) forums like the new Task force on Nature-related Financial Disclosure (TNFD)[3] and United Nations Environment Programme's (UNEP) work on Principles for Sustainable Insurance (PSI)[4]. The TNFD are actively seeking methods to assess impacts, exposure, and

dependencies on ecosystem services and to create a common framework to report and set targets on these areas. The TNFD categorises the nature-related financial risks to be either physical, transitional or systemic[5]. In addition, policy developments like the EU Sustainable Finance Action Plan[17] and the EU Taxonomy on sustainable activities[18] have developed a classification system, establishing a list of environmentally sustainable economic activities which include Insurance as a sector. Some insurance companies have actively participated in research projects on NbS and/or are in the process of developing new products and services around NbS. However, the awareness and activities are quite variable within the Insurance sector, although the topic is rapidly being considered higher in the agenda, particularly with the larger more global (direct) insurance companies and reinsurance companies.

There are areas where additional technical work is needed. Most insurance companies do not have a full understanding of the technical NbS solutions available to reduce physical climate risk, and to understand the link between physical risk and NbS. This means that new information and data on these linkages would help the Insurance industry to include these solutions into their risk assessment process, tools, models and compensation systems. NbS could be used for risk reduction and as adaptation measures to climate change to reduce exposure and vulnerability to increased hazard extreme events, which would contribute to making sure assets remain insurable.

The industry needs a widely accepted framework to describe and quantify the risk reduction effectiveness of nature-based solutions. Such data is crucial to enable insurance companies to use them in their day-to-day business. The sharing of new data will require cooperation between the public and private (Insurance) sector with e.g. the pooling of traditional insurance loss data and data from NbS. Making these data more transparent will be useful to both the industry and public decision-makers. Such cooperation is now included in the EU strategy on climate adaptation which will "encourage at the national level a voluntary approach of public private partnerships for the collection and sharing of loss data based on enhanced cooperation with Member States, cities and industry"[6].

To mainstream NbS, the insurance experts recommended to look into (1) how can insurance value and support NbS based on their potential for risk reduction and climate change adaptation, and (2) how can NbS be insured based on the economic and ecological value they provide to facilitate update (e.g. to protect the investment in NbS).

5.1.3 NbS and their potential for supporting the sector and good examples of NbS for the Insurance sector

The Insurance sector is now looking at how to provide new products and services in relation to NBS. For example, in Spain the Spanish Consorcio de Compensación de Seguros has been sharing loss data to help make better investment decisions e.g., on floodplain restoration in a number of river basins. In Norway the state introduced a legal requirement in 2018 in the building and planning act where the preservation, restoration or establishment of nature-based solutions should be considered (such as existing wetlands and natural streams or new green roofs and walls, artificial streams, and pools, etc.). And if other solutions are chosen, reasons must be given as to why nature-based solutions have not been chosen. In addition, there are examples of the collaboration between public and private actors for both small and large scale NbS. In Holland, Achmea, a Dutch insurance cooperative and mutual holding company, is promoting the installation of green roofs in homes to reduce damages from heavy rainfall[7]. At the global level, Swiss Re has also collaborated with the State Government of Quintana Roo's Coastal Zone Management Trust in the Mexican state of Quintana Roo to create an NbS-insurance product to help protect and restore coastal reef damaged from storms or hurricanes, since they provide flood protection during such events[8]. Another best practice is the MarFund[9] where Axa Climate is providing parametric hurricane insurance to four key coral reefs on the Caribbean coast. This means in case of a hurricane crossing the protected areas, a payment is immediately made to carry out emergency response activities. With this type of parametric insurance, the aim is to react very quickly and limit the damage on living ecosystems. One of our MERLIN cases, the Basque country MERLIN case study, looks at the hydro-geomorphological restoration of the Deba River, and includes benefits such as decreased risk of flooding. This is an example of how further work between our MERLIN case studies and the sector will be explored to identify synergies and opportunities. Our MERLIN cases are related to large area restoration on regional and transnational, rural, peri urban and urban locations. These involve transition in land use and floodplain reconnection, targeting flood risk and drought reduction, as well as enhanced compliance with the Birds and Habitats Directive and Water Framework Directive, as well as recreation enhancement. There is also an opportunity thanks to the current draft law on Nature Restoration.

5.2 Challenges and Opportunities of the Insurance sector

The Insurance sector consists of non-life, life and reinsurance companies. These therefore provide very different insurance products and are also subject to different regulations. MERLIN has therefore developed a conceptual model that will consider these different types of insurance, like for example non-life insurance which compensates for damages to assets.

Below we present some initial results taken from interviews and a Roundtable with Insurance experts.

5.2.1 Challenges

From the point of view of policy and regulation:

- The Insurance sector is strongly regulated (including on how to calculate the risk.) NbS, nature risk, or nature-related risk, are not terms that are part of, or defined in the insurance regulation (Solvency II directive) in contrast to climate risk.
- Each country has their own insurance regulatory set up (public, public-private, private) which means solutions - and how NbS fit into this system - will need to be tailored to their specific context.
- *From the point of view of products and services (including other sectors):*
- The sector does not yet use NbS in traditional non-life insurance products, coverages and pricing. To get there, the risk must be calculated to an adequate, risk-based premium which can be set wherever the insured non-life asset is located (e.g. the house in a floodplain area exposed to flooding). In this case, the incorporation of NbS into risk models, poses important questions on the kind of data needed, and what type of data is available.
- Furthermore, and also particularly relevant for MERLIN, is the case when third parties incorporate NbS into their insurable assets, e.g. Agriculture, Water Supply and Sanitation, or Navigation.
- *From the point of view of investment:*
- It is a changing landscape in relation to the Insurance sector and the consideration of risk reduction measures as part of their role (e.g., river restoration for flood protection). The Insurance sector can incentivize risk reduction in a number of ways like educational programs, the insurance contract, risk engineering services, risk assessment, data-sharing or on occasions as investors, and through public private projects.
- The Insurance sector is, however, very aware of the need and urgency to adopt risk reduction measures since otherwise the rise of insurance premiums could lead to affordability issues or even more structural problems like the whole insurability of the system and its long-term viability.
- There is a need for accurate cost benefits analysis of NbS to quantify the various losses and damages, exposure and vulnerability, to better understand the causality between NbS and risk reduction that could catalyse a series of actions like e.g. effective communication with funders of these measures or how to upscale them.

5.2.2 Opportunities

- The Insurance sector is more aware of their role in the adoption of NbS: 1) as data collectors and how by sharing insurance loss data, better investments can be made to reduce risk [10, 11]; 2) through the insurance contract incentives that can be created for the uptake of NbS (conditions; public-private partnerships (PPP) with NbS) through the pricing mechanism like e.g., the reduction of price/premium when customers implement NbS.
- The Insurance sector has an increased interest in better defining what and how NbS can be incorporated into insurance products and services, e.g. to help incentivize investment into NbS for risk prevention or with new products e.g. to insure green assets.
- The Insurance associations can help by advocating for the awareness, sharing of good practice and use of NbS both within their own sector/members, and towards/in cooperation with public decision-makers in both local (municipalities), regional and national governments. Also with EU and international level, e.g. through Insurance Europe and similar organisations, and in cooperation with other relevant enterprises/SMEs, research institutions and NGOs like WWF.
- The current financial regulation Solvency II adopted in 2021 includes the prudential treatment of sustainability risks. The adopted amending regulations require the integration of sustainability risks in the risk management and governance of (re)insurance undertakings. There are some very relevant questions to be further analysed related to MERLIN like “How does this apply to the use of NbS?” or, “How could the EU

taxonomy incentivize the Insurance industry towards developing new sustainable products with the use of NbS for risk reduction/prevention?".

5.3 Cooperation (MERLIN & the Insurance sector)

A conceptual frame will be developed to explore the different ways that Insurance could engage in restoration. For example, how to better define the NbS benefits to use in new insurance products or how natural capital itself could be insured. In the MERLIN project we will focus our work with the sector on the issues in bold:

As an example in the first case of new insurance products MERLIN will work with the Insurance sector to:

- First, identify how to better adapt risk models to include NbS benefits - larger Insurance companies use natural catastrophe (natcat) models to understand how natural catastrophes can influence their risk (if a loss will occur, and the size/pay out).
- Second, explore new products and services - better understand how NbS can "fit" to the insurance products in traditional insurance products and other new risk-transfer solutions, or in new type parametric insurance which "covers the probability of a predefined event happening instead of indemnifying actual loss incurred"[12].
- Third, undertake joint advocacy workshops/meetings with the sector through key actors like Insurance Europe and national insurance associations to reflect on the main steps taken to implement current initiatives like PSI and TFND to assess their biodiversity impact and dependencies.
- Fourth, revise regulatory frameworks to align all instruments - to make it easier to invest in green assets while ensuring access to capital during disasters.

This will allow us to move from a broad understanding of the sector to a more focused and therefore in-depth engagement to identify the main barriers and the opportunities.

A number of important cross sectoral issues were identified. First, how insurance can help incentivize other sectors to adopt NbS through their own insurance policies to these sectors and second, a direct connection to the Agriculture sector in particular as a particularly vulnerable sector and opportunities for innovative agricultural insurance schemes[13]. Our policy interviews revealed the need to take a closer look at agriculture to identify examples in this area, as well as to consider farmers as a viable and potential part of the solution.

In addition, the potential to understand better how to finance restoration of freshwater with NbS which is more relevant for the life insurance and reinsurance (investment) sectors since their products include long-term investment. This is an area of cooperation between the non/life insurance and the investment world where insurance could help as a de/risking mechanism to attract more investments into e.g. nature conservation or restoration. The non-life insurance sector is based on short (one-year) contracts and with a short investment period, thus there is a need to better understand and/or identify the current Solvency II regulations on any potential constraints, or how the changes included in 2021[14] will affect the use of NbS in the Insurance sector. Private Investment/financing of restoration is a fairly new discussion, mainly held within international forums like UNEP PSI/FI[4] and TNFD[3].

5.4 Next Steps

Overall, we are building a Community of Practice to support an understanding of NbS and how we can enable the mainstreaming of NbS in the Insurance sector; and also how Insurance can work with other sectors.

Together with participants from the six sectors, in the next year we will:

- Better understand the EU and international policy framing and the available opportunities and barriers on how current and future policy could enable scaling of restoration and NbS in relation to Insurance.
- Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS with a specific focus on some use cases with the MERLIN case studies.

In the longer term, we will:

- Identify opportunities for cross sector partnerships by applying a value chain approach.
- Co-develop route maps for transforming the sector's relationship with NbS.
- Provide concrete examples on potential innovative insurance schemes and public private collaboration.

For more information on how we will collaborate with the sectors' representatives or to discuss how you can help MERLIN please contact Anna.Berczi-siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk. For MERLIN Insurance sector specific questions or queries please contact elopezgunn@icatalist.eu or avionloisel@icatalist.eu.

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6 Briefing for Navigation Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Transformation

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].*

This briefing focuses on the navigation sector (either public sectors-waterway authorities, or private sector). It summarises our understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of our collaboration. The briefing proposes how MERLIN (more information about the MERLIN project can be found here) can support the navigation sector to implement NbS.

How can MERLIN support transformation?

The navigation sector can play a crucial role in responding to Europe's Green Deal objectives, particularly sustainable transport. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets, and citizens. MERLIN will support this through understanding how and why the navigation sector is already making positive changes, sharing good practice between European countries, and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from involving individuals actively engaged in the navigation sector (using Round Table Discussions (RTDs), questionnaires, interviews) and a desktop review of formal documents. We are very grateful for the insights shared to date, which have helped us understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within our developing Community of Practice. Our Community of Practice concerns EU and Member State level policy and commercial actors of the Navigation sector who share a common interest in improving their practices better through regular interaction and sharing information.

6.1 Relationship of the Navigation sector with freshwater restoration and NbS

6.1.1 Brief description of the sector

In MERLIN we are focusing on inland navigation (domestic freight and inland waterway passenger transport). The development and maintenance of fairway conditions is one of the reasons for the significant alterations of the rivers' hydromorphological conditions, which might change by using NbS. The sector needs a waterborne transport infrastructure including fairway dimensions that guarantee and maintain the ease and safety of navigation where fairway conditions fit the navigation class of the river stretches and where water levels are stable and predictable for calculation of transport times and costs.

A waterborne transport infrastructure that takes into account relevant physical and other factors (e.g. proximity to market and connectivity to the wider transport network)[2].

Acknowledging conflicts as well as potential benefits with environmental interests, the sector actively seeks stakeholder engagement and aims to develop win-win solutions, which maximise environmental benefits in future waterborne infrastructure development. Synergies between the sector and restoration are most likely infrastructure optimisations involving restoration measures, targeting physical river structures (e.g. riverbed, banks, etc.).

Inland waterway infrastructure is mostly publicly funded, which reduces incentives of individual companies to invest directly in restoration, especially since a traditional and not widely reflected view is that the sector does not directly depend on healthy ecosystems and mostly has not the legal duty to care about that. Nonetheless, the sector could support restoration finance either through enabling investment, collectively through umbrella

organisations, or in the form of offsetting requirements. Obviously, there is a paradigm shift to co-benefit from investments in restoration measures.

6.1.2 NbS and their potential for supporting the sector

One of the challenges to the navigation sector is the problem of too high or too low water levels which is critical to fairway depth and width conditions. NbS can't influence the water discharge (it highly depends on the precipitation), but might have an impact on mitigation of these unfavourable conditions of several interests. NbS could improve water availability, riverbed conditions and address issues of flooding and sediment balance or imbalance which is also a challenge for many sectors including navigation. NbS is also an effective tool to balance divergent interests of stakeholders.

Technical measures which have an impact on sediment balance already exist and these are usually similar to measures serving other purposes (flood risk reduction or restoration). The NbS approach is an opportunity to get closer to the planning procedures and implement them (including the proposed measures) in a harmonised way.

Climate change, decreasing discharges, deepening riverbeds and filling floodplains, as well as significantly less amount of sediment are the conditions at which solutions need to be thought about, and taking into account the diverse roles and functions of water/rivers, the balance of the hydrological cycle which would ensure more stable fairway conditions as well.

Within this framework there are interventions from which navigation can benefit in the short or long term. Discharge can be directly influenced, with spot-like barrages but slowing down of the hydrological cycle can be achieved by breaking down coastal pavements and initialising sinuosity, tributaries and vegetation will be restored and the coastal part of the stoneworks regulating navigation will be demolished.

6.1.3 How the sector currently understands NbS

As discussed at the roundtable meeting with the Navigation sector in MERLIN, while increasing the share of waterborne transport by Navigation (as a European Green Deal goal), restoration efforts may face the challenge of coping with intensifying traffic. Connected to this, risk of increased impact on riverine ecology cannot be excluded.

According to a roundtable meeting with the Navigation sector, with regard to the EU level targets, waterways authorities take as a reference the existing EU environmental legislation for projects. These do not contain any specific NbS targets but push for non-deterioration and enhancement of ecological values, to be reached e.g. by forward-looking restoration which by their nature favour the trend towards more NbS.

Sustainable and smart mobility is more about zero emission and there is less attention on fairways' maintenance impact on rivers' hydromorphological and ecological conditions. Zero emission doesn't contribute to the no biodiversity loss principle and doesn't substitute that. Fields of cooperation need to be identified and developed in that respect [3].

Solutions to climate change are also different among the sectors, nature conservation's view is to mitigate the effects and make natural structures more resilient again, e.g. make the sidearms able to keep water and the fairway maintenance structures hinder this in most cases; in spite of this Navigation sector would still increase navigability days on intact sections as well which, especially on intact stretches lead often to a deterioration of ecosystem services.

More frequent and extended low water seasons are critical both to navigability and habitats' conditions. During low waters nature's demand are wide and shallow water conditions (in order to provide habitat suitability for adapted riverine biota), while Navigation requires a specific hydrological discharge in the main river course in order to provide the minimum water depth requirements). These are contradictory requirements which often require contradictory measures. Interventions without full understanding of collateral damages and load to other stakeholders is also a problem (e.g. increased capacity or year-round navigability would bring even more traffic which has a negative effect for fish or macroinvertebrates but also for recreation), as it was a clear lesson learnt at the roundtable meeting.

There are different types of waterways, some historically have been modified more than others – context matters in decision making (e.g. difference between Rhine that is heavily modified and the Danube).[4]

NbS for the Navigation sector is realised in concrete measures, where a complex view and planning is needed with the main focus on improvement of natural resources.

6.1.4 Good examples of NbS for the Navigation sector

Fairway maintenance on Danube downstream Vienna

Danube is free-flowing and well connected to floodplains and has good ecological status under the WFD between Vienna and Bratislava. However, river ecology declined and hydromorphology was severely altered as a result of upstream hydropower dams, loss of continuity and the way the river was managed for Navigation.

The need for secure navigation and to prevent deterioration under the WFD in an integrated manner spurred a series of pilot projects between 2007 and 2014. The Danube Action Programme[10] was developed to prevent deterioration in navigation or WFD status. The Action Program and pilot projects were both designed in close consultation between the competent authority and stakeholders.

The Action Programme included many projects on selected spots to implement restoration actions like:

- ➔ replacing groynes to significantly reduce the erosion of the riverbed, and to restore a natural shoreline and better fish passage,
- ➔ removing or reducing the height of embankments to allow more riverbank dynamics, and side-arm to be reconnected,
- ➔ testing of 'granulometric' improvements to improve knowledge on solutions for stabilising riverbeds.

Very positive is the mutual understanding and cooperation between different interests, and the will of river managers to improve the ecological and morphological situation. However, important problems are not solved yet, and new problems arise.

- ➔ Hydropower dams hold back sediments and cause erosion of the riverbed. This effect is amplified by dredging, done for waterway maintenance. Transport of sediment upstream helps to avoid further deepening of the riverbed. Nevertheless, erosion continues, though at a lower rate.
- ➔ Increasing numbers of passenger ships (with a high velocity) cause increasing fish mortality, because of waves (washing young fish ashore).

Specific pilot projects demonstrate the ability[5] to make substantial improvements to both navigation and ecology. Nevertheless, much more has to be done to prevent negative effects on threatened biodiversity features.

6.2 Challenges and Opportunities of the Navigation sector

6.2.1 Challenges

- ➔ Low river flows, climate change, riverbed degradation, siltation of sediment, flooding (too much water), salt intrusion during drought impacting lock regimes are all concerns
- ➔ Inland waterway transport is vulnerable to climate change because river navigation depends on water levels for its operations and extreme events may become more frequent[6]
- ➔ NBS has been successfully identified as an important approach in combating climate change and biodiversity loss. In spite of potential benefits of NBS in maintaining and developing waterborne transport infrastructure have been less well recognised and considered in policy agendas. This has potentially contributed to lower market demand (by mainly public authorities) and the availability of financing[7].

6.2.2 Opportunities

- ➔ Flexibility in applying regulations e.g. some sections of waterways on free-flowing sections can be exempt from minimum fairway width requirements – recognition that waterways need to be treated differently from other transport infrastructure such as roads. Flexibility is needed with waterways [i.e. more complex systems] to treat some sections as free flowing – where different parameters may be agreed.
- ➔ Rivers are living corridors and provide ecosystem services. These are not considered on the value which these could be. Further assessments (on valuing ecosystem services) would be necessary in selected Member States, or on certain river stretches). The impacts of harmful infrastructure developments on rivers (esp. free-flowing) are also risks on ecosystem services The free-flowing character includes longitudinal and lateral connectivity, preserve, and protect the habitats, hydromorphological status, to maintain and support natural sediment mobilisation processes
- ➔ Recognition that waterways are multifunctional systems – Navigation is one of a number of other important aspects to balance and are interconnected (e.g. environmental considerations can benefit the Navigation sector). This should be considered in decision making, however economic aspects still dominate.
- ➔ Tourism and recreation benefits recognised as linked to health, more natural freshwater ecosystems. More natural freshwater ecosystems support better tourism and recreation sectors.
- ➔ Section 2 of EU Regulation 1315/2013 deals with inland waterway infrastructure. The Regulation provides for the harmonisation of the Water Framework Directive and the Nature Directives (92/43/EEC, 2009/147/EC) at

EU level. The Environmental Impact Assessment (EIA) procedure, the Strategic Environmental Assessment (SEA) and analysis under 4(7) paragraphs of WFD are the main tools for this. However, implementation of these procedures is challenging. The good morphological condition of natural rivers is often difficult to reconcile with the interests of Navigation.[7]

- Recognise all dimensions of GD: Recognition that Green Deal by the Navigation sector relates to wider environmental challenges, not just emissions. Recognition that the Green Deal also implies "more transport over water". Revising regulations: (to include environmental considerations better): Evaluation and revision of TEN-T regulations underway (over last 2 years) and involvement of water managers (e.g. not just with responsibility for navigation) with a focus on waterway maintenance to help (re)define the future requirements for inland waterways. This has highlighted the need to account for different characteristics of each waterway.
- Participants of the roundtable organised in March 2022 had little knowledge on what restoration and NbS means, they were open for further improvement of this knowledge. Dedicating staff capacity to that is a prerequisite to gather and share knowledge. It was also declared on the roundtable that currently NBS is no/less risk to inland navigation and fairway maintenance projects if properly and jointly designed: integrated sustainable projects, involving stakeholders - common and shared vision. Even potential opportunities to co-benefit for navigational targets are to be expected. There is a room for improvement in understanding NbS, which might motivate the cooperation with stakeholders from other fields of expertise;
- Financial influence – who, how and why make any steps for influencing financial decisions toward transition? What is the role of the market and regulations? Who could be eligible if joint project proposals are developed? Who has the responsibilities and what kind of?

When applying these opportunities, we concentrate on a) heavily modified rivers and b) more or less natural rivers which need more 'training' for navigational purposes. NbS can help in both cases.

We recommend to differentiate the priorities and suggestions on NbS in light of Navigation sector depending on rivers' status and conditions from hydromorphological point of view:

There are other opportunities on fully or partially channelized or dammed rivers (a) with relatively poor ecological status (rivers without bottlenecks for navigation); no big infrastructure developments are expected on these rivers, but maintenance works in the navigation corridor are necessary and improvement of the ecological status as much as possible is a high expectation. Here, emphasis can be on mitigation measures of previous waterway infrastructure developments. The sector expects that fairway conditions will not deteriorate.

Restorations or fairway improvement on rivers (b) that have more bottlenecks can have a different emphasis, because these are usually still rich in habitats in the main river course, have wide floodplains and side-branches (free-flowing rivers without dams). In these sections, the sector tends to expect infrastructure projects to improve the condition of the fairways. Under the guidance of the Green Deal, NbS can be an alternative to the traditional grey measures and allow improved navigation while preserving the integrity of hydromorphological conditions, habitats and rivers' ecosystem services. Fairway conditions can improve, but not at the cost of natural conditions.

6.3 Cooperation (MERLIN & the Navigation sector)

Whilst many different aspects of how the Navigation sector may connect with NbS were discussed, we would like to focus on integrated project delivery . In the MERLIN project we will focus our work with the sector on the issues in bold:

- Evidence of applying NbS in sustaining fairways for navigation; evidence of applying NbS for delivering integrated solutions; showcasing results from navigable waterways where restoration was implemented with favourable effects on navigation and, or included clear navigational target - on Merlin case study sites if possible.
- Reach and engage other actors and cross-sectoral cooperation – river managers, water engineers and all who do the restoration, affected local communities, fairway maintenance administration bodies, etc.
- Raise awareness of NbS - improvement of the knowledge (training events on applying NbS in the Navigation sector) is necessary from both practical / technical and decision-making aspects.

6.3.1 Transformation and mainstreaming

- Currently NBS is no/less risk to inland navigation and fairway maintenance projects if properly designed: integrated sustainable projects, involving stakeholders - common and shared vision. Integrated planning

principles to be approved and applied and using the 'case-by-case approach at all bottlenecks, which removal is requested to maintain fairway conditions[2]

- Understanding rivers high ecological complexity requires comprehensive observations and management at the catchment scale – a holistic approach that is required by the EU Water Framework Directive[2]
- Wide stakeholder involvement approach is necessary with participation of responsible governmental bodies, sectors' representatives (transport, nature conservation and other related ones), NGOs and research institutions[2]
- it is important that new projects should be assessed with consideration for the main natural functions of river systems; in other words that they ensure maintenance of the key functions and ecological functions [9]
- Opportunities: several financial mechanisms are available (see in NAIADES reports e.g. CEF etc.) - barrier is about planning integrated projects, environmental components shall be included, building shared vision. To show and justify benefits of NbS for Navigation and nature conservation and other sectors and compiling cost-benefit analysis on project and programme level.
- The sector (its EU wide representatives) is keen on transforming/modernising sectoral policies/procedures; new guidelines are needed. Joint statements and their implementation increase the understanding of the two sectors (Navigation, Restoration)
- An innovative methodology for project cost-benefit-analyses is needed to display the multi-target effects to economic aspects;
- Keeping in mind the high sediment dynamics of the Danube and Rhine River, maintenance of navigation conditions is inevitable. Nevertheless, this should not contradict the natural sediment regime and navigation measures should aim to establish a dynamic equilibrium of the riverbed. (statement is from the Danube Sediment project's recommendations and is valid on other rivers, not only on Danube).

For cross sectoral cooperation (including ones outside MERLIN sectors) we need to understand the relationship between the Navigation sector and freshwater NbS. In general all the MERLIN sectors (Hydropower, Navigation, Peat Extraction, Agriculture, Insurance) rely on the others to manage water resources better to avoid floods and droughts which means that their sectors can continue to operate profitably. Navigation - as with Insurance - requires stable flows. Navigation could benefit from water recharge from NbS upstream implemented on agricultural land and peatlands if it generates stable flows. River cruises also promote themselves partially 1based on the scenery and wildlife provided by river and floodplain restoration.

6.4 Next steps

Overall, we are building a Community of Practice to support an understanding of NbS and how we can enable mainstreaming of NbS in the Navigation sector; as well as how Navigation can work with other sectors.

Together with participants from the six sectors, in the upcoming project year we will:

- Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS
- Examine the EU policy context and how in the future policy could better enable NbS.
- Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term until the end of the project we will:

- Identify opportunities for cross sector partnerships by applying a value chain approach.
- Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how we will collaborate with the sectors' representatives or to discuss how you can help MERLIN please contact Anna.Berczi-siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk.

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7 Briefing for Peat Extraction Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Transformation

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.[1]"*

This briefing focuses on the Peat Extraction sector. It summarises MERLIN's understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of the collaboration. The briefing proposes how MERLIN (more information about the MERLIN project can be found here) can support the Peat Extraction sector to implement NbS.

How can MERLIN support transformation?

The Peat Extraction sector can play a role in responding to Europe's Green Deal objectives via biodiversity restoration, wise land use and resource efficiency. Peatlands, in their natural conditions, function as important carbon sinks, which help to store a substantial amount of carbon. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets, and citizens. MERLIN will support this through understanding how the Peat Extraction sector is already making positive changes, sharing good practice between European countries, and exploring how NbS could help overcome some of the challenges faced by the sector. The activities of Peat Extraction, including licensing and restoration requirements, vary across different European states. However, this briefing presents a general reflection of the European condition, despite the individual state differences. The briefing is based on a range of insights from involving actively engaged individuals from the Peat Extraction sector (using Round Table Discussion (RTDs), questionnaires, interviews) and a desktop review of formal documents. The MERLIN team is very grateful for the insights shared to date, which have helped to understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within the developing Community of Practice of MERLIN. The Community of Practice concerns EU and Member State level policy and commercial actors of the Peat Extraction sector who share a common interest in improving their practices better through regular interaction and sharing information.

7.1 Relationship of the Peat Extraction sector with freshwater restoration and NbS

7.1.1 Brief description of the sector

In Europe, peat extraction is not a major contributor of peatland degradation, as the sector uses a relatively small area of peatlands (0.1%).[11] As for the sector's GHG emissions, there is a data gap regarding their actual contribution, as figures are generalised for all peatland purposes. Yet it is known that peat extraction emissions (on- and off-site) are the smallest of all land use type emissions from drained peatlands, lagging behind that of agriculture and forestry. Despite peat extraction's relatively smaller impact on peatlands, the sector should contribute to the rehabilitation of peatland ecosystems, especially because they have benefited from its prior degradation. The sector could also help to sequester carbon and GHG emissions.

Peatlands have a strong natural ability to absorb and store carbon[13], playing an important role as an NbS for climate change mitigation. While they only cover around 5% of Europe's land surface (Figure 1), they store five times more carbon than forests on the continent[12]. Peatlands consist of a variety of ecosystems which are important habitats for a multitude of species. They are the homes of many adapted, rare and threatened animals and plants, making them unique ecosystems (European Commission, 2020)[4]. In the EU, peat extraction does not take place on protected or pristine peatlands, unless a historic licence still permits it.

Peat is extracted for a variety of purposes, mostly horticulture and energy generation. Extraction mostly takes place in Central Europe, Baltic States and Scandinavia[2]. The process necessitates removal of the current

vegetation followed by drainage and levelling of the extraction area, harvesting of moist peat, which is later dried on site and transported to be further processed.[14, 15] MERLIN acknowledges the important role peat serves e.g. in the need for plants, food, and energy. Therefore, its main focus is the rehabilitation of degraded peatlands in line with NbS.

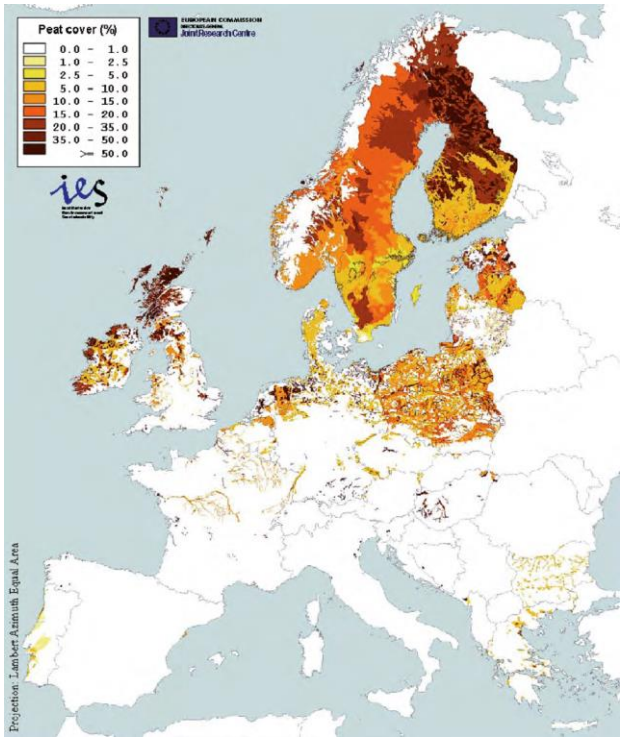

Figure 1. Peatland distribution in Europe (the map shows the relative cover (%) of peat and peat-topped soils in the soil mapping units of the European Soil Database[4].

Note: this map is for all peatlands in Europe of which peat extraction is a small proportion

7.1.2 NbS and their potential for supporting the sector

MERLIN envisages large-scale revegetation, rehabilitation and protection of peatlands as an NbS to enhance restoration of freshwater ecosystems, to reinstate key ecosystem services, and to address societal challenges. There is still a lot of potential for peatland restoration, as the European Commission considers the conservation status of European peatlands still unsatisfactory[4]. The aim of peatland restoration is to return degraded peatlands to conditions in which ecosystem functions and services, such as carbon sequestration, nutrient dynamics, biodiversity, climate and water regulation, and biomass production, are as close as possible to natural conditions at reasonable cost[6]. There is a preference to focus peat extraction on degraded, drained or disused peatland (especially that converted to Agriculture (pasture). Therefore, the sector could help with the restoration of these sites and turn an extracted peatland into a carbon sink again.

7.1.3 How the sector currently understands NbS

The term NbS is not commonly used by the sector, and NbS standards such as inclusion, transformation potential or biodiversity net-gain are not specifically discussed. However, the after-use procedures implemented by the sector, for example rewetting by blocking drainage channels, building dams and introducing water and peat-forming plants, are all part of an NbS approach. While the methods presently used by the sector for rewetting and restoration are acceptable NbS practices based on individual state regulations, they are not on the scale required by MERLIN. Therefore, discussion will be held on how this transformation may be brought about, because the sector has the equipment and expertise to do so, which could enable the sector to move towards net zero emissions.

In the sector, rewetting and rehabilitation are being carried out only at the local level of peat extraction fields, not on a landscape scale, as individual companies are only responsible for their part of their site of extraction.

Hence, the measures are mostly based on the industry's corporate sustainability practice and regulation requirements, which may differ by each extracting company. Restoration of peatlands is operated on a single site scale according to licensing conditions, if there is a legal requirement to rewet. A peat extraction licence may specify a different after-use, or none at all. If a peatland can no longer be restored, the preferred option of after-use may be forestry, paludiculture, open water wetlands or generation of solar or wind powered energy. The choice selected for after-use will depend on peatland type and former management, landowners' will as well as on the condition of the 'used' peatland.

7.1.4 Good examples of NbS for the Peat Extraction sector

Even though more and more peatland restoration projects are conducted in Europe, only a few of them are known to have been led on sites previously extracted by the sector. In this briefing, we chose to include three good restoration examples on peat extraction sites, that are in line with NbS practices.

Table 1: Examples of NbS for the Peat Extraction Sector

Country, date	Lead stakeholders / project	Key measures	Retrieved from (link)
Ireland, since 2021	Bord na Móna: a semi-state owned, former peat extractor, now a climate solutions company, aiming to contribute to the climate- neutrality of Ireland	➔ Formally ending all peat harvesting on their lands in 2021 ➔ Over 19700 ha of bog has been rehabilitated to date by the company ➔ Over 79300 ha are planned to be rehabilitated, currently 3127 ha of bog is under rehabilitation	https://www.bordnamona.ie/bord-na-mona-announce-formal-end-to-all-peat-harvesting-on-its-lands/
Lithuania, 2013-2017	Lithuanian Ornithological Society Tyruliai - Life: a LIFE project, aiming to restore the Tyruliai bog (which was one of the largest peat mining field in the country) as part of an initiative to the rewetting of Lithuanian peatlands	➔ Ensuring a favourable conservation status of bittern, spotted crake and migratory common crane ➔ Restoration of the hydrological regime in the area of 600 ha ➔ Raising public awareness of restoration possibilities of the destroyed bog	http://www.tyruliai-life.lt/upload/user_uploads/Ataskaitos/After_Life_Conservation_Plan_FINAL2.pdf
France, 2014-2021	Conservatoire d'espaces naturels de Franche-Comté LIFE Jura peatlands: a LIFE project, aiming to improve the conservation status of habitats in the peat bogs of the Jura Mountains affected by peat extraction	- Restoration of 32.6 ha of extraction area 12 Natura 2000 sites - Restoration of 15.1 km of streams on 6 Natura 2000 sites - Purchasing 48.34 ha of strategic areas from private landowners to make it possible to implement appropriate conservation methods across the whole target area	https://webgate.ec.europa.eu/life/publicWebsite/project/details/3947

7.2 Challenges and Opportunities of the Peat Extraction sector

7.2.1 Challenges

The sector believes that it would be hard to completely replace peat for horticulture and food production at this stage.[9] There is an increasing demand for high-quality growing media, for which peat is still the best mainstream raw material.[7] Even though promising alternatives are known, such as coir, bark, compost, biochar[8], they are still far from being widely practised. For instance, biochar is still quite small, and mostly needs to be mixed with peat for quality reasons and limited availability. Meanwhile, the sector is more and more urged to make their activities more in line with EU climate and environmental goals. Peat extraction in general has an increasingly negative reputation in Europe because it is linked with carbon emissions and biodiversity loss. As mentioned above, it

concerns a relatively small proportion of peatlands, yet, the sector uses degraded peatlands where biodiversity otherwise could be restored.

Restoration itself is challenging, primarily because degraded mire ecosystems have a very slow reaction to such measures. If these are successful, it can take several decades for ecosystems to improve their conservation status.[4] Moreover, peat extraction licences are vague on details of restoration: apart from it being a requirement, there are no specifications in many cases. Rewetting is still a common practice, which is problematic, because not all extracted peatlands are suitable for rewetting depending on underlying soil, cutover topography, and water availability. This practice alone does not create functioning peatlands either without proper rehabilitation, and revegetation measures.

Restoration would be more efficient if it was not only focused on a single site scale where peat extraction happened, but on a large-scale landscape scale. This is contested by the fact that extraction companies are not responsible for going beyond their own sites. There are also some companies who are legally extracting on protected lands, as they received their licence before regulations have taken place, and these licences could be viable even after decades. Overcoming regulatory bureaucracy and the fragmented policy framework across Europe is challenging as well. Different countries have their own conditions for peat extraction and peatland restoration, while some EU policies contradict each other on these matters.

7.2.2 Opportunities

Biodiversity may be enhanced or recovered after Peat Extraction ends if appropriate rehabilitation and revegetation measures are implemented[16]. The other main driver behind peatland restoration is that restored peatlands can store more carbon than degraded ones, therefore they have a part to play in emissions absorption[17]. In some European areas, applying NbS to peatland restoration also has the potential to mitigate flooding, as it would retain floodwaters, reduce flood peaks and consequently, safeguard urban areas and communities. Furthermore, as can be seen from the Irish Bord na Móna example from above, restoration can provide employment in rural areas or for those who previously worked on peat extraction within the company.

Additionally, restoring peatlands can have a positive impact on local tourism and offer recreational opportunities. Positive solutions such as bog bridges and boardwalks already exist on several peatlands, also serving as an educational element, which is well-needed, since the value and benefits of wet peatlands are still largely underestimated.[12] Therefore, restoration can contribute to achieving the Sustainable Development Goals as well, since it can result in peatlands offering a clean and reliable source of water, helping generate economic benefits and reduce exposure and vulnerability to disasters.[5]

Restoring its good reputation through applying NbS could be a motivating aspect for the sector. Especially because in Europe, peatlands are the most degraded ecosystems,[10] therefore, there is a huge potential for the sector to contribute to changing this. Rehabilitation and revegetation of peatlands is a business opportunity for the industry, given that companies are motivated to undertake peatland restoration as a corporate and social responsibility. Thereby, they are applying for 'best practice' certification that includes commitment to restore sites when extraction ends. Peat extraction companies have the machinery and knowledge for peatland restoration, which, with the appropriate regulatory environment and finance, could be upscaled to the landscape level.

7.3 Cooperation (MERLIN & the Peat Extraction sector)

Regardless of peat extraction's coverage of peatlands in Europe, the sector could play a significant role in addressing environmental challenges respective to the sector. MERLIN needs to base suggestions on transformation and mainstreaming on practical experience and evidence-based learning. Whilst many different aspects of how the Peat Extraction sector might mainstream NbS were discussed, we would like to focus on revegetation not just on-site rewetting and linking the extraction sites to wider peatland restoration approaches. In the MERLIN project we will focus our work with the sector on the issues in bold:

- ➔ Provide information and training on how to revegetate sites and sustain the vegetation through appropriate after-use site management
- ➔ Enable large-scale restoration beyond sites of peat extraction to the wider landscape level, since companies have the tools and expertise that could be upscaled. This would ensure that NbS standards are met and that NbS is implemented not only on peat extraction fields, but at a landscape level as well, in cooperation with other sectors.

- Enhance cooperation between peat extraction industry and other stakeholders including public agencies and other private organisations, to fund NbS projects at a landscape level and tap into the skills, knowledge, and equipment of the industry to mainstream NbS.
- Share innovative funding mechanisms and business approaches for a wider peatland restoration that involves the sector, in order to increase financial motivation for restoration. For instance, blue carbon credits can incentivise peatland restoration, as their generation is based on the tonnes of carbon captured and stored by the project, and these credits can later be sold to larger entities wishing to offset their GHG emissions.
- Calculate, if possible, GHG emissions from extracted peatlands and methodologies for achieving net zero emissions in the sector.
- Help improve planning and licence processes to overcome the regulatory bureaucracy, which hinders the appropriate restoration of peatlands following extraction. MERLIN could serve as an intermediary between the peat extraction companies and various state regulators to facilitate the transformation process, with the aim to make the licences clearer with regards to restoration.

For cross sectoral cooperation, the relationship between the peat extraction sector and freshwater NbS has to be understood. In general all the MERLIN sectors (Hydropower, Navigation, Peat Extraction, Agriculture, Insurance) rely on the others to manage water resources better, to avoid floods and droughts to keep operating profitably. Peat extraction is directly related to parts of Agriculture, such as Horticulture, and through rewetting, it can help with water levels for Insurance, Hydropower, Navigation and Water Supply and Sanitation. According to the MERLIN Case Studies (CS14), restoration of Peat Extraction helps treat water quality. The industry could also support and help the restoration of wetlands on peat-based habitats used for Agriculture.

7.4 Next Steps

Overall, MERLIN is building a Community of Practice to support an understanding of NbS and how MERLIN can enable the mainstreaming of NbS in the Peat Extraction sector; as well as how Peat Extraction can work with other sectors.

Together with participants from the six sectors, in the next year MERLIN will:

- Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS
- Examine the EU policy context and how in the future policy could better enable NbS.
- Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term, MERLIN will:

- Identify opportunities for cross sector partnerships by applying a value chain approach.
- Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how MERLIN will collaborate with the sectors' representatives or to discuss how they can help MERLIN, please contact Anna.Berczi-Siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk.

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8 Briefing for Water Supply and Sanitation Sector

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Transformation

A collaborative approach with key economic sectors d is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to mainstream restoration as a Nature-based Solution (NbS). Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> *NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1].*

This briefing focuses on the Water Supply and Sanitation (WSS) Sector. It summarises our understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of our collaboration. The briefing proposes how MERLIN can (more information about the MERLIN project can be found here) support the WSS sector to implement NbS.

How can MERLIN support transformation?

The Water Supply and Sanitation Sector (WSS) can play a crucial role in responding to Europe's Green Deal objectives, particularly secure supplies of clean water. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets, and citizens. MERLIN will support this through understanding how and why the WSS sector is already making positive changes, sharing good practice between European countries, and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from involving individuals actively engaged in the WSS sector (using Round Table Discussions (RTDs), questionnaires, interviews) and a desktop review of formal documents. We are very grateful for the insights shared to date, which have helped us understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within our developing Community of Practice. Our Community of Practice concerns EU and Member State level policy and commercial actors of the WSS sector who share a common interest in improving their practices better through regular interaction and sharing information.

8.1 Relationship of the WSS sector with freshwater restoration and NbS

8.1.1 Brief description of the sector

The WSS sector oversees drinking water and wastewater activities (including wastewater treatment) for households, industrial, agriculture and commercial customers. In Europe public utilities and private operators are in charge of Water Supply and Sanitation and sewage networks and wastewater treatment plants. MERLIN's focus is on upstream restoration to preserve water supply and will therefore entail working together with the sector on the availability of drinking water in a landscape context, mainly in rural areas. To represent the perspective of the public and private operators from the WSS Sector and the sector relationship with NbS, it was important to involve a group of sector leaders who were invited to participate in the first roundtable organised by the MERLIN team. The group consists of representatives from Aquafed and Aqualia (representing the views of private operators), Aqua Publica Europea (the European association of public water operators and representatives), and representatives from the European Water Managers Association (EUWMA).

Figure 1: NbS for lowering flood risk in different river sections. Adapted from the Norwegian Environment Agency[2]

There are many different types of NbS that can be used in the water sector, as seen in Figure 1[2]. However, to address some of the main environmental and socio-economic challenges that the sector is facing (such as water scarcity, flooding, water quality, etc.) some of the proposed NbS are the following:

- Development of freshwater wetland and restoration efforts that focus on improving flood management capacity while providing water treatment services such as filtration and pollutant trapping. These actions aim to renew sediment profiles, introducing and creating conditions for autochthone species and return of natural habitats. This can in turn address the impact of soil and water conditions on nutrient dynamics and ecosystem services.
- To reduce flood infrastructure risks, restoring wetland forests[3] in areas with low flood waves is suggested. Combining wetland trees and shrubs with traditional levees and embankments made from earthen barriers[4] can reduce wave heights, provide habitat value, and support biodiversity.
- Developing inland buffer zones within regional water systems in order to buffer both floods and drought conditions and allow flexible stormwater capacity.
- Creating freshwater habitats through conservation and restoration of wetlands to increase the biodiversity net gain. Conserving and restoring wetlands also increase the buffering and filtering capacity of adjacent land, improving both water quality and quantity.
- Using NbS for water storage combined with integrated watershed management for stormwater or wastewater allows improved infiltration in the ground. The potential to link urban water resources may have the potential to ease water pressures and promote biodiversity.

8.1.2 NbS and their potential for supporting the sector, How the sector currently understands NbS

The sector often addresses the NbS as “green” solutions to solve the current challenges. Water managers are increasingly asked to integrate ‘green’ approaches into WSS and treatment practices. “Green” technologies - which are believed to offer environmentally conscientious, energy-efficient, and/ or increasingly economically viable solutions to address challenges - are generally understood to complement and sometimes replace more traditional ‘grey technologies’.

The most common application of NbS in the WSS sector is to handle water overflows during intense rainfall events, when the current infrastructure cannot cope.

The sector seems interested in NbS upstream to protect resources, particularly with increased potential for drought under climate change, but this is often large-scale ecosystem intervention that is difficult for water companies to deliver on their own.

It is important to mention that public and private operators look at water management and implementation of NbS in a different perspective. Public operators believe that the management of water belongs in the public domain and that all the revenues generated from water management services should be reinvested in the water cycle, while private operators advocate for the benefits of public-private partnerships. Even though both perspectives support sustainable use of water resources, MERLIN should aim to tackle all sides of the story so that investment decisions can be made with more certainty.

8.1.3 Good examples of NbS for the WSS sector

- Anglian Water[5] - A biodiverse wetland to treat effluents. Prioritising natural capital approaches Anglian Water is the largest water and water recycling company by geographic area in England and Wales, committed to solving environmental problems at source and water quality threats prompted evaluation of nature-based approaches to water management. The Anglian Water case study demonstrates how NbS projects can actually save money for business and customers. Their experience showcases the critical role of customer engagement and how strengthening the relationship between utilities and the general public can create avenues to prioritise natural capital approaches.
- De Watergroep-Catchment protection through ecosystem restoration[6]- De Watergroep is the largest drinking water supplier in the Flanders region of Belgium. In the densely populated and cultivated region of Flanders, investing in the long-term protection of these water supplies through nature-based solutions (NBS) is a means of addressing serious water quality issues stemming from agricultural and industrial pollution. De Watergroep tackles pollution threats from the increased threat of nutrient and pesticide leaching into surface water supplies and a diminished dilution of chloride coming from industrial discharges, by focusing NbS on the protection and enhancement of the ecosystems that surround their abstraction areas.
- Skanderborg Forsyning- Climate Change adaptation using Nature-based Solutions[7] - The Danish water utility Skanderborg Forsyning affirms that when it comes to water security in a changing climate, using nature-based solutions at the local level was never a question. In recent years, the municipality of Skanderborg, has experienced increasing and more frequent rainfall resulting in extensive flooding of urban areas. Rainwater accumulation can lead to sewage overflow and surface water quality degradation, impacts that will be exacerbated by the onset of climate change. Climate change projects are an opportunity to adapt using nature to deal with increased rainfalls and prevent the flooding of urban areas.

8.2 Challenges and Opportunities of the WSS sector

The WS sector grasps the potential of NbS but would like to have more specific cases as examples to illustrate how NbS can preserve resources, reduce investment (NbS are often cheaper in the long term than traditional engineering) and also reduce energy and carbon footprints. There are certain barriers in mainstreaming restoration and NbS in the sector, consisting of challenges such as:

- Knowledge and information gaps: limited data on river flows, as well as evidence on the value of freshwater and terrestrial ecosystems brings a lack of knowledge on the costs and benefits, technologies, markets, and financial products associated with NBS. The absence of available best practices and expertise for investors creates uncertainty related to bidding processes.
- Administrative: NBS often combine different scales in urban water management, from individual buildings to municipal and larger levels which require work implication from different authorities and institutions.
- Financial gaps: lack of funding resources for large scale restoration projects, construction, rehabilitation, or operation & maintenance.
- The opportunities that could promote NbS in the sector are related at first to understanding the benefits of NbS versus traditional engineering in urban water management. There is a green solution opportunity towards each urban management issue. To address the complexity of these issues - technical, financial, administrative; various policy, regulatory and financing opportunities have been developed.
- The socio-economic benefits of NbS may seem to outweigh its financial benefits,[8] but it is of utmost importance for the WSS sector to additionally recognize the financial benefits in investing in NbS. In general, where NbS were implemented, successes were observed with generally less intensive capital outflow, and an appreciation in value over time with the regeneration of the ecosystem services.[9]

- NbS can also avoid or postpone the costs of building new, or extending existing, grey infrastructure.
- Policy and regulatory opportunities- The Water Framework Directive (WFD)[10] provides a series of technical directives for the EU member states. The compliance to WFD translates into clean and safe access to drinking water, healthy freshwater ecosystems, flood defence and flood risk assessment, disaster management, minimising treatment costs downstream etc. Furthermore, EU member states should rely on the EU Strategy on Green Infrastructure that promotes the use of nature-based green and blue infrastructure solutions.

8.3 Cooperation (MERLIN & the WSS sector)

MERLIN aims to base suggestions on transformation and mainstreaming on practical experience. Whilst many different aspects of how the WSS sector might be transformed and mainstream NbS were discussed, we would like to focus on specific aspects (possible low hanging fruits) of how the WSS sector might be transformed and explain how NbS might be mainstreamed. In the MERLIN project we will focus our work with the sector on the issues in bold:

Although MERLIN acknowledges that "sanitation" is an important topic for the sector and that many NbS solutions are based on wastewater treatment and water reuse, we see the priority cooperation opportunities are through raising awareness of the importance of working upstream on restoration. A 2020 study by Chausson et al.[11] has shown that upstream forests and water utilities' conservation and restoration "in the world's 534 largest cities could better regulate water flows and save up to $890 million in treatment costs annually", and this could be replicated if NbS gets widely implemented.

The Stakeholder analysis identified relevant water organisations to be contacted regarding NbS, restoration and transformation. These organisations, representing the private/public water sector, were part of the MERLIN sectoral RTDs, and are aware of the climate change challenges and the need for sustainable use of water resources. Some of them have existing projects surrounding responsible water management, reducing their carbon footprint and to protect biodiversity. Most of the public operators are responding to climate change by optimising energy management (use of renewable energy, generation of energy in water cycle management, reduction in electricity consumption in wastewater treatment plants etc.

Participants from the RTDs expressed interest in NbS upstream activities to protect resources, particularly with increased potential for drought under climate change, but this is often large-scale ecosystem intervention that is difficult for water operators to deliver on their own because of a lack of a clear legal mandate to intervene at river basin scale and/or administrative constraints. Instead, they rely on working in partnership with other stakeholders and this approach can increase the governance challenges. However, there are promising developments, such as the recent "Gestion des milieux aquatiques et prévention des inondations (GEMAPI)" law[12] in France, where water operators and municipalities can be granted the responsibility and financial means to also manage water resources upstream, with restoration-protection objectives. This example of a good practice initiative promotes a stronger connection between water management in the urban cycle and upstream management of water resources and inspires replication in other areas.

The WSS sector acknowledges that strategic and innovative finance solutions are required to raise funds and meet investment needs. Such solutions may also finance green infrastructure and NbS. Some of the potential financial schemes associated with the sector are the following:

- External (commercial) finance (from outside the company): Relevant instruments could include green loans or green bonds, which exclusively finance 'green projects' that generate environmental benefits, while maintaining the basic characteristics of conventional loans or bonds. What constitutes a green project is not concretely or legally defined. However, the European Commission has been establishing guidelines and definitions based on the Sustainable Finance Taxonomy Regulation, with the aim to standardise and upscale green finance.
- Internal finance (from within the company): Following the principle of full cost-recovery, restoration could theoretically be funded through the share of revenues collected via water pricing mechanisms used by water service providers, as far as restoration measures can count as investments in the availability, replenishment, and quality of freshwater. Alternatively, the disposal of assets can provide financial means to invest in restoration.
- Blended finance (internal/external private + public funding): Public funding may leverage green infrastructure to correct for market failure, where such measures are less cost-effective (or riskier) than grey

infrastructure but provide public or shared environmental benefits. Relevant instruments could include subsidies, tax rebates, grants, or guarantees for loans.

For cross sectoral cooperation we need to understand the relationship between the WSS sector and freshwater NbS. In general, all the MERLIN sectors (Hydropower, Navigation, Peat Extraction, Agriculture, Insurance) rely on the others to manage water resources better to avoid floods and droughts that mean that their sectors can continue to operate profitably.

Water Supply relies on stable provision of water - Agriculture is the largest consumer of ground and surface water - so water saving Agriculture helps reduce competition for resources in drought. The WSS sector is also in conflict with Navigation and Hydropower in times of low river flows. However, upstream implementation of NbS by Peat Extraction and Agriculture businesses that enhance environmental flows can all help WSS retain access to water resources. Reducing agricultural pollution will reduce WSS treatment costs.

8.4 Next Steps

Overall, we are building a Community of Practice to support understanding and uptake of NbS and how we can enable mainstreaming of NbS in the WSS sector; as well as how the WSS sector can work with other sectors.

Together with participants from the six sectors, in the next year we will:

- ➔ Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS
- ➔ Examine the EU policy context and how in the future policy could better enable NbS.
- ➔ Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term, we will:

- ➔ Identify opportunities for cross sector partnerships by applying a value chain approach.
- ➔ Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how we will collaborate with the sectors' representatives or to discuss how you can help MERLIN please contact Anna.Berczi-siket@wwf.hu or Kirsty.Blackstock@hutton.ac.uk.

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9 Conclusion

Mainstreaming aquatic restoration using Nature-based Solutions: supporting transformation with six economic sectors

This deliverable has introduced our baseline for working towards transformation with the six MERLIN economic sectors (Agriculture, Hydropower, Insurance, Navigation, Peat Extraction and Water Supply and Sanitation) over the rest of the MERLIN project.

The deliverable shows the different views held by our sector participants regarding how their economic sectors depend on rivers and wetlands, and how Nature-based Solutions (NbS) could be developed.

The briefings suggest a different level of 'readiness' to engage with NbS from enthusiasm expressed by the natural catastrophe Insurance sector to explore new products, to general support from the WSS, to sectors that would like to really understand what NbS means for their sector and assurances that NbS could help and not hinder their economic development.

There were many commonalities such as the fact that NbS needs to be related to sustainability more commonly used in economic sectors; the need for more data on costs and benefits; and the need to align NbS recommendations with sectoral business planning cycles and processes. NbS can generate cross-sectoral synergies but achieving them requires careful planning and negotiation. Central to these synergies are the institutional aspects of working across sectors for common goals in a catchment. However, there were also some more difficult commonalities emerging such as potential or actual trade-offs involved in implementing NbS.

Therefore, the proposed cooperation points range from engaging on explicit products and data exchange (Insurance) or resolving issues with planning and policies (Navigation, Peat Extraction, WSS) to further deliberation over the enabling conditions required to raise awareness of the benefits of freshwater NbS to the sector (Agriculture) and how the sector fits within the catchment context.

The deliverable provides a foundation for MERLIN's Community of Practice to further deliberate on common issues and to exchange information between policy, practice and scientists. Together with participants from the six sectors, we will:

- Continue to engage with the sectors to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS.
- Examine the EU policy context and how in the future policy could better enable NbS.
- Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.
- Identify opportunities for cross sector partnerships by applying a value chain approach.
- Furthermore we will co-develop route maps for transforming the sector's relationship with NbS.

10 Annexes

Annex 1: Methodology

- Desktop literature reviews were done for each sector which identified the stakeholders, sectoral "windows of influence", key policies and value chain issues related to NbS and freshwater restoration. These six reports (each around 40 pages long) are a resource for the full project to use and continue to be updated as additional relevant documents are identified by the team.
- Stakeholder identification and analysis: An excel template was developed to enable identification and analysis of stakeholders. There are two templates: one for European and member state organisations that support or influence mainstreaming of NbS, and another for individuals affiliated to or representing these organisations. The organisational template has several tabs that help understand the context for the stakeholder engagement, the type of organisation, sectoral identity, geographic scale of operation and their power, interests and networks within the topic. For the individuals, there are tabs to track the on-going engagement. Hence, for each individual, we are able to know what fields they are kind being involved in; when the person was contacted; and the feedback after being contacted. Currently there are 225 organisations and about 347 individuals identified that we are approaching for our activities across the WP. Both templates are living documents and are regularly updated.
- Questionnaire: An economic sector questionnaire was also developed that was used to complement the roundtables to get a sense of the perceptions, understanding and challenges the sectors face in relation to NbS and freshwater restoration. The survey was conducted online using the James Hutton Institute's Qualtrics platform, and the survey was piloted in the first sectoral roundtables of WP4, which garnered 24 responses. The second-round targeted economic sector (private, public and NGOs, etc.) experts whose work relates to the freshwater ecosystem, and resulted in 112 respondents who had a 100% completion rate. The full report can be accessed here. The questionnaire results were used to develop the cross-sector briefing within D4.1.
- Sector Roundtable: Five roundtable discussions were conducted in 2022 for the sectors except Agriculture, as the EIP process was seen to duplicate this process. The length of each sector roundtable ranged from 2-3 hours and were all held on-line. Broadly each roundtable was structured for the participants to: 1. Get better informed about the aims and objectives of MERLIN and specifically WP4, with an emphasis on working with sectors to seek 'win-win' opportunities; 2. Get a general understanding of other actors participating in roundtable discussions; 3. Discuss and learn from examples of NbS related activities already underway in some areas of their sector (to help inspire new ideas and stimulate group discussions); 4. Understand what the WP4 team has learnt so far about the sector's relationship to restoration and potential opportunities for applying NbS within the sector from the desk-based analysis and initial findings from the questionnaire completed by some participants; 5. Explore key themes identified in the desk based analysis, discuss ideas and provide suggestions on how MERLIN could work with and support the sector in applying NbS to help restore freshwater ecosystems. For all sector roundtables these key themes broadly related to a) the sectors perceptions of and engagement in restoration and understanding of the term NbS, b) Threats/challenges for the sector and how NbS could help, c) What needs to be transformed to make NbS more widespread and effective within the sector.
- The sectoral roundtable representatives came from associations and organisations (See Annexes 4, 5, 7, 8 & 9) involved in organic farming, landowners, biodiversity organisation, energy electricity industry, hydropower (both EU and member levels), forestry, fishing, marine and water management, waterborne transport infrastructure, transboundary river commission, soil, peatland, insurance (both EU and member levels), water operators, public water management, as well as environmental consultancy and institutes.
- For each sector roundtable a brief summary report was produced and shared with participants. Full transcripts of each roundtable were produced and analysed to identify key cooperation points (i.e. for working with the sector within MERLIN). The WP4, other WPs, invited experts, and the RT participants were also provided the opportunity to comment and provide suggestions. This was a challenging process to manage multiple perspectives but necessary - the deliverable became a boundary object to build shared understanding beyond the initial discussions at the RTs. About these initial findings to help develop D4.1 report "Mainstreaming aquatic restoration using Nature-based Solutions". This report includes sector specific and cross-sectoral briefings and details the cooperation points for each sector that has informed our future activities for developing the community of practice.

- We have built connections with some participants - such as Naturland, BfG for PIANC, ICA, IPS, APE, SYKE, not only through the first roundtable discussion, but also through face-to face interactions in WP4 partner meetings and other WP4 tasks.
- Agriculture sector interviews: Interviews were conducted with around 20 agricultural actors (See Annex 3) across Europe in lieu of the Agricultural Roundtable, and insights from participation in the EIP platform on NbS for water under climate change were also used to inform our thinking.
- Policy interviews: Interviews with policy makers (See Annex 10) from DG Agri, DG MOVE, DG Env, DG Clima and EEA were conducted to complement the RTs sectoral perspectives in June 2022. These insights were also integrated in Deliverable 4.1 - Briefings on national / EU sector perceptions workshop.
- Policy Webinar: On the 5th of October 2022, Hutton and WWF held a virtual (See Annex 10) meeting with members of the EU Commission to discuss how economic sectors can mainstream nature-based solutions. The discussions highlighted the need to generate "implementation momentum" and supportive work beyond individual small on-farm projects for the Agriculture sector; confirmed the need for sharing insurance data to advance understanding of NbS at scale, and the influence of the EU Taxonomy on Sustainable Finance for the Insurance sector; and validated that rewetting is still more prevalent than revegetation in the Peat Extraction sector. An overall understanding to improve policy coherence is not only needed to mainstream NbS, but to get the support of the business sectors and to move focus beyond urban green-blue infrastructure.

Annex 2: Number of roundtable participants and interviewees based on organisation types and scale of operation

Sector	Total number of RT participants per organisation type					
	Public	Private (commercial)	Public-private partnership	NGO	Network	Other (e.g. academic, etc)
Hydropower	2	2	0	1	4	0
Insurance	3	5	1	0	0	0
Navigation	8	0	0	0	5	0
Peat Extraction	0	5	1	5	2	2
Water Supply and Sanitation	0	3	0	0	2	0

Sector	Total number of RT participants per organisation scale of operation				
	National	Regional	Europe	International	Other
Hydropower	5	0	3	1	0
Insurance	5	2	0	2	0
Navigation	6	0	6	1	0
Peat Extraction	8	0	3	3	0
Water Supply and Sanitation	0	0	3	2	0

Sector	Total number of sector interviewees per organisation type (including DGs)					
	Public	Private (commercial)	Public-private partnership	NGO	Network	Other (e.g. academic, etc)
Agriculture	9	7	0	1	1	5
Hydropower	0	0	0	0	0	0
Insurance	4	2	0	0	0	0
Navigation	1	0	0	0	0	0
Peat Extraction	0	0	0	0	0	1
Water Supply and Sanitation	3	0	0	0	0	0
Cross-sector	8	0	0	0	0	0

Sector	Total number of sector interviewees per organisation scale (Including DGs)				
	National	Regional	Europe	International	Other (e.g. local)
Agriculture	9	0	7	2	5
Hydropower	0	0	0	0	0
Insurance	3	0	3	0	0
Navigation	0	0	1	0	0
Peat Extraction	1	0	0	0	0
Water Supply and Sanitation	0	0	3	0	0
Cross-sector	0	0	8	0	0

Annex 3: Replies to reviewers' comments

Reviewers' comments	Reply
Tables of interviewees, RTD participants etc would be helpful, in an Annex – even as basic summaries (country, practice-sector, role, public/ private/academic etc). It would be helpful to document this, in order to supplement evidence regarding the benefits of NBS to each sector. During the review meeting it was discussed whether the methods were set out in the questionnaire report or the 6 sectoral briefings, and it was confirmed that they are not covered (at this stage). As in D2.1 all the qualitative information from the workshops/ surveys is indirect. There are not direct quotes from the industry representatives involved in the workshops/surveys.	JHI (Hassan) have prepared new Annexes with the requested information, see Annex 1 and 2
The critical element of cost-benefit analysis does not receive much attention or discussion, beyond some important introductions: • P25. "Where farmers are managing their environments well, they believe they are not receiving due market value for these actions. Therefore, the whole food value chain - determined by the market, demands and cost - can play a significant role in valorising NbS. " • P28." NbS could support the emergence of new value chains particularly making more market value from good environmental stewardship of water on farms and across the basin - including using existing certification to increase visibility or gain premiums from the buyer. " However, it is well noted that the CBA is the topic of a separate deliverable and milestone.	*As it was noted by the reviewers the CBA work will be done in a separate deliverable in WP3 (T3.5) and not in WP4. In Deliverable 4.4 about value chains WP4 will build upon the results of this work.* *Some details from WP3 colleagues (Nicolas) responsible for CBA:* *What will be done:* *5 CBAs in selected basins. 3 already selected (Rhine, Sorraia, Forth), 2 still to be confirmed (likely to be Tisza and Finland).* *Quantification and valuation of Ecosystem Services delivered by NbS: nutrients and sediment retention, flood and drought risks reduction, carbon sequestration, nature recreation, food and biomass provision (list to be fine-tuned based on priorities in each basin).* *When we might get some results:* *- Rhine: end 2023* *- Sorraia and Forth: 2024* *- 2 others: 2024/2025* *Connection to sectors:* *Agriculture: benefits to farmers in terms of flood/drought risk mitigation, analysis of trade-offs taking land out of production/benefits from NbS.* *Water supply and sanitation: benefits to the sector in terms of water quality improvement (nutrients removal, reduced sedimentation)* *Insurance: demonstration of benefits of NbS on flood & drought risks reduction* *For the 3 other sectors, hydropower, navigation, peat extraction, the connection is less clear.* *Regarding the topics highlighted by the reviewers, i.e. making more market value from good environmental stewardship in the food value chains, I think it is beyond the scope of what we are planning in the CBA.*
Several elements of the desktop review findings did not cite primary data sources, across all sector analyses. This is understandable for the final versions of briefings which need to be kept punchy, but for a report of this length one might hope to see more referencing. Hopefully the source material has been kept and can be re-incorporated. This is particularly important where statistics and headline figures are given.	Referencing has been added, where necessary (pages 34 and 40).
p.27 "Monitoring and performance assessment: the indicators used for the monitoring, the identity of people conducting the monitoring, the way performance should be rewarded - are still unknown." Unknown to whom?	textual change p. 25: "Monitoring and performance assessment: the indicators used for the monitoring, the identity of people conducting the monitoring, the way performance should be rewarded - are often not properly defined."
The reports intended audience i.e. Communities of Practice is not really defined in the document. As a result it is slightly difficult to	The cross sectoral briefing (Chapter 2) defines our community of practice. It varies between the six sectors;

judge what kinds of people are to be targeted with the briefings, and hence what channels, messages are appropriate. E.g. commercial actors of the WSS sector – very diverse group encompassing consultants, construction side, infrastructure systems planners, operators, trades, thought leaders, representative bodies etc. Perhaps this could be addressed by cross-referencing the challenges, examples and recommendations with specific target audience/ stakeholders.	therefore we decided not to define the concept more. The COP evolves parallel with the project. 'Our Community of Practice concerns EU and Member State level policy and commercial actors who share a common interest in improving their practices better through regular interaction and sharing information.'
P34 "MERLIN needs to base suggestions on transformation and mainstreaming on practical experience". Does this mean practical experience alone? Or in conjunction with other evidence? Why is this justified? The briefings can provide useful high-level overviews and addressing these modest downsides would be worthwhile to enable the briefings to be used to support wider project impact, through external dissemination. A final point is that it is great to see that Merlin builds on existing processes and assets e.g. Agricultural European Innovation Partnership (EIP-AGRI).	This introductory text is in all the sectoral briefings by the cooperation points. MERLIN builds on the practical experience of the 18 Merlin case studies and on other good practices from freshwater NbS.