



NBRACER
Nature Based Solutions
for Atlantic Regional Climate Resilience

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Monitoring Journey Guide for Regions

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About NBRACER

The impacts of climate change on people, planet and prosperity are intensifying. Many regions and communities are struggling to avoid losses and need to step up the effort to increase their climate resilience. Ongoing natural capital degradation leads to growing costs, increased vulnerability, and decreased stability of key systems. Whilst there has been noticeable progress and inspiring examples of adaptation solutions in Europe, the pressure to make rapid and visible progress has often led to a focus on stand-alone, easy-to-measure projects that tackle issues through either direct or existing policy levers, or sector-by-sector mainstreaming. But the dire trends of climate change challenge Europe, and its regions, needs exploration of new routes towards more ambitious and large-scale systemic adaptation. The European Mission on Adaptation to Climate Change (MACC) recognizes the need to adopt a systemic approach to enhance climate adaptation in EU regions, cities, and local authorities by 2030 by working across sectors and disciplines, experimenting, and involving local communities.

NBRACER contributes to the MACC by addressing this challenge with an innovative and practical approach to accelerating the transformation towards climate adaptation. Transformation journeys will be based on the smart, replicable, scalable, and transferable packaging of Nature-Based Solutions (NBS) rooted in the resources supplied by biogeographic landscapes while closing the NBS implementation gap. Regions are key players of this innovative action approach aiming at developing, testing, and implementing NBS at systemic level and building adaptation pathways supported by detailed and quantitative analysis of place-specific multi-risks, governance, socio-economic contexts, and (regional) specific needs.

NBRACER works with 'Demonstrating' and 'Replicating' regions across three different Landscapes (Marine & Coastal, Urban, Rural) in the European Atlantic biogeographical area to vision and co-design place based sustainable and innovative NBS that are tailor-made within the regional landscapes and aligned with their climate resilience plans and strategies. The solutions are upscaled into coherent regional packages that support the development of time and place specific adaptation pathways combining both technological and social innovations. The project is supporting, stimulating, and mainstreaming the deployment of Nature-Based Solutions beyond the NBRACER regions and across biogeographical areas.



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Summary

This report presents the NBRACER Monitoring Journey Guide, a structured methodology to support regions in defining and implementing Key Performance Indicators (KPIs) for assessing the effectiveness of Nature-based Solutions (NbS). Aligned with the NBRACER approach and the Regional Resilience Journey (RRJ), the guide outlines an eight-step process that includes establishing a monitoring team, understanding the baseline, setting a vision, selecting NbS, defining KPIs, and conducting pre- and post-implementation monitoring followed by impact assessment. The approach emphasises adaptability, stakeholder engagement, and iterative learning to ensure that monitoring supports climate resilience goals.

The deliverable also includes updates from the five Demonstrating Regions, showcasing diverse monitoring strategies across marine/coastal, urban, and rural landscapes. While regions are at different stages of implementation, commonalities include the use of environmental, social, and governance indicators, and challenges such as data gaps and stakeholder coordination. The report highlights the importance of monitoring not only for evaluating NbS performance but also for informing replication, upscaling, and policy integration. It serves as a practical tool for NBRACER regions and others aiming to mainstream NbS in climate adaptation planning.

Keywords

Monitoring; Nature-based Solutions Effectiveness; Key Performance Indicators; Climate Adaptation; Increasing Resilience; Impact Assessment

Abbreviations and acronyms

Acronym	Description
CRIC	Climate Risk Impact Chains
ES	Ecosystem Services
EU	European Union
KCS	Key Community Systems
KEC	Key Enabling Conditions
KPI	Key Performance Indicator
M&E	Monitoring and Evaluation
MACC	Mission on Adaptation to Climate Change
NbS	Nature-based Solutions
P2R	Pathways2Resilience
RMT	Regional Monitoring Team
RRJ	Regional Resilience Journey
SoS	Systems of Systems
ToC	Theory of Change
WP	Work Package



1 Setting the Scene: the NBRACER Approach

The NBRACER Operational Climate Resilience Approach provides a flexible, co-designed framework to support regional climate adaptation using Nature-based Solutions (NbS). It responds to the growing need for transformative, system-oriented strategies that move beyond fragmented, project-level interventions. The approach views regions as complex Systems of Systems (SoS), integrating biophysical, socio-cultural, and governance domains to guide resilience-building in a way that is context-sensitive and community-driven. NbS serve as the core intervention, designed not in isolation but as part of multi-dimensional portfolios that align with local values, risks, and institutional landscapes.

The NBRACER operational framework equips decision-makers with adaptable tools and processes tailored to diverse regional contexts and scales. By employing an iterative, participatory approach and advanced spatial analysis, the framework helps regions build and sustain resilience that is adaptable to evolving risks. Emphasising NbS and incorporating socio-ecological systems and ecosystem services dynamics, the framework supports comprehensive resilience planning, providing regions with a cohesive pathway to operationalise resilience strategies and prepare for climate uncertainties. This approach is applied across diverse regional landscapes - including Marine & Coastal, Urban, and Rural areas - within the Atlantic Biogeographical Region. NBRACER works directly with Demonstrating regions, serving as living laboratories for innovation, and Replicating regions, which test and adapt solutions for transferability. Regional pathways are rooted in participatory processes, while technical assessments - such as Climate Risk Impact Chains (CRICs), ecosystem service mapping, and multi-hazard risk profiling - help shape tailored NbS packages that respond to specific risks and local assets.

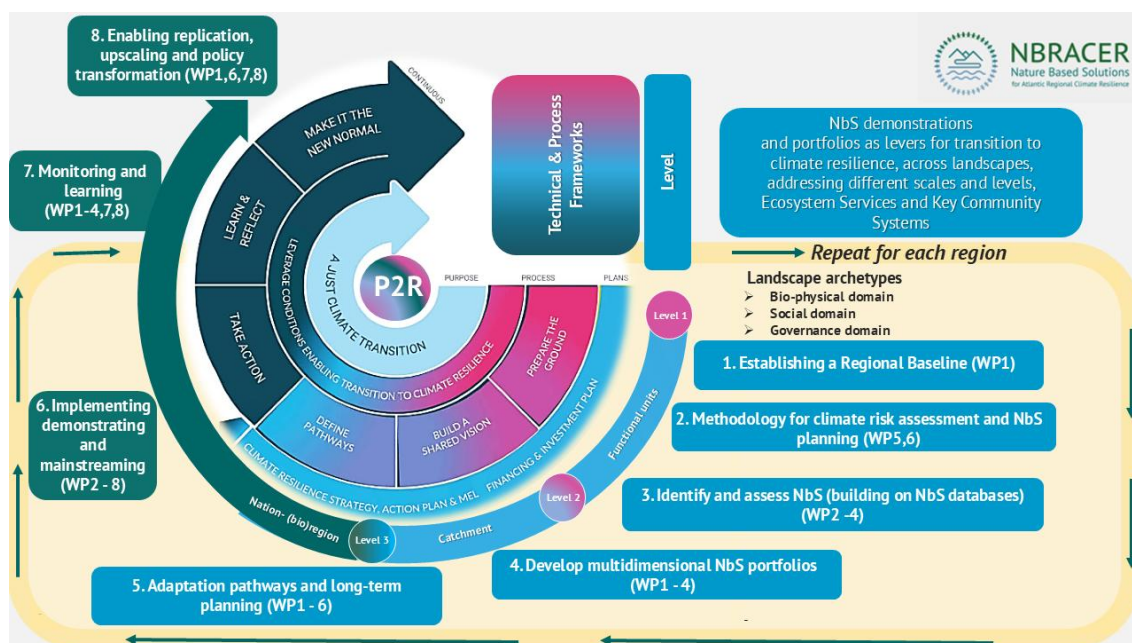


Figure 1: Overview of the NBRACER Approach with 8 steps, elaborating an iterative process for achieving a just climate transition through multi-level, multi-scale and multi-domain planning

The present deliverable is deeply embedded within this NBRACER approach. By introducing a structured Monitoring Journey and a methodology for defining KPIs, this guide supports regions

in operationalising the monitoring and evaluation pillar of the NBRACER approach. It complements the outlined strategic planning phases by providing tools for assessing the effectiveness of NbS interventions and generating evidence to inform adaptive management and future decision-making.

This Monitoring Journey Guide builds directly on the iterative and participatory principles of NBRACER, offering a practical pathway for regions to track progress, learn from implementation, and refine their strategies. It aligns with the project's ambition to foster transformation through locally tailored, scalable NbS packages and contributes to the broader goals of the MACC. By enabling regions to monitor outcomes and impacts systematically, the deliverable strengthens the foundation for replication, upscaling, and cross-regional learning—key elements of NBRACER's vision for accelerating climate adaptation across Europe.

2 Contextualising Monitoring

In general terms, monitoring is a systemic process to collect evidence and analyse and use it to report and inform generally about the performance, impact and progress of projects, programmes or policy. Monitoring is key for understanding the level of success with respect to a specific established goal.

There exist multiple methods for monitoring climate resilience in general, and measures and adaptation solutions in particular. In NBRACER, the NbS are the focus of the monitoring, and the considered methodology is indicator-based. Following that description, this report is aimed at presenting a **Monitoring Journey with Key Performance Indicators (KPIs)** (defined, including key environmental components and relationships) that could be used at different stages of the design and implementation of NbS.

Assessing NbS performance is crucial for mainstreaming NbS into regulations, norms, and plans (ETC/CCA, 2021). The resulting monitoring, evaluation and learning data can inform the development of policies aiming to mainstream NbS in land management and urban development (EEA, 2023). For gathering evidence about the effectiveness of NbS, a commonly used method is through the evaluation of changes through measurements of KPIs.

2.1 NBRACER NbS Monitoring Journey in the context of Regional Resilience Journey

The **Regional Resilience Journey (RRJ)** is a systemic, transformative framework designed to help regions transition to climate resilience in a just, equitable, and sustainable manner. It goes beyond incremental adaptation by fostering systemic shifts that address the root causes of climate vulnerabilities, integrating principles of justice, innovation, and collaboration. The framework guides regions through a structured planning process—spanning three core phases: preparing the groundwork (establishing baselines, understanding systems, and assessing risks), building a shared vision of a climate-resilient future, and designing actionable adaptation pathways (Figure 2). By combining stakeholder engagement, multi-level governance, and cross-sectoral collaboration, it ensures that strategies and action plans are inclusive, participatory, and aligned with long-term goals. The journey emphasises iterative learning, recognising that climate resilience is not a linear process but one that evolves through continuous refinement and adaptation to new insights and challenges.

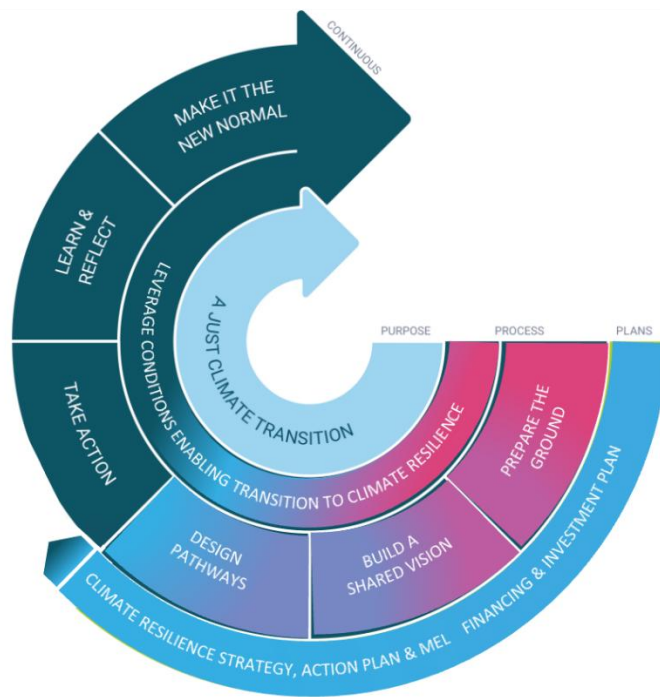


Figure 2: Regional Resilience Journey (Source: P2R)

Central to the RRJ is its focus on **transformational adaptation**, which prioritises systemic change over isolated interventions. It encourages regions to adopt a portfolio approach, integrating diverse levers of change—such as policy, finance, technology, and community engagement—to create synergies and drive lasting societal transformation. The framework also aligns with the EU’s climate resilience goals of the Mission on Adaptation to Climate Change (MACC), supporting 150 regions to achieve climate resilience by 2030 and broader global targets by 2050. By embedding principles of **just transition**, it ensures fair distribution of burdens and benefits, prioritising vulnerable populations and fostering inclusive governance. Complemented by the **Adaptation Investment Cycle**, the journey provides a roadmap for mobilising financial resources and scaling impactful projects, ensuring that climate resilience strategies are both visionary and actionable. Ultimately, it empowers regions to navigate the complexities of climate change through a holistic, forward-looking approach that balances immediate needs with long-term sustainability.

The RRJ does not guide on the implementation of action plans or solutions, nor on the monitoring of the climate resilience strategy or plan, but acknowledges its importance. Monitoring is a fundamental process that plays a crucial role in guiding and supporting resilience-building and adaptation efforts. At its core, monitoring involves systematically tracking and evaluating various aspects of a project or process—such as context, risks, capacities, solution performance, and learning outcomes. Rather than functioning as a standalone activity, monitoring is often embedded throughout different phases of a transformation journey toward resilience. It serves not only to measure progress but also to inform decision-making, identify areas for improvement, and ensure that strategies remain relevant and effective in changing circumstances.

The NBRACER Monitoring Journey is a structured approach designed to support climate adaptation by strengthening the monitoring and evaluation pillar aligned with RRJ but focused

on NbS performance. It aims to assist regions in developing NbS effectiveness monitoring strategy¹ and plan². The NbS implementation and, thus, NBRACER Monitoring Journey may be informed by the baseline and the vision formulation, which can originate from the RRJ. This vision can be refined for the implementation of NbS which would be integrated into the resilience strategy portfolio. Additionally, stakeholder engagement procedures and protocols may also be derived or aligned with the RRJ.

Both frameworks serve different but complementary purposes:

P2R Regional Resilience Journey

- Focuses on developing a strategy for long-term climate resilience at the regional scale, i.e. it focuses on the first three phases of the RRJ.
- Supports transformative planning, including selecting suitable adaptation pathways and options, which can be NbS.

NBRACER Monitoring Journey

- Focuses on monitoring the effectiveness of NbS interventions at multiple stages, i.e. building from the strategic planning, it focuses on acting and supporting the learning.
- Ensures evidence-based learning from NbS implementation.

Thus, the NBRACER Monitoring Journey is designed to provide a structured methodology for systematically evaluating the effectiveness of NbS. This process involves the definition of KPIs and the assessment of their impact, enabling a comprehensive understanding of outcomes and informing iterative improvements and upscaling in NbS implementation. It is worth mentioning that some steps of this journey can be addressed not only to individual NbS, but also to NbS portfolios as such, understood as a collection of NbS with diverse goals, challenges, or geographical contexts.

2.2 Monitoring liaisons with NBRACER Conceptual Framework

Monitoring the Effectiveness of NbS is designed as a multi-phase process that allows for both ex-ante and ex-post evaluation of NbS interventions, supported by a Regional Monitoring Team (RMT). This enables the performance of different solutions, analysed through the measurement of specific KPIs, to be compared with pre-monitoring scenarios. Various resources can be utilised for proper measurement of the selected indicators, such as sensors, multi-criteria analysis,

¹ It provides the overarching approach and rationale for monitoring activities. It outlines the goals, objectives, and key performance indicators (KPIs) that will be used to measure success. It focuses on the "why" and "what" of monitoring

² It details the specific procedures and methods for carrying out the monitoring activities. It is more detailed and operational, focusing on the "how," "when," and "who" of monitoring. It specifies the data collection methods, timelines and responsibilities.

modelling tools, community-based monitoring, and participatory approaches like group-based deliberative valuation.

NbS interventions **support climate resilience** by enhancing absorptive, adaptive, transformative, and response/recovery capacities. An NbS that is proposed to contribute to climate resilience should aim to reduce climate change impacts. In this case, they should focus on addressing a primary hazard, designed to mitigate a specific risk, while also contributing to the mitigation of additional risks. Therefore, **climate risk and vulnerability scenarios for decision making** (T.5.2) – considering its three components: hazard, exposure, and vulnerability—should support the proposal of NbS.

The impacts to be generated by the NbS, as well as the expected co-benefits, should **support the provision of certain ES**. Characterising and modelling the biodiversity and these ES (T5.3) generates a valuable input to guide decisions regarding the demand for NbS, the definition of types of NbS to be implemented, the co-design of solutions and development of an integrated portfolio of solutions, the identification of means to integrate and mainstream NbS into planning instruments, and the level of contribution to minimizing climate impacts. These models also help identify the potential for NbS to enhance resilience capacities over time (and space) by simulating their performance under different climate stress scenarios.

The Monitoring Journey aims to lead to a robust impact assessment, which in turn helps understand the effectiveness of the implemented solution in generating the expected impact. Throughout this process, valuable **learnings can be gathered from the challenges and enablers encountered** (T2.2/T3.2/T4.2). This includes insight into how specific interventions support or hinder different resilience capacities, helping refine future design and implementation strategies.

After implementation, monitoring, evaluation of impacts, and reflections on learnings, **alternatives for replicating and/or upscaling an NbS** can be considered based on the level of success and analysis of enabling factors and barriers (T2.3/T3.3/T4.3). Quantitative data and qualitative findings from previous stages help identify these enablers and barriers (e.g., regulatory, economic, social, and technical) that contribute to effective NbS implementation and deployment. Lessons from the monitoring process will also inform the strategic replication of successful solutions across scales, particularly by identifying which resilience capacities were strengthened and how.

Depending on the scale of the solution implemented, the direct impacts generated and level of success, it can contribute to climate resilience either by itself or through the practical implementation of a robust upscaling and replicating plan. In the case of NBRACER regions, the solutions to be monitored are mainly spot-based and very locally implemented, so the contributions to regional resilience could be known just after developing integrated portfolios (across landscapes) in combination with a proper replicating and upscaling plan. Transferability of knowledge may also be part of this process, with **replicating successful lessons and learning extending beyond regional boundaries** (WP7, Replicating Regions). The monitoring framework will also support **cross-regional learning and feedback loops** (T1.4), helping align local NbS interventions with larger-scale adaptive resilience strategies and regional transformation pathways.

Besides, monitoring should occur at both the level of the NbS (e.g., ecological or social outcomes) and the institutional level (e.g., shifts in governance or collaboration), since it plays a vital role in maintaining momentum, especially when transformation feels daunting due to systemic complexity and uncertainty. Small, manageable steps can gradually build toward significant change—boosting confidence, reducing resistance, and **strengthening the overall transformation process** (WP6, Accelerating transformation).

2.3 Monitoring the effectiveness of the NbS

Monitoring the effectiveness of the NbS is the mayor goal of this task (T5.4), and the overall content of this document. This deliverable is developed as a guide for defining the Monitoring Strategy, going beyond the definition of the KPIs itself, as initially proposed. **The Monitoring Journey presented consists of eight steps which are suggested to be followed by any region that plans to assess the impacts of the implementation of an NbS.**

It is important to note that the content presented is not the only and absolute methodology to monitor the effectiveness of the NbS, but it is meant to be a compilation of experience in an easy-to-read material that could be useful for NBRACER regions to go through their journey. The use of an appropriate language, inclusion of visuals and references and practical examples aims to facilitate the understanding and use of this manual by both demonstrating and replicating regions in NBRACER, but also by other regions beyond the project timeline.

3 NBRACER Monitoring Journey

3.1 General considerations

This report aims to present a **methodology to support the definition of NbS impact monitoring**. These KPIs are defined to include key environmental, social, and economic impacts and their interrelationships, and are intended to be applied at various stages of the design and implementation of NbS. The goal is to assess the extent to which the intended objectives of the NbS are being achieved, thereby evaluating their effectiveness.

To ensure the effective monitoring and evaluation of NbS, several key aspects must be considered. These include the selection of appropriate indicators, the implementation of adaptive management practices, the potential for upscaling, and the long-term utility of the monitoring framework.

- The **selection of KPIs will vary from case to case**—even among similar solutions. Therefore, it is essential to make a conscious and coherent selection of KPIs for each case, based on a predefined reference set.
- An **adaptive management cycle**, supported by feedback mechanisms, will promote continuous improvement and adaptability in each region through the practical implementation of regional monitoring strategies (Tasks 2.2, 3.2, 4.2), where NBRACER regions will monitor the solutions in practice, guided by the framework steps and tailored to their specific needs.
- It is important to emphasise the **role of upscaling and replication** in contributing to climate resilience at the regional level and reducing regional risks. These efforts depend on factors such as scale and the success of implementation.
- This guide is intended to remain **useful beyond the duration of the project**. It should serve as an ongoing reference for conducting monitoring activities at any time.

This Monitoring Journey Guide for Regions will contribute to supporting the Regions in monitoring the effectiveness of their implemented NbS and evaluating the impacts they generate. This can directly, or indirectly through upscaling, help maximise their climate resilience and contribute to the MACC in achieving its goals.

3.2 Design of the Monitoring Journey

Based on existing Monitoring Frameworks, the wide experience on monitoring the effectiveness of solutions in EU projects such as CLEVER Cities, GrowGreen, Regions4Climate, and TECNALIA developed this guide to support regions to go through a Monitoring Journey. Although the guide is meant to be useful for any region wanting to perform an impact assessment, it presents suggested steps to create a monitoring narrative that better adjusts to the needs of the NBRACER regions.

While other frameworks and approaches exist, the steps presented in this guide have been selected based on their grounding in established methodologies, as well as their feasibility and ease of implementation. As mentioned above, this is supported by experiences raised over the

last few years shared in the NbS EU arena with EU-funded projects, as well as other cross-cutting initiatives such as P2R discussions, NetworkNature Taskforces activities, and the Thematic Working Group on monitoring of the MIP4Adapt.

While a **Monitoring Strategy** provides an overarching approach and rationale for monitoring activities, outlining goals, objectives, and KPIs that will be used to measure success ("why" and "what"), a **Monitoring Plan** details the specific procedures and methods for carrying out the monitoring activities, with a more detailed and operational focus ("how," "when," and "who"). It specifies the data collection methods, timelines and responsibilities.

This **Guide is meant to support the definition of both the Monitoring Strategy and Plan**, built upon eight concrete steps. However, different actions may require varying resources (effort, expertise, budget, and responsible parties), and the successful completion of each step depends on the region's expertise, budget, and time availability within the NBRACER context. Figure 3 shows the steps to be followed to build a coherent and robust *Monitoring Framework*, which are extended and detailed throughout this chapter.

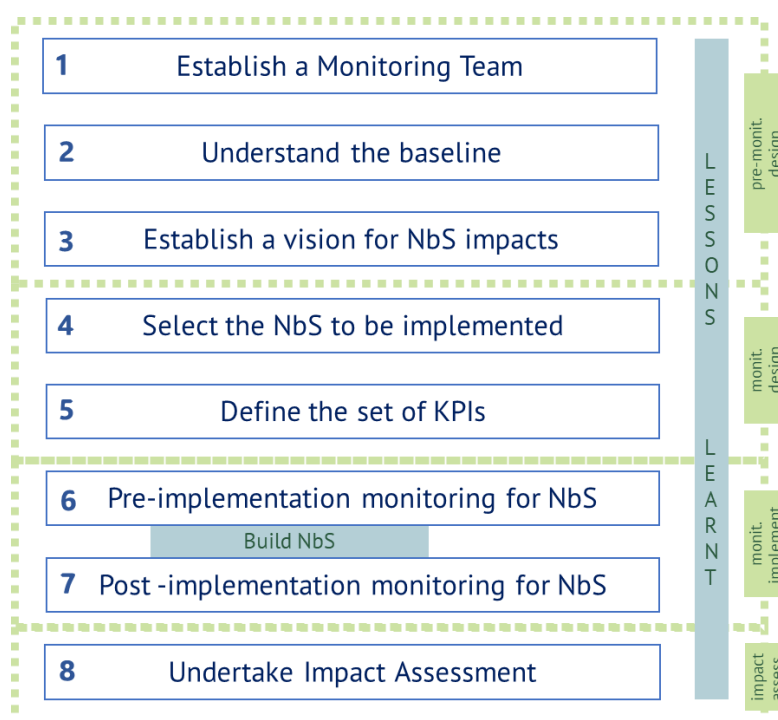


Figure 3: Steps of NBRACER Monitoring Journey

Monitoring the NbS and proving their effectiveness is key to mainstreaming them as a fundamental climate adaptation solution. In a holistic perspective, successful NbS will be implemented, replicated and scaled, and be considered a central contribution for increasing the resilience to climate change in regions.

Before going through the steps, it is important to note that, even though steps 2 to 4 are not monitoring *per se*, they are needed to set a monitoring plan, since both the baseline (step 2) and the vision for impacts (step 3) should inform the selection of the NbS (step 4) to ensure coherence.

NBRACER CONTEXT

The Monitoring Journey developed is aligned with the RRI (Session 2.1) and coherent with the iterative process for achieving a just climate transition through multi-level, multi-scale and multi-domain planning as defined in the NBRACER approach (Chapter 1). Monitoring is embedded at multiple stages of this approach and informs them in various ways through the outcomes and impacts generated. In this context, cross-references between both approaches are expected and beneficial, though they do not necessarily occur in a one-to-one or linear manner. These complex interconnections reflect the richness and complementarity of the two underlying processes.

The Monitoring Journey developed is aligned with the RRI (session 2.1) and is coherent with the iterative process for achieving a just climate transition through multi-level, multi-scale and multi-domain planning defined in the NBRACER approach (chapter 1). Monitoring is present at multiple stages of this approach, which will be informed in different ways by the outcomes and impacts generated. In this sense, cross-references linking both approaches are expected and positive, and happen not necessarily in a one-to-one or linear. This complex link reflects the richness and complementarity of the underlying processes.

In NBRACER, given the nature of HEU projects, where demonstrators are already defined from the proposal stage (and refined in T2.1/T3.1/T4.1), regions embark on the monitoring journey in Step 5. The regions already have some NbS identified for monitoring along the timeline of the project, so the previous steps are not strictly followed for the specific solutions selected (although here we start from the assumption that the regions have gone through all the steps before joining the NBRACER project).

Steps 1 to 5 are the Monitoring Strategy per se, committed in NBRACER through T2.2/T3.2/T4.2, from which Lessons Learnt will be gathered and shared by the end of the project. Those 5 theoretical steps will be developed indistinctively for the three landscapes considered – marine/coastal, urban, and rural. The reflection and interpretation focused on each of those three landscapes will be done (i) during step 5, (ii) with respect to the lessons learnt collected, and (iii) beyond, and will be useful inputs for upscaling and replicating strategies.



3.3 STEP 1: Establish a Regional Monitoring Team

OBJECTIVES OF STEP 1

- *Set a Regional Monitoring Team (RMT), considering the local expertise*
- *Define roles and responsibilities within the monitoring team*
- *Enhance accountability*
- *Facilitate continuous communication and improvement*
- *Facilitate resource allocation in future steps*

A well-structured monitoring team is one of the foundational pieces of monitoring and NbS impact assessment. This guarantees the successful definition and further implementation of a monitoring strategy. It is necessary that the involved team has an overarching perspective and is aware of all the steps of the process, and co-defines the specific challenges, expertise, and methodology to be followed. For that, the first step of the process is *Establishing a Regional Monitoring Team (RMT)* to **follow the progress and deploy the monitoring journey**.

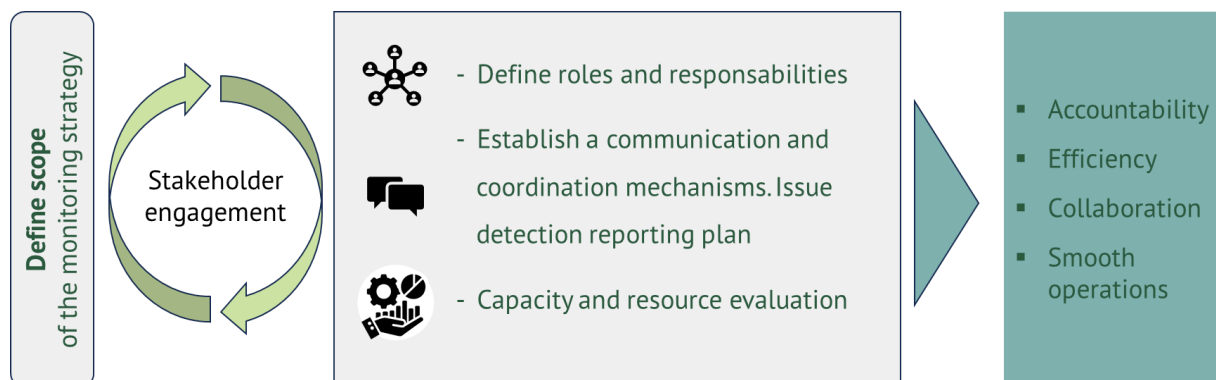


Figure 4: Main components and outcomes in Step 1: Establish a monitoring team.

As visualised in Figure 4, once the scope of the monitoring strategy has been established, the monitoring team leader, driving the monitoring process, needs to identify and engage the necessary stakeholders to develop and implement the monitoring strategy. This is often the case, as NbS impact evaluation may require different expertise and monitoring methods. Note that stakeholder engagement is not confined to this step in the monitoring journey—it is a continuous and critical element that contributes to the effectiveness and legitimacy of NbS monitoring. Ideally, the leader should have enough expertise and capacity to ensure optimal and coherent engagement and input from the RMT. For this, it is essential to establish appropriate communication and coordination mechanisms to identify any issues that may arise from the monitoring journey and set any improvements towards the successful achievement of the goals of the monitoring strategy.

The learnings to be gathered along the monitoring journey will allow the RMT to implement corrective actions before they escalate, minimising negative impact on the timeline, budget or overall project success.

After defining who takes part in the RMT, both the roles (e.g. indicator identification, data storage, establishment of communication channels, promoting measurement campaigns, etc.) and responsibilities of each stakeholder need to be established to streamline the workflow. This enhances the accountability for the team's contributions, promoting a culture of ownership and responsibility.

For this task, it is relevant on the one hand to set agreed working procedures and assess the capacities and resources of the monitoring team. Any inconsistency between the responsibility and capacities, and resources, will lead to potential risks; thus, it is important to secure the necessary resources before monitoring so as to enable the RMT to perform their duties effectively.

The Box below shows a list of **suggested items to be considered by the regions to successfully establish a Regional Monitoring Team (RMT).**

S U C C E S S C H E C K L I S T
1. Define the Scope of the Monitoring Strategy ☐ Outline the initial scope, monitoring strategy boundaries and expected outcomes of the monitoring strategy (to be updated along the monitoring journey).
2. Appoint a Monitoring Team Leader ☐ Select a leader with sufficient expertise and capacity to drive the monitoring process Ensure the leader can effectively engage stakeholders and facilitate collaboration.
3. Identify and Engage Key Stakeholders ☐ Identify the key challenges and expertise required for NbS impact assessment. ☐ Identify the necessary stakeholders, including technical experts, policymakers, and community representatives. ☐ Engage stakeholders based on their expertise and role in the monitoring process. ☐ Develop strategies to ensure effective participation and collaboration.
4. Define Roles and Responsibilities ☐ Assign clear roles to team members. ☐ Ensure alignment between responsibilities and available capacities/resources. ☐ Establish working procedures to streamline workflow and prevent inconsistencies. ☐ Ensure the team has an overarching perspective on the entire monitoring process.
5. Set Up Communication and Coordination Mechanisms ☐ Define communication channels for internal coordination and external reporting. ☐ Implement regular meetings and reporting structures to track progress. ☐ Establish mechanisms to identify issues and set continuous improvements.
6. Monitor Progress and Document Learnings ☐ Identify and address any issues that arise during the monitoring process. ☐ Document key insights and best practices to enhance future monitoring efforts.



NBRACER CONTEXT

*In NBRACER, the **Regional Monitoring Teams** for the eight regions – five demonstrators and three replicators – were established during the first six months of the project. In most cases, they coincide with the Regional Coordinators of the regions. In some cases, technical partners were assigned as part of the RMT; in others, specific members were included as supporters for the monitoring tasks. The expertise of the RMT in different regions results in heterogeneity, which is common in this kind of project. They are assigned as indicated below:*

- **Cantabria:** FIHAC, Cantabria University, Santander Municipality
- **West Flanders:** Province West Flanders, VITO, Inagro
- **Nouvelle-Aquitaine:** Nouvelle-Aquitaine Region, Marais Poitevin Regional Natural Park, SMEAG
- **Porto:** Porto municipality
- **Central Denmark:** Klimatorium, Aalborg University
- **East Flanders:** VLM, VITO
- **CIM Cávado:** CIM Cávado, Universidad de Lisboa
- **Fryslân:** Fryslân Province

3.4 STEP 2: Understand the Baseline

OBJECTIVES OF STEP 2

- *Define the baseline conditions: scope and scale*
- *Collect and analyse current environmental, social, and economic conditions*
- *Identify data and capacity gaps that could hinder effective monitoring and evaluation*
- *Identify resource sources to build a monitoring strategy*

Establishing a baseline for evaluating the impact of NbS requires a comprehensive approach that considers local context. But first, the initial scope and scale of the NbS impact evaluation need to be in place. Thus, the baseline begins with **defining the problem framing, including climate risks** (refined along the delivery of the steps), **and the expected effects to be addressed by NbS** to ensure that the solutions align with local conditions and requirements.

An important step of any baseline is to survey what reports and analyses already exist for the region. Reviewing such documents, particularly pre-existing baselines, helps to provide perspective on where knowledge gaps exist and what additional specific information is required. Stakeholder engagement can be a central component of the scope and problem framing as it involves understanding the needs and expectations of different institutional departments, social groups or cross-sectoral stakeholders. This will help ensure that NbS can deliver benefits equitably across these groups.

There are various methods for framing a problem and setting the scope for NbS deployment. This guide introduces the Pentagonal Problem (Figure 5) as an example of a tool that helps break down the issue into its key components while establishing a shared understanding for future actions. This approach is particularly useful for addressing complex, multi-faceted challenges—such as climate change—that require consideration from multiple perspectives.



Figure 5: Visual template to Pentagonal Framing resources³

Once there is an initial understanding of the problem to be addressed and what NbS are sought for, the **relevant contextual existing information needs to be collected/compiled**. This includes assessing the socio-economic, environmental and policy conditions that may influence the NbS implementation and performance. It is key to gather knowledge in NbS deployment – not only good practices, but also failures, derived from previous experiences. In this baseline analysis of the information (as well as later in the process), it is desirable to include a cause-and-effect analysis for attributing observed or expected changes to the implementation of specific NbS versus other external factors. It means establishing a framework that maps out all potential cause-and-effect relationships and identifies which factors can be directly influenced by NbS interventions and which are beyond control (e.g., economic trends, policy shifts). A comprehensive understanding of these factors might help select solutions that are well-suited to the specific context.

This template (Table 1) outlines potential types of information that may be required to establish a baseline for NbS impact assessment. The specific data needed will depend on, among others, the scope and scale of the project.

Table 1: Example of information that may be included in the baseline analysis

Baseline information for NbS definition and impact assessment	
Type of information	Example of information
Climate and environmental conditions	- Climate historical data - Extreme events monitoring (heat waves, floods, droughts, storms...) - Climate projections (global and regional models) - Local and indigenous knowledge on climate patterns - Climate risk assessment - Environmental quality information: air pollution, noise and other potential data related to the environmental benefits of NbS - Community-based climate knowledge

³ <https://www.youtube.com/watch?v=3r15POXHgkA>; Pentagonal Problem | Virtual Hackathons

Ecosystem assessment and natural hazards	• Current land use and ecosystem conditions • Ecosystem connectivity assessment • Biodiversity assessments (species distribution, habitat quality) • Water and soil systems and quality • Hydrological studies (river flows, groundwater recharge, coastal dynamics)
Future Climate Change Impacts and Vulnerabilities	• Climate risk and vulnerability assessments at regional and sectoral levels • Research reports on expected ecosystem shifts and biodiversity changes • Local expert consultations and participatory assessments
Socio-Economic Future Projections	• Demographic and economic projections • Land use and spatial planning scenarios • Market and policy shifts affecting nature-based solutions • Urbanization and infrastructure development trends • Cultural and governance aspects influencing NbS implementation
Relevant Strategies, Policies, and Plans	• Adaptation and mitigation strategies and policies • Biodiversity conservation strategies • Water and resource management plans • Sustainable urban planning and ecosystem restoration policies • Disaster risk reduction and climate resilience frameworks
Resources and capacity	• Human, technological, financial, institutional resources • Technical, organizational, institutional capacities
Participatory governance frameworks	• Multi-stakeholder platforms • Stakeholder mapping and engagement strategy • Case studies of community-led NbS initiatives

Identifying data availability and capacity that allow effective selection, implementation, and monitoring and evaluation of NbS involves a comprehensive assessment of the previous information. An early identification of potential gaps regarding data (missing or insufficient data, inconsistent or incompatible data collection methods) and capacity (lack of technical expertise, monitoring skills, institutional coordination, or financial resources), and definition of overcoming strategies, is important to ensure overcoming actions are taken timely.

Addressing these gaps may require **establishing standardized data collection methods, enhancing technical and organizational capacities through training, ensuring adequate funding, and fostering collaboration with experts**. It may be the case that part of the baseline data is available at a spatial or graphical resolution that does not match the scale of the NbS intervention. This often necessitates the use of **assumptions and proxies to better understand the local context and design the intervention** in a way that realistically addresses impacts and delivers expected benefits. Strengthening monitoring systems and creating data-sharing platforms are essential for effective NbS impact evaluation and ensuring long-term success.

A baseline report should be developed comprising all this information, and should serve as foundation for impact evaluation, providing a structured reference-point to compare future changes, understand what resources and enabling conditions may be needed, and to identify and set a stakeholders' engagement while setting expectations. The baseline could take different formats such as reports, storytelling, interactive dashboards, and/or executive summaries,

ensuring stakeholders can easily access and apply the information for decision-making, planning and resource allocation.

The Box below shows a list of **suggested items to be considered by the regions to guarantee the baseline is correctly understood.**

SUCCESS CHECKLIST

1. Define the scope, scale, and problem framing

- ☐ Identify the geographical, temporal, and thematic boundaries of the baseline.
- ☐ Frame the context and initial problem that the NbS could potentially address.
- ☐ Ensure alignment with local climate risks, adaptation pathways, and resilience needs.
- ☐ Engage stakeholders to define and later refine the problem framing and validate key concerns.

2. Collect and analyse contextual Information

- ☐ Gather existing environmental, socio-economic, and policy data related to NbS.
- ☐ Analyse past NbS experiences, including successes and failures, for lessons learned.
- ☐ Distinguish between direct impacts (attributable to NbS) and external influencing factors to address the problem.
- ☐ Assess the availability, consistency, and quality of relevant data.
- ☐ Identify missing or insufficient data for contextualizing the problem and evaluating NbS impacts.
- ☐ Evaluate gaps in technical expertise, institutional capacity, and financial resources for monitoring.
- ☐ Develop strategies to address data and capacity limitations

3. Develop and share the baseline report

- ☐ Organize baseline findings into a structured report, ensuring clarity for stakeholders.
- ☐ Choose an appropriate format (e.g., reports, dashboards, spatial maps, executive summaries, or storytelling).
- ☐ Share the baseline with relevant stakeholders to establish a shared understanding for future steps.

NBRACER CONTEXT

In NBRACER, the problem framing may come from the regional resilience journey and is meant to be aligned with the climate risks and adaptation pathways represented. Regional workshops were held in the project to understand the main priorities of stakeholders within the region through a visioning exercise. The main outcomes from these exercises were vision statements.

The NBRACER regional baseline compiled in a document (D1.1), aimed to get a joint understanding among stakeholders of natural and social systems, where data and information about the natural, socio-economic and governance systems that are forming unique characteristics of the region, enhancing or affecting its regional resilience are collected. Individual baselines for each region are also presented. The baselines are a general overview of the region however and it may be necessary to add additional context dependent on the focus of the NbS impacts and context being considered.

Another task of the project is framing the demonstrations across landscapes, which identifies each regional NbS to be demonstrated and tested in NBRACER (T1.2). This also provides an overview on the potential solutions that may be part of their adaptation pathways, and which will partially contribute to improving the regional resilience.

However, some NBRACER Regions had selected the NbS before a full problem framing or system understanding was in place. While this is not the ideal approach, the monitoring strategy can still play a critical role in identifying gaps in understanding and guiding further analysis. In such cases, the monitoring process can be used iteratively to refine the problem framing and ensure the selected NbS is aligned with local needs and expected outcomes.



3.5 STEP 3: Establish a vision for NbS impacts

OBJECTIVES OF STEP 3

- Define the challenges and impacts that the NbS or NbS portfolio should address and achieve.
- Craft a vision statement that can guide the selection and implementation of NbS, aligning with the region's priorities and challenges.

Developing a clear and compelling vision is essential for regions aiming to implement NbS effectively. A well-articulated vision provides direction, inspires stakeholders, and serves as a foundation for strategic planning and action of the impacts the region expects to produce because of the NbS's implementation.

In cases where relevant regional visions already exist, they should be reviewed and used as a foundation to ensure alignment and avoid confusion or redundancy. When broader visions are in place, the focus should be on how the potential impacts of the portfolio of NbS can contribute to and complement these overarching visions.

Various methods and tools are available to help define the vision for NbS impacts in the context of the climate risks identified in Step 2. Despite their different formats, they generally follow similar steps or components (Figure 6).

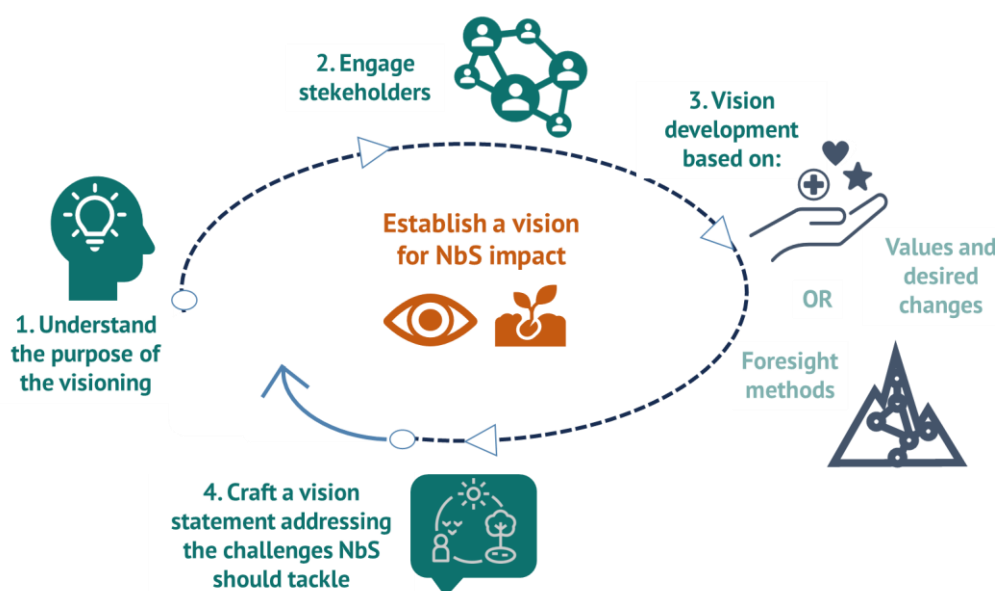


Figure 6: Main components of Step 3 to establish a shared vision for NbS impact.

1. Understand the purpose of visioning⁴: Visioning a shared desired future can help regions to plant the seeds for a roadmap that guides the implementation of NbS initiatives. This strategic process enables regions to (1) explore scenarios around the benefits of the NbS (aligned with the prioritized climatic and non-climatic challenges identified in step 2), (2) identify and describe a preferred future state that reflects the aspirational outcomes to achieve through the future NbS implementation, (3) inform decision-making and policy development, and (4) align stakeholders around common goals.

2. Engage stakeholders in the visioning process: Like in many other processes, inclusive participation is important for developing a vision that reflects the desires and needs of the community in the scope of new NbS implementation. Engage relevant stakeholders through workshops and/or, surveys, and public forums to gather insights and foster a sense of ownership and shared responsibility.

There are different ways to approach vision development (step 3), depending on the region's context, capacity, and priorities. Some regions may choose to explore possible future scenarios using foresight methods to guide the vision (3a), while others may prioritize defining core values and desired changes as a more direct and values-based approach (3b). These methods can be used independently or in combination, though starting with one approach is often recommended to avoid unnecessary complexity and ensure clarity in the visioning process.

3a. Utilise foresight methods: Employing foresight methods can help regions anticipate future challenges and opportunities related to NbS. Before starting with the task, the groups must clarify the topics to focus their vision, and which findings from the previous steps should be included in their vision for the NbS implementation. Techniques (e.g., scenario planning) considering key climate and non-climate drivers' trajectories, trend analysis, and back-casting enable stakeholders to explore different futures and identify strategic actions to achieve the desired vision (Figure 7). These methods facilitate proactive planning and resilience building.

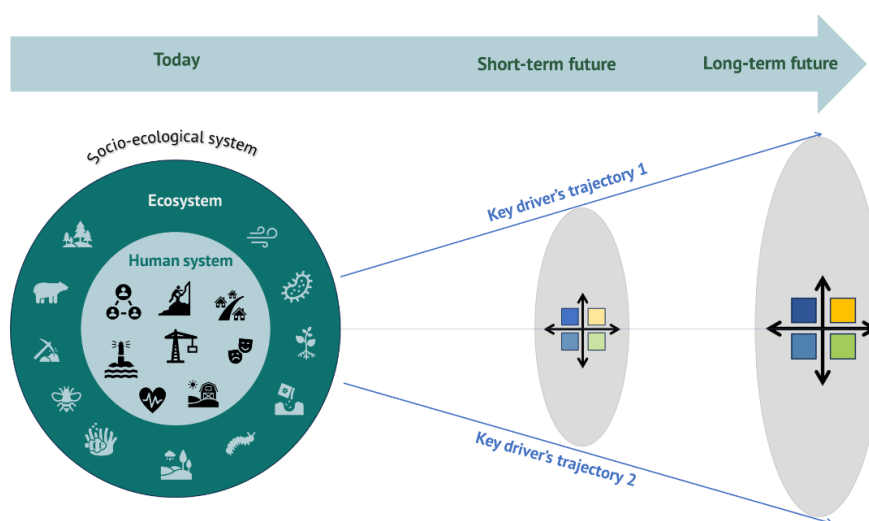


Figure 7: Conceptual representation of a foresight work representation based on scenario planning.

⁴ If a previous overarching vision has been developed, it is advisable for the regions to use it as a foundation and build a more concrete vision for the NbS

3b. Define core values and desired changes: Establishing core values and principles ensures that the vision for NbS impact aligns with the region's cultural, social, and environmental context. They should consider values such as sustainability, inclusivity, resilience, and innovation to guide the development and implementation of NbS initiatives (Figure 8).

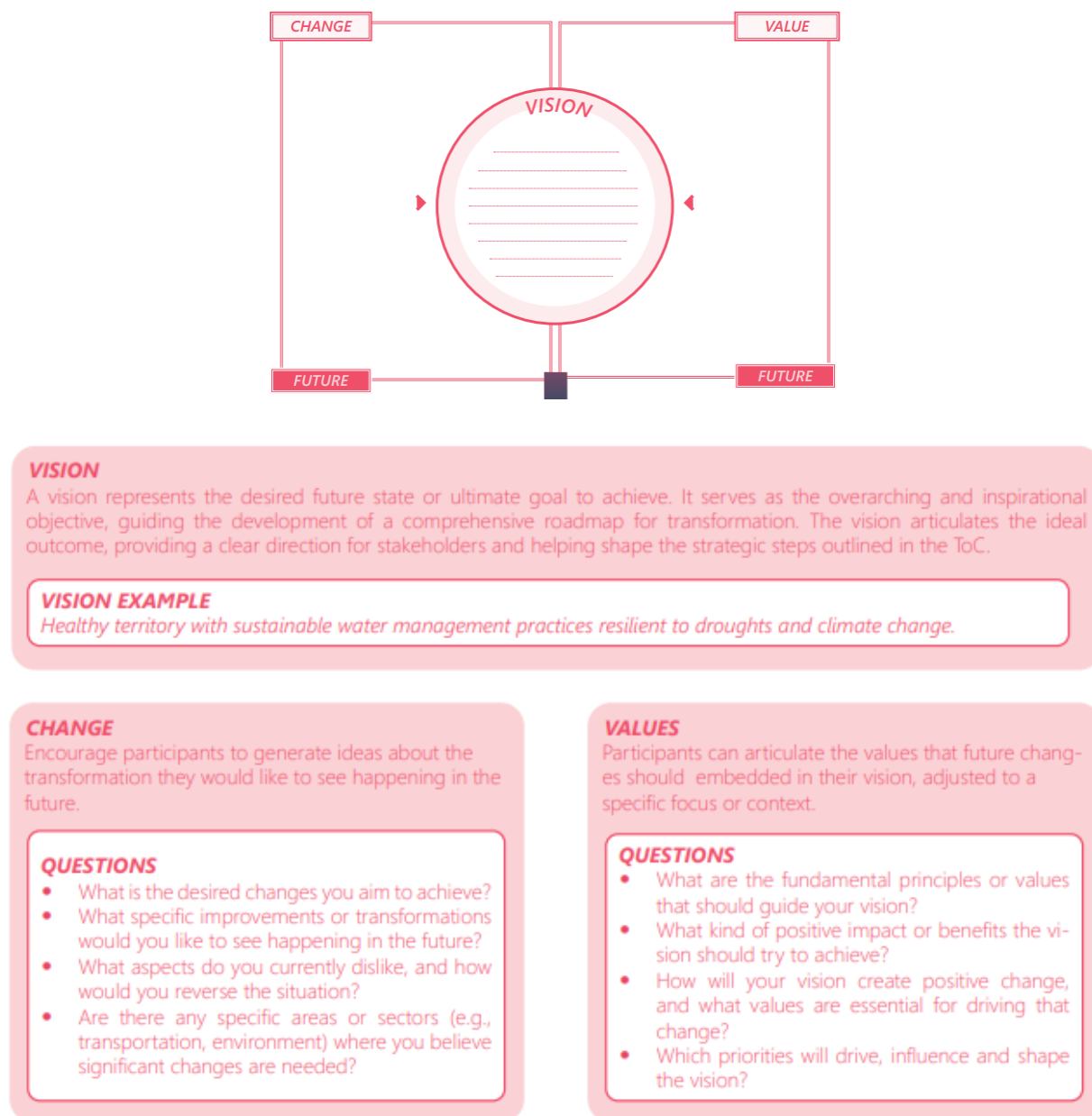


Figure 8: Examples of guiding questions to establish a vision based on the desired change and the values that should be embedded in the future vision (developed by TECNALIA).

4. Craft a vision statement addressing the challenges NbS should tackle: Develop a concise and compelling vision statement that encapsulates the region's aspirations for NbS impact. Ideally, the statement should be *aspirational* (reflecting the desired future state), *clear and concrete* (easily understood, avoiding misunderstandings and vagueness) and *inspirational* (motivating stakeholders to be involved).

For example, a vision statement could be: *"A region where nature-based solutions reduce flood risks, restore and connect natural ecosystems, and foster community well-being"* – reflecting the aspirations of a region aiming to address its challenges, such as flooding, fragmented green spaces, and few accessible natural areas for recreation and connection with nature. Further description of the expected impacts and co-benefits can accompany the vision for further clarity.

The Box below shows a list of **suggested items to be considered by the regions to establish a vision for NbS impacts**.

SUCCESS CHECKLIST

1. Communicate the purpose of visioning

- ☐ Review key findings from the previous assessment steps to inform the vision, including the main challenges the region aims to address through NbS.
- ☐ Clarify the use of a vision and what is expected to be achieved.

2. Engage stakeholders in the visioning process

- ☐ Identify and invite relevant stakeholders.
- ☐ Collect stakeholder inputs on priorities, needs and expectations through inclusive methods, ensuring their involvement for stakeholders unable to attend in person.

3. Develop a vision

- ☐ Define the methodology to develop a vision.
- ☐ Develop the vision with stakeholders to ensure its ownership and validity.
- ☐ Draft a vision statement that reflects the desired future state, considering the NbS and key drivers (e.g. climate change, land use changes). Include a reference to the key impacts and co-benefits expected from the NbS.
- ☐ Optionally, accompany the statement with a longer narrative or visualisations to expand on the impacts envisioned.



NBRACER CONTEXT

In NBRACER, a visioning exercise was held during some of the first Regional Workshops organised by WP1. West Flanders, Central Denmark (example included below), and Nouvelle-Aquitaine worked through a process of defining a vision for 2050 for the regions. This occurred after first considering the NBRACER baseline for each region, with a particular focus on the key climate risks the region faces and how they might compound with changing demographics, environmental factors, etc. There was also an activity to identify and discuss pre-existing NbS in the region.

Cantabria and Porto used the workshop to focus on different objectives and stakeholder groups, which were more relevant to their position in their regional journey at the time. For instance, from previous projects in the region, Porto had spent considerable time understanding stakeholder

and community priorities. Their goal for the kick-off workshop was therefore to communicate and validate their plans for the Quinta de Salgueiros with key stakeholders.



3.6 STEP 4: Select the NbS to be implemented

OBJECTIVES OF STEP 4

- *Identify NbS options that directly address the region's challenges and vision*
- *Set the most suitable criteria for the characterisation and prioritisation of the NbS*
- *Evaluate the suitability and feasibility of potential NbS*
- *Prioritise and select NbS*

After identifying the region's challenges, the vision and the impacts that the NbS should address, it is time to **explore suitable NbS options**. At this stage, it may be useful to check existing NbS catalogues⁵ or typologies (e.g., urban forests, green roofs, wetlands, permeable surfaces) to explore interventions that align with your goals and context. In the case of multiple goals (e.g., wetlands that reduce flooding and boost biodiversity), it is desirable to prioritise multifunctional solutions that may address more than one challenge. Once NbS screening and portfolio of solutions have been established, it gives space for the **assessment and selection process**. There are multiple ways to assess the potential spots for implementing solutions, and for all, specific goals should be clearly defined, although overarching objectives are common in a climate resilience context, such as the provision of ecosystem services, the consideration of different key community systems, the minimisation of a concrete risk, etc. Among the existing ways forward, Figure 9 presents a general scheme with evaluation criteria and methodology to do so.

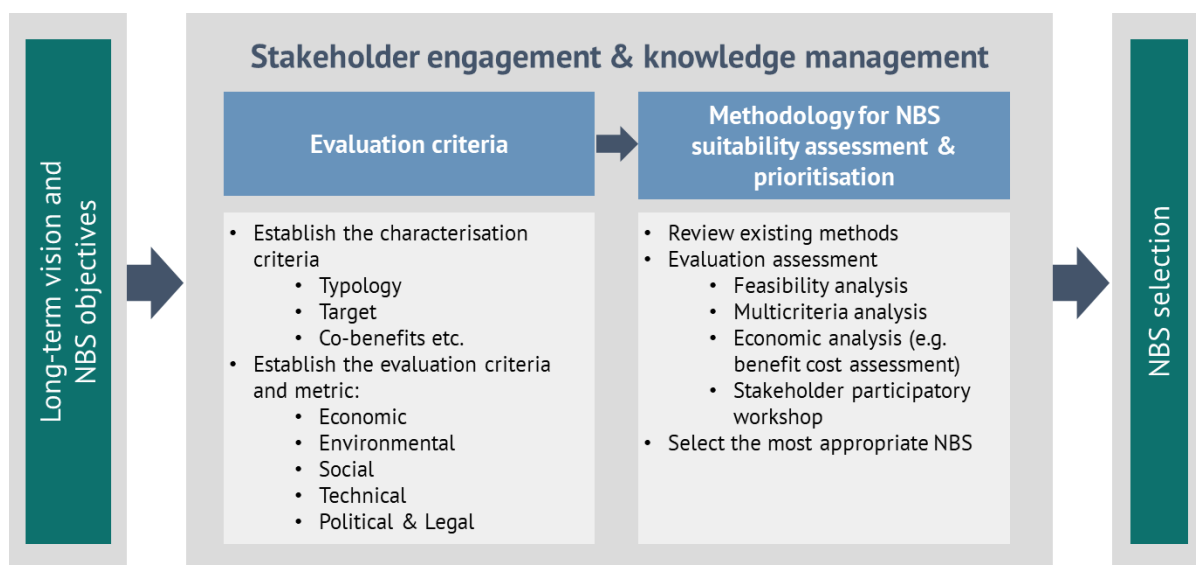


Figure 9: Example of a framework for assessing and selecting NbS.

In this stage, it is important to select the characterisation criteria considering the availability and robustness of the data. The number of NbS to be assessed, the type of the criteria, and the

⁵ Few NbS catalogues may be found in [Pathways2Resilience Climate Toolbox](#)

complexity of acquiring the information may determine the final procedure. However, in general, NbS require the evaluation of the spatial, legal, social, economic, and ecological context of the region.

Feasibility assessment is often used to ensure that the selected NbS are practical, cost-effective, and aligned with the vision and goals. It helps determine whether a proposed NbS can be realistically implemented within existing constraints, such as available resources, technical capacity, implementation location and local conditions. Other relevant assessment criteria may be the environmental performance of the NbS in other similar contexts or obtained through modelling exercises.

Once the assessment criteria have been selected and the NbS characterisation has been done, the integration of the different criteria or dimensions takes place to **prioritise and select the most suitable option**. Multi-criteria analysis⁶ (MCA), or simpler methods (Table 2) can be used to score and compare different NbS options across the different criteria. It is again important to engage stakeholders throughout the assessment process to foster commitment and capture local knowledge, needs and concerns.

Table 2: Example of a possible feasibility assessment and prioritisation methodology

NbS Type	Feasibility criteria					Results	Priority NbS
	Technical	Environmental	Social	Economic	Legal		
A	Low	Medium	High	High	Low	10	3
B	Low	Low	High	Medium	Medium	9	4
C	Low	High	Medium	High	High	12	2
D	Low	Low	High	Low	Medium	8	5
E	Medium	Low	Low	Medium	High	9	4
F	High	High	Low	High	High	13	1

⁶ [1132618.pdf](#); [Multi-criteria analysis manual for making government policy - GOV.UK](#); [Guide to multi-criteria analysis | Infrastructure Australia](#)

Table 3: Example of how to assess the feasibility of an NbS.

Context	Key questions	Tools/Methods
Environmental feasibility Determine whether the natural conditions and ecological context support the proposed NbS.	- Will the NbS contribute positively to the vision in relation to nature (e.g. biodiversity, ecological resilience, water management, habitat connectivity, etc.)? - Is the local ecosystem or land use suitable for the intervention (e.g., wetlands, urban forests)? Is the NbS technically suitable for the local topography, hydrology, and soil conditions? - Are there existing environmental risks (e.g., contamination, invasive species) that might affect success?	GIS mapping, ecological baseline assessments
Technical feasibility Evaluate whether the necessary knowledge, technology, and materials are available to implement and maintain the NbS.	- Can the NbS be implemented at the local or regional administrative level without further support? If support is needed, would it be difficult to get this support or acquire this knowledge in the future? - Would the necessary skills and competencies to manage and maintain the NbS function be available? If not, it would be difficult to get support or get these skills in the future? - Are there risks of failure due to complexity or poor adaptation to the local context?	
Economic feasibility Analyse the cost-effectiveness and funding options of implementing and maintaining the NbS over time.	- What are the upfront investment costs and long-term operation and maintenance costs? - Are there available funding sources (e.g., public, private, EU funding)? - What economic benefits or savings could the NbS generate (e.g., avoided flood damage, health cost decrease)? - Is there a favourable cost-benefit ratio compared to other NbS or grey infrastructure alternatives?	Online finance databases, Quotations, Cost-Benefit Analysis (CBA), ecosystem services valuation
Social feasibility Assess the social acceptability, inclusiveness, and potential impact on the local population.	- Could the intervention cause displacement, gentrification, or conflicts over land use? - Will the NbS meet community needs and expectations? - Are vulnerable groups considered and engaged in the planning? - Is there capacity and willingness among local communities to support and co-manage the NbS?	Stakeholder mapping, participatory workshops, social impact assessments, surveys
Political and legal feasibility Consider whether the NbS aligns with the legal framework, actual policies and has institutional support.	- Does the national/regional/local legal framework hinder the implementation of the NbS in the intended land use or context? - Is land ownership clear and supportive of implementation? - Are there supportive policies or plans that the NbS can align with or leverage?	Policy analysis, legal review, governance mapping, and interviews with decision-makers

The Box below shows a list of **suggested items to be considered by the regions to select the NbS to be implemented.**

SUCCESS CHECKLIST

1. Identify NbS addressing regional challenges and vision

- ☐ Review existing NbS catalogues and create a portfolio of NbS.

2. Set the NbS characterisation and prioritisation criteria

- ☐ Identify and invite relevant stakeholders during the assessment process to foster the incorporation of local knowledge, needs and concerns.
- ☐ Identify relevant criteria across different domains (environmental, social, economic, etc.) and select a proper evaluation method.
- ☐ Assess the feasibility of obtaining necessary information for each criterion.
- ☐ Characterise NbS using the selected criteria.
- ☐ Compare NbS, and rank and prioritise them.
- ☐ Summarise the findings of this task in a document/report, clearly identifying the purpose of the NbS selection.

NBRACER CONTEXT

*In NBRACER, there is one task supporting the regions to create their **portfolio of solutions**, tailored to the specific characteristics of each considered landscape archetype (T2.1/T3.1/T4.1). This portfolio will serve as a robust reference for the regions, guiding their decision-making and the strategic development of NbS.*

The co-design of NbS ensures that solutions are locally relevant, context-specific, and supported by stakeholders. The landscape archetypes developed within NBRACER provide a structured way to categorise and apply solutions across different ecological and socio-economic settings, enhancing the scalability and adaptability of the NbS portfolio.

*The selection of **NbS potential sites** is linked to a series of interconnected processes proposed across transversal tasks, mainly from WP2, WP3, and WP4, with support from WP5 and WP6. This process begins with **building climate risk and vulnerability scenarios** (T5.2), which helps regions identify and mitigate the impacts of climatic hazards on the **KCS**. Additionally, the **characterisation and modelling of biodiversity and ecosystem services** (T5.3) are essential to support the regions in planning, selecting and implementing their NbS network. Furthermore, evaluating the effectiveness of NbS contributes to **assessing the impacts of solution portfolios and adaptation pathways in the regions** (T2.3/T3.3/T4.3). These insights are crucial for the **development of the regional portfolios and adaptation pathways decision support tool** (T5.5).*

*In parallel, the **identification of Key Enabling Conditions (KEC) and barriers** (WP6) to transformation will be integrated into the process, helping regions understand the prerequisites and challenges for building resilience.*



3.7 STEP 5: Define the set of KPIs

OBJECTIVES OF STEP 5

- *Identify appropriate Key Performance Indicators (KPIs) to evaluate the expected outcomes derived from the selected NbS*
- *Ensure KPI follow SMART principles (Specific, Measurable, Achievable, Relevant and Time-bound)*
- *Develop a monitoring and evaluation strategy that builds on the selected KPIs*
- *Ensure the viability of the monitoring and evaluation plan*

Defining Key Performance Indicators (KPIs) is a critical step for setting a monitoring strategy, but it can be challenging if approached solely from the perspective of what impacts or vision NbS are expected to achieve. While the visions respond to identified climate risks and societal challenges, a more structured approach is often needed to trace how change is expected to occur and how it can be measured.

This is why Step 5 builds directly on the visioning work conducted in Step 3. The vision statement developed earlier defines the desired long-term impacts of NbS implementation. It provides the strategic direction and qualitative goals from which measurable outcomes and KPIs should now be derived.

To bridge this gap between high-level aspirations and measurable progress, regions are encouraged to use the Theory of Change (ToC)⁷. This tool has proven useful to help trace how and why a certain set of activities and interventions – including NbS – are expected to contribute to a desired short- and long-term outcomes and vision. Through backward mapping, the ToC reveals causal links between activities, outputs, outcomes and impacts (Figure 10). This strategic foundation is essential for selecting meaningful KPIs and designing a robust monitoring and evaluation framework.

⁷ [Rogers, P. \(2014\). Theory of Change, Methodological Briefs: Impact Evaluation 2, UNICEF Office of Research, Florence.](#)

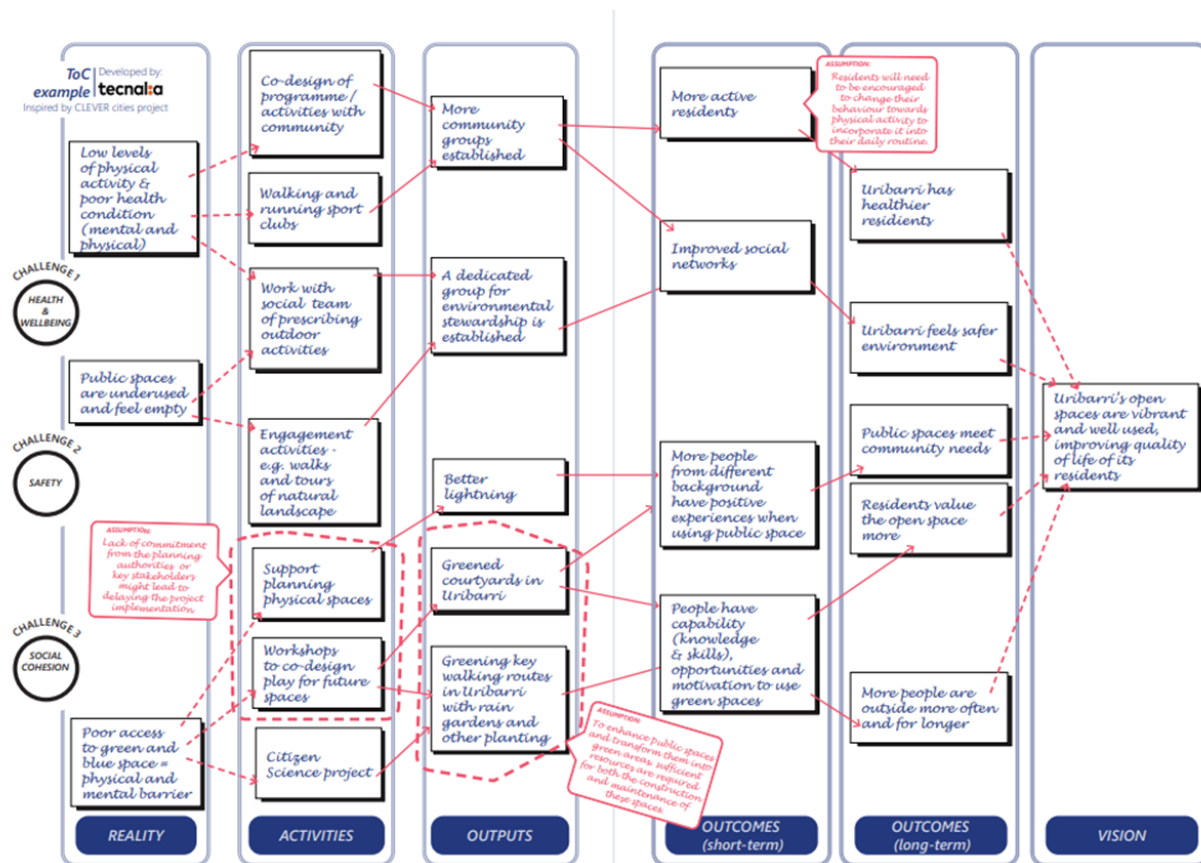


Figure 10: Example of outputs of a Theory of Change exercise, modified from a real case study. Source: CLEVER Cities

Understanding the synergies and trade-offs across multiple domains is also key, since NbS interventions may generate positive effects in one area (e.g., public health) while inadvertently causing negative effects in another (e.g., maintenance burden on municipal services). Mapping these interactions through the ToC supports more holistic monitoring.

Figure 11 illustrates a step-by-step process for identifying the KPI following the ToC methodology. This structured approach helps ensure that the selected KPIs are directly linked to the region's identified societal challenges, goals, and expected outcomes, both at short- and long-term.

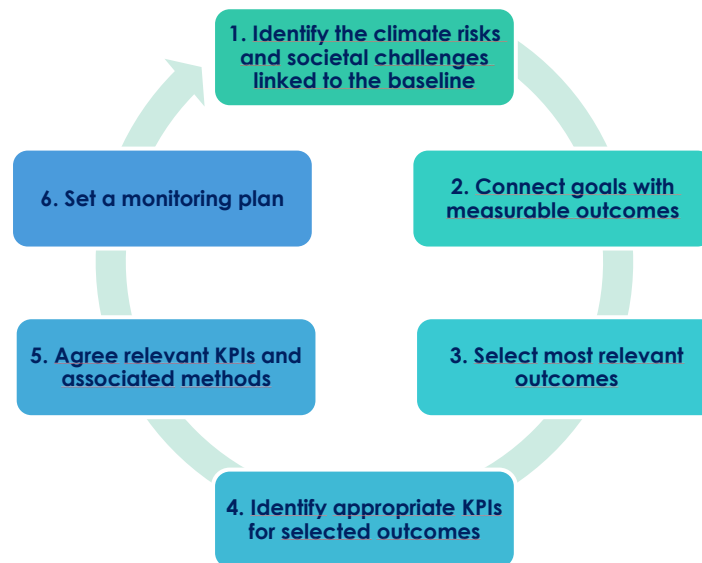


Figure 11: Process for KPI identification and selection to assess the expected changes and impacts derived from NbS implementation

1. Identify the climate risks and societal challenges linked to the baselines: The process begins with a clear definition of the core societal or environmental challenges, including climate risks, that the intervention aims to address. These risks and challenges are identified in the early phases of the monitoring journey – Steps 2 and 3 – and provide the foundation for defining outcomes and indicators.

2. Connects goal with measurable outcomes: This can be done via, e.g. Theory of Change (ToC), which articulates how and why the desired changes are expected to happen. It maps the pathway from current conditions to intended impacts & vision (set in Step 3), helping align goals with on-the-ground realities and constraints. There are various guides and materials available to develop a ToC⁸. One such resource is the soft tool “[*Theory of Change: Navigating transformation towards a desired vision*](#)”, which provides practical support for facilitating ToC workshops.

3. Select the most relevant outcomes: Based on the results of the previous step, identify the outcomes that are most critical to achieving the overall goals of the NbS. These outcomes reflect the key changes the intervention aims to bring about—whether environmental, social, or economic—and will serve as the foundation for monitoring progress and evaluating impact.

Begin by clearly **defining each outcome**. A well-formulated outcome statement should articulate what change is expected, for whom, where, and why it is important. For example, instead of a general outcome like “increase in walking,” a more specific formulation would be: “Increased pedestrian activity among residents in District A due to the implementation of new green corridors aimed at promoting active mobility and reducing vehicle dependency.”

Since a single NbS initiative may generate multiple outcomes across various domains (e.g., biodiversity, public health, social cohesion), not all of them can or need to be monitored in detail. It is therefore important to **prioritise the most relevant outcomes** – those that are most strategically significant, feasible to monitor, and aligned with the concerns of key stakeholders

⁸ Some of them can be found in the P2R Toolbox in [Pathways2Resilience Climate Toolbox](#).

and the vision. This prioritisation process helps focus resources and ensures that monitoring efforts are targeted, meaningful, and manageable.

4. Identify appropriate Key Performance Indicators for the selected outcomes: At this stage, measurable indicators are identified for each selected outcome. KPIs should be specific, measurable, and clearly aligned with both the defined outcomes and the broader objectives of the project. To support effective monitoring, outcomes should be translated into observable or quantifiable elements that can be tracked over time. Table 4 provides examples of how this translation from outcomes to KPIs can be applied in practice.

Table 4: Example of outcome translation into KPI.

Topic	Outcome	Example of KPI
Use of a function	Increase in local food production among residents in District A due to the implementation of community gardens.	Gardening space per area
Mental & physical health	Improved physical fitness and active mobility among residents in the NbS intervention area due to the development of green corridors	Physical activity in the NbS intervention area
	Increased pedestrian and cycling activity among residents in District B due to the implementation of NbS green corridors	Number of individuals walking and cycling in and around areas of intervention
	Improved mental health and well-being among residents in the NbS intervention area due to increased access to green spaces	Self-reported mental health status
	Reduced stress and anxiety levels among residents in the NbS intervention area due to the creation of accessible, peaceful green spaces	Self-reported stress and anxiety

To ensure pertinency and adequacy of the KPIs to the objectives, it is highly recommended to follow a quality analysis control following, for example, the **SMART** criteria that establishes that the indicators should be:

- **Specific** (focused on a clear aspect of the outcome)
- **Measurable** (quantifiable with collectable or available data)
- **Achievable** (realistic given the resources and timeframe)
- **Relevant** (closely tied to the project's objective)
- **Time-bound** (measured over a defined period)

KPIs may include both **quantitative and qualitative indicators**, especially when evaluating less tangible outcomes such as social cohesion, governance quality, or equity impacts. These indicators can be derived through interviews, focus groups, or participatory observation methods.

Where relevant, disaggregating KPIs by gender, age, income level, or other **vulnerability factors** can reveal whether benefits (or risks) are distributed equitably across the population.

As a starting point, practitioners may consult the “Handbook for Practitioners: Evaluating the impact of Nature Based Solutions” (appendix of methods) (EU, 2021), which provides a structured

collection of indicators examples across 12 relevant domains to NbS performance assessment (Figure 12). This resource can support the initial selection of candidate KPIs before tailoring them to local goals and context.

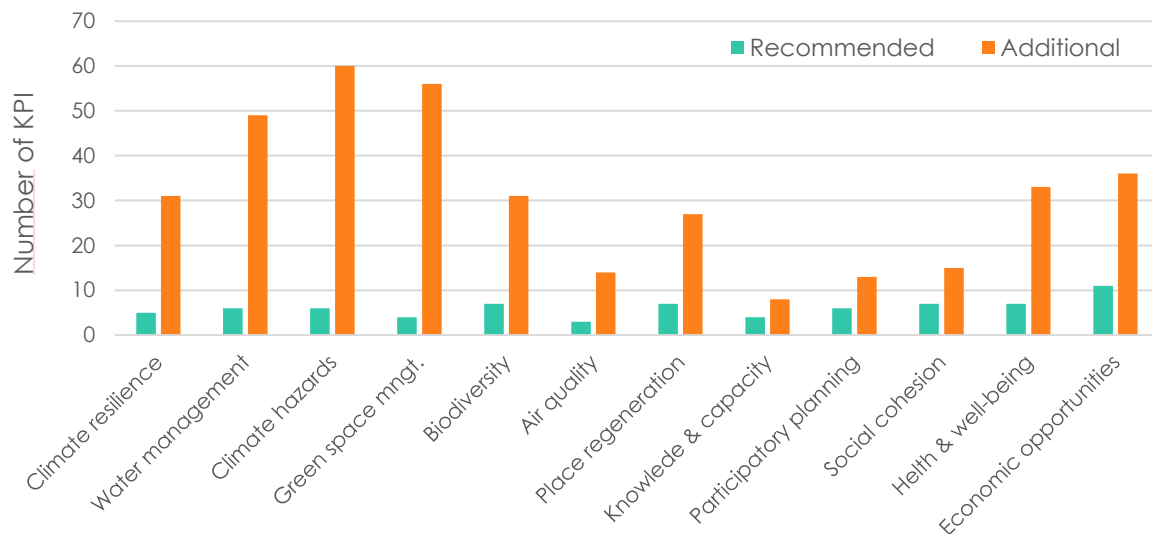


Figure 12: Number of recommended and additional KPIs per societal challenge (EU, 2021)

5. Agree on relevant KPIs and associated data collection methods: Engage stakeholders – including local authorities, community representatives, technical experts, and data providers – to review and validate the proposed KPIs. This collaborative process ensures that the selected indicators are not only relevant and meaningful but also feasible to monitor within local or regional capacities. When selecting KPIs, municipalities and regions should assess the availability, quality, and accessibility of existing data sources, as well as the need for new data collection efforts.

Equally important is the evaluation of **appropriate methods for data collection, analysis, and reporting**. These may include community surveys, environmental sensors, administrative records, or citizen science initiatives. Stakeholders should consider the cost-effectiveness, technical requirements, and reliability of each method to ensure long-term sustainability of the monitoring system. It is also essential to clearly define the purpose of the collected data – whether it will inform policy decisions, track compliance, engage citizens, or support funding applications – to ensure that data collection efforts are targeted and useful. Early planning for roles, responsibilities, and resource allocation will also support smooth implementation and consistent data tracking over time.

6. Set a monitoring plan: The monitoring and evaluation (M&E) plan is a structured and strategic document – often formalised as a stand-alone plan or embedded within broader project documentation – that outlines how the implementation and impacts of NbS will be systematically tracked, analysed, and reported over time. In essence, it defines what will be monitored, why it matters, how data will be collected, when and how frequently monitoring will occur, and who is responsible for each component.

The M&E plan builds directly on the steps of defining outcomes, selecting KPIs, and agreeing on data collection methods. It typically includes the following components:

- *Monitoring and data collection plan*: specify the indicators to be tracked, data sources, tools and methods (e.g., surveys, sensors, field observations), frequency of data collection, and responsible parties.
- *Evaluation plan*: outline how the collected data will be analysed and interpreted to assess progress toward objectives. It may include baseline comparisons, target-setting, and performance reviews at defined intervals.
- *Data management and storage plan*: ensure that data is securely stored, consistently formatted, and accessible to relevant stakeholders. It may include the use of portals, databases, dashboards, or GIS platforms to support the collection and storage of data.
- *Communication and reporting mechanisms*: define how results will be communicated to internal and external audiences, supporting transparency, stakeholder engagement, and policy alignment.
- *Learning and adaptation plan*: promote continuous learning by using monitoring results to reflect on what works, what doesn't, and why. It supports adaptive management and helps integrate feedback into ongoing and future actions. Since multiple outcomes may result from a single intervention (including some unexpected ones), it is recommended to complement the M&E framework with a broader learning journal or similar methodologies. These tools can help capture qualitative insights, unintended effects, and contextual factors that may not be fully reflected through predefined indicators.

It is advisable to revisit the initial work developed by the RMT (Step 1) to ensure existing capacities among the engaged experts, to monitor and post-process the data generated from the measurement of KPIs.

Table 5: Brief example on the structure and type of information present in a monitoring and evaluation plan (Source: NBRACER, Ramage intervention – Nouvelle Aquitaine)

I. Monitoring and data collection plan					
What		How			
Outcome	KPI	Data collection source	Data collection method	Notes on data collection (when, whom, etc.)	Target sample
Regulate water flow and drought	Quantitative status of groundwater	Water agency SDAGE	Authority document published	Potentially once a year	n/a

II. Evaluation plan	
Who	How
Data analysis	Method
Data analyst (social science)	Qualitative analysis

III. Data management and storage plan	
Who	How
Data access	Outputs
Public data	Project report

Some further considerations are that **establishing a robust monitoring infrastructure** may involve both technical tools (e.g., digital platforms, data dashboards, field instruments) and institutional arrangements (e.g., assigning responsibilities to municipal departments, engaging local partners

or universities). Importantly, the infrastructure should be as scalable and adaptable as possible to respond to evolving challenges, data needs, and resources over the course of the NbS implementation process. Furthermore, a M&E plan should ensure accountability, transparency, and evidence-based decision-making. This enables authorities to demonstrate the effectiveness of NbS, fulfil reporting obligations, and continuously improve planning and implementation processes.

The Box below shows a list of **suggested items to be considered by the regions to define the set of KPIs to be measured.**

SUCCESS CHECKLIST

1. Develop a Theory of Change

- ☐ Clearly define the core societal/environmental issues that NbS aims to address and the vision it should achieve.
- ☐ Engage stakeholders in workshops or participatory sessions to co-develop a meaningful ToC for the local context.
- ☐ Use available ToC facilitation resources to map the causal pathway from current conditions to intended outcomes and impacts.
- ☐ Clarify assumptions, drivers and barriers along the causal pathway as well as enabling conditions required for success.
- ☐ Select the most relevant outcomes based on key criteria such as strategically significant, feasible to monitor, aligned with stakeholders' values and project vision.

2. Identify appropriate Key Performance Indicators for the selected outcomes

- ☐ Identify a corresponding KPI for each selected outcome and output.
- ☐ Ensure KPIs are SMART (Specific, Measurable, Achievable, Relevant and Time-bound).
- ☐ Consult stakeholders to review and agree on proposed KPIs.
- ☐ Assess the availability, consistency, and quality of relevant data.

3. Set a monitoring plan

- ☐ Choose appropriate data collection methods.
- ☐ Evaluate the feasibility, cost-effectiveness and sustainability of methods.
- ☐ Clarify roles, responsibilities and resources for data collection.
- ☐ Develop a data collection, evaluation and communication plan.
- ☐ Set a data management and storage protocol.
- ☐ Reflect and set learning and adaptive management guidelines or protocols.
- ☐ Establish the monitoring infrastructure.

NBRACER CONTEXT

Defining the set of KPIs is identified as the main task related to monitoring within the NBRACER. To accomplish this, the demonstration regions have undergone a guided process to individually define their KPI sets, as these are closely tied to the specific solutions being implemented. The KPIs are formulated based on the impacts each region expects its solutions to achieve.

*At the time of this report's delivery, the KPIs are not yet fully defined across all NBRACER regions. Detailed updates on the status of monitoring are provided in **Chapter 4** of this document.*

3.8 STEP 6: Pre-implementation monitoring for NbS

OBJECTIVES OF STEP 6

- *Establish the reference conditions to provide a starting point to measure change and impact over time*
- *Identify data gaps and issues to ensure data comparability and representativeness*
- *Refine monitoring methods if needed and mitigate potential monitoring risks*

Before implementing NbS, it is essential to **perform a pre-monitoring phase to establish a robust knowledge** on the status of the system (often called *monitoring baseline*) before the NbS implementation that enables meaningful comparison over time. This step focuses on collecting data for the agreed KPIs, following the sampling strategies, data sources, and frequency outlined in the monitoring plan.

The purpose of pre-monitoring is not only to measure existing conditions (Figure 13) but also to ensure that data is representative, reliable, and relevant for evaluating the expected changes generated after the intervention.

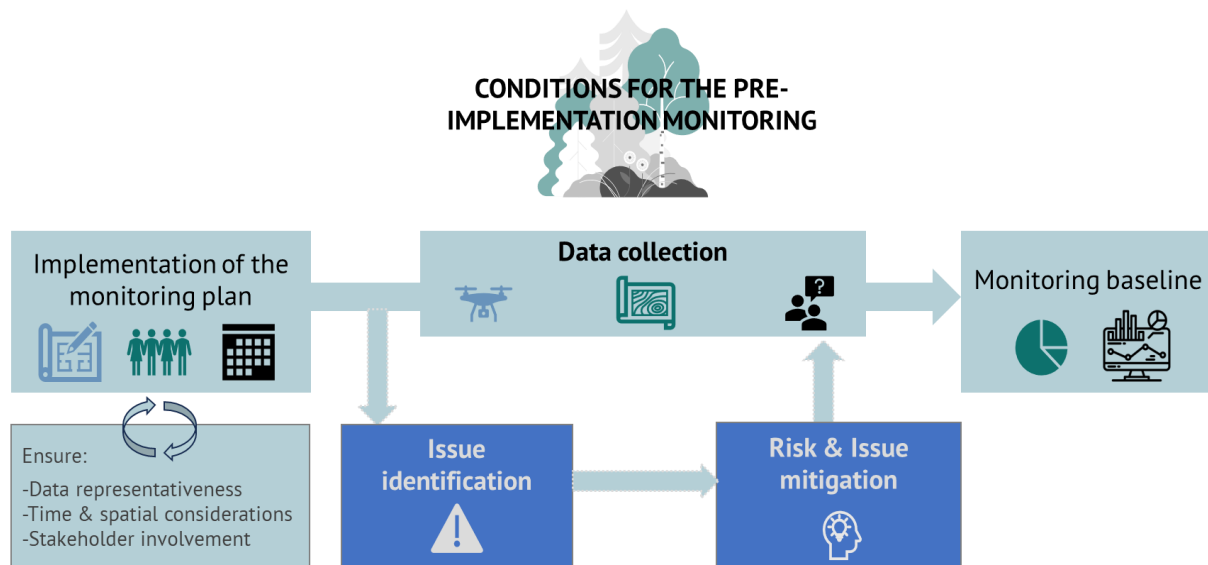


Figure 13: Conditions for the pre-implementation monitoring⁹

Key considerations in this phase include:

- *Measure KPIs using established protocols:* Data collection should follow the methods and timelines defined in the monitoring plan. This ensures consistency and comparability with future monitoring efforts.

⁹ Icons taken from flaticon.com

- *Conduct a monitoring baseline:* Capture conditions before the NbS intervention begins, using a combination of quantitative (e.g., air quality sensors, biodiversity counts) and qualitative (e.g., interviews, focus groups) methods. This reference will serve as the starting point for impact evaluation.
- *Ensure representativeness:* It is important to collect a sufficiently large and diverse samples to reflect variations in the target area (e.g., different neighbourhoods, population groups, or ecological zones). This will allow for disaggregated analysis and help reveal who benefits—or does not—from the intervention.
- *Allow adequate time before implementation:* Plan the pre-monitoring with enough lead time to avoid overlap with early NbS effects. Some indicators, such as soil moisture or community perceptions, may require seasonal or repeated measurements to establish robust baselines.
- *Document all data collection efforts:* Keep records of sampling locations, dates, responsible actors, tools used, and any contextual notes. This supports transparency and repeatability, particularly if other stakeholders will continue the monitoring in the future.
- *Identify and early address data quality issues:* If reference data reveals gaps or inconsistencies, make necessary adjustments to protocols before the post-implementation monitoring begins.

Pre-monitoring lays the groundwork for assessing NbS effectiveness. It also provides an opportunity to engage local stakeholders in the monitoring process, increase ownership, and test the feasibility of selected KPIs and methods.

The Box below shows a list of **suggested items to be considered by the regions to pre-implementation monitoring**.

S U C C E S S C H E C K L I S T
1. Pre-implement monitoring ☐ Document all activities and the data collection efforts following quality protocols ☐ Measure KPIs using established protocols to ensure consistency and comparability, and collect baseline data considering sampling representativeness and factors impacting data collection (e.g. seasonality) ☐ Ensure representativeness by collecting data from diverse and sufficiently large samples ☐ Allow adequate time before implementation to avoid overlap with early NbS effects ☐ Check data quality and adjust protocols if needed

NBRACER CONTEXT

In NBRACER, the development of KPIs is approached as a dynamic and iterative process, tailored to the unique context, priorities, and capacities of each region. While some regions are at an advanced stage, having already defined and begun measuring a set of KPIs, others are still in the early phases of visioning and goal setting, which is essential for visualising expected impacts and designing meaningful indicators. This diversity reflects the variability in regional contexts, including differences in ecological conditions, societal priorities, and technical expertise.

To ensure consistency and mutual learning, the RMT plays a central role in guiding the measurement process, ideally starting before the implementation of NbS. This allows for the establishment of a reliable baseline, which is crucial for tracking progress and evaluating impact over time.

NBRACER supports cross-regional analysis of common indicators, enabling peer-to-peer learning, best practice exchange, and joint problem-solving. At the same time, it acknowledges and respects the legitimacy of region-specific KPIs, which may reflect biophysical, technical, social, or governance-related outcomes, depending on local needs and capacities.

In cases where NbS implementation is already underway, the monitoring process may need to be adapted to the situation. For example, it may be possible to calculate pre-monitoring indicators retroactively, or to adjust data collection methodologies to ensure valid and comparable results.

NBRACER aims to be a platform for harmonisation and support, helping regions overcome challenges and strengthen their monitoring capacity in a coordinated and inclusive manner.

3.9 STEP 7: Post-implementation monitoring for NbS

OBJECTIVES OF STEP 7

- *Carry out the monitoring after the NbS has been implemented to assess whether expected outcomes are being achieved*
- *Track the operation and maintenance of the NbS to ensure continued benefits over time*

After the NbS have been implemented, the monitoring process **transitions into its post-intervention phase**. The goal is to assess whether and how the expected changes—defined by the KPIs—are being realised over time. This step ensures that performance is tracked consistently, emerging impacts are documented, and evidence is gathered to inform future planning and decision-making.

Key considerations in this phase include:

- *Continue tracking the same KPIs:* Maintain consistency with the indicators and data collection methods used during the pre-monitoring phase. This comparability is essential for evaluating changes and trends attributable to the NbS intervention. It is also key to ensure representative monitoring periods to capture meaningful and reliable data.
- *Use the same teams and protocols where possible:* To ensure continuity, reliability, and institutional memory, it is recommended to involve the same monitoring teams or institutions whenever feasible. This helps preserve methodological consistency and reduce variability in data collection or interpretation.
- *Report and communicate results:* Monitoring results should be periodically analysed and reported to the involved stakeholders. Transparent reporting supports accountability and can boost support for NbS as an effective solution. Use visual tools (dashboards, story-maps, infographics) to make findings accessible and engaging to a broader audience.
- *Complement monitoring with other tools and methods:* Post-implementation monitoring may not rely exclusively on the predefined KPIs. Additional insights may be gained by gathering critical learnings from the experience (e.g., to address behavioural changes), learning stories, etc.
- *Plan for long-term monitoring beyond the project:* This step ensures that the monitoring system is designed for continuity past the project's funding cycle. This may involve:
 - Integrating NbS indicators into municipal or regional monitoring systems
 - Partnering with universities, NGOs, or citizen science groups to co-lead future monitoring
 - Securing resources for long-term data collection, storage, and maintenance

While sustainability of the monitoring can and should ideally be planned during the pre-monitoring phase, it may also be revisited and refined in the post-monitoring phase, especially when adaptive learning (e.g., consideration of limitations in the data collection methods or indicators, need to secure funding or institutional buy-in after demonstration etc.) from early monitoring is sought.

- *Include considerations for maintenance and management:* Performance monitoring may be necessary to be linked to the ongoing operation and maintenance of the NbS. Degradation or lack of upkeep may affect ecological or social outcomes. Therefore, tracking maintenance activities—such as vegetation management, cleaning of water features, or engagement with local users—can be important supplementary indicators.

Effective post-implementation monitoring closes the feedback loop between design, action, and learning. It enables cities and regions to demonstrate the value of NbS, adapt their strategies as needed, and lay the foundation for more resilient and evidence-based planning in the future.

The Box below shows a list of **suggested items to be considered by the regions for post-implementation monitoring**.

SUCCESS CHECKLIST

1. KPI Tracking

- ☐ Engage the same RMT and apply the same data collection protocols
- ☐ Continue data collection for the same KPIs and use the same methods defined in the pre-monitoring phase.
- ☐ Ensure monitoring occurs during representative time periods
- ☐ Update or adjust KPIs only if justified by significant contextual or implementation changes

2. Analysis, Reporting and Communication

- ☐ Apply data cleaning and quality control procedures
- ☐ Periodically analyse performance, trends and learning
 - Compare current KPIs values to pre-implementation phase
 - Identify trends over time or significant changes
 - Map spatial distribution of NbS impacts, if applicable
 - Compare outcomes across sites, groups or time
 - Identify unexpected ecological, social, and economic co-benefits and any negative side effects
 - Document lessons learnt, and identify improvement recommendations
 - Link performance outcomes to maintenance activities
 - Identify and respond to signs of NbS degradation or misuse
- ☐ Communicate results clearly and regularly to stakeholders
 - Use visual and accessible tools
 - Communicate monitoring outcomes, challenges, and opportunities
 - Communicate lessons learnt to inform future NbS planning and implementation

2. Long-Term Monitoring Planning

- ☐ Identify and secure resources for future data collection
- ☐ Establish relevant partnerships
- ☐ Plan for periodic reviews and updates of the monitoring strategy
- ☐ Integrate NbS KPIs into local or regional monitoring frameworks

NBRACER CONTEXT

In NBRACER, the NbS proposed for implementation are currently in the planning or early construction phase. While some projects are already implemented or under development, the majority have not yet reached the stage of full implementation.

Post-implementation monitoring is not explicitly included as a task in the current NBRACER workplan/timeline. Nevertheless, the regions are strongly encouraged to plan for and allocate sufficient budget and human resources to support this essential phase. This is crucial for assessing whether the expected outcomes of the NbS are being achieved and for ensuring their continued performance and adaptation over time.

The checklist provided in this step offers a useful reference for the regions to consider how post-implementation monitoring can be integrated into their planning. While some elements, such as KPI tracking and data collection protocols, are already being addressed during the pre-monitoring phase, others—such as long-term monitoring planning and maintenance tracking—may need to be revisited and expanded as the projects progress.

It is important to note that post-implementation monitoring is not only a technical activity but also a strategic one. It supports adaptive management, enables the identification of unintended consequences or co-benefits, and ensures that lessons learned are captured and used to improve future NbS planning and implementation. In NBRACER, the regions are encouraged to begin thinking ahead about how they will sustain monitoring efforts beyond the current project lifecycle, including through partnerships, institutional integration, and resource planning.



3.10 STEP 8: Undertake an Impact Assessment

OBJECTIVES OF STEP 8

- *Evaluate NbS effectiveness (against the pre-implementation baseline) and track progress towards goals*
- *Support adaptive management to adjust, scale, or replicate NbS interventions based on evidence*
- *Inform planning on future policies and NbS design, implementation and monitoring approaches*
- *If relevant, provide evidence for funders, policymakers, or relevant stakeholders on the return on investment*

This step involves evaluating the overall effectiveness and impacts of the NbS intervention by comparing post-implementation monitoring results against the pre-implementation baseline and predefined KPIs, and extracting actionable insights for future planning and decision-making. The assessment provides critical evidence on whether, in some instances, the expected environmental, social, and economic outcomes have been achieved. Thus, it supports learning, accountability, and the future replication or scaling of NbS efforts.

The assessment should include both quantitative and, where relevant, qualitative analyses to capture the full range of ecological, social, and economic outcomes. It also offers an **opportunity to reflect on the implementation process, identify lessons learned, and inform replication or upscaling efforts.**

At this stage, **the evaluation plan should be put into action.** With both pre- and post-implementation data collected, and data comparability ensured through earlier steps, it is now possible to carry out the KPIs analysis over time. For quantitative analysis, it is key to use appropriate statistical tools (e.g. mean, median, standard deviation, t-test, ANOVA, regression analysis, etc.) to assess whether the changes observed are significant. At the same time, it may be relevant to perform a qualitative analysis (e.g. semi-structured interviews, focus group discussions, narrative approaches, etc.) by identifying and documenting unintended outcomes, emerging impacts, and stakeholder experiences. Evaluate the achievement of goals and explore co-benefits and trade-offs, applying lenses such as social justice or equity to better understand who benefits—and who may not—from the intervention. Broader impacts may emerge that go beyond the original KPIs (e.g. gentrification, economic trade-offs, safety concerns, etc.), offering valuable insights into the NbS contribution to resilience and well-being. In parallel, it is relevant to document lessons learned by identifying enabling conditions for success, challenges faced during monitoring or implementation, and areas for improvement. These insights are essential for replication and scaling.

Once there is a clear picture of what changed and why, results should be shared. Communicating findings in a clear, transparent, and engaging way—through tailored outputs such as dashboards, story-maps, or community briefings—not only builds trust but also helps bring the results to life

for different audiences. Involving previously engaged stakeholders, implementation teams, local institutions and external stakeholders, if relevant, in these conversations ensures that the knowledge gained is widely understood, used and builds shared ownership of the results.

Finally, **impact assessment plays a vital role in strengthening adaptive planning**. The insights generated should directly inform future policies, funding decisions, and the design of new NbS interventions. Ultimately, this step is not just about evaluating past performance—it’s about learning from it. A well-executed assessment helps cities and regions improve their strategies over time, ensuring that NbS continue to deliver real value and resilience in a changing world.

The table below shows a list of **suggested items to be considered by the regions to undertake an impact assessment**.

S U C C E S S C H E C K L I S T
1. NbS effectiveness assessment ☐ <i>Ensure pre- and post-implementation data are complete and comparable</i> ☐ <i>Conduct quantitative and qualitative analysis of the KPIs</i> ☐ <i>Generate insight</i> <i>○ Reflect on NbS implementation and maintenance factors affecting effectiveness</i> <i>○ Identify enabling conditions and barriers for NbS performance</i> <i>○ Assess lessons learned and areas for improvement</i> <i>○ Reflect on the unexpected or negative impacts</i> 2. Inform Future Planning ☐ <i>Share results with relevant stakeholders and institutional partners</i> ☐ <i>Use findings to support adaptive planning and decision-making.</i> ☐ <i>Build a shared ownership of the findings</i> ☐ <i>Inform future NbS design, replication, scaling and financing</i> ☐ <i>Feed results into policies and funding strategies.</i>

NBRACER CONTEXT

In NBRACER, the timing of the project is a limit to undertake the impact assessment, since the post-monitoring should be done after the solution is implemented. Besides, there may be some challenges for the post-measurements, such as timing (if they are surveys, it may be a longer process), seasoning (naturalising evidence may be taken during a specific season to prove success), and community participation (engaging the same targets contacted in the pre-monitoring stage).

The management of those limitations is part of the process and will be identified along the project development. Some actions may be planned to finalise after the project ends.

Whenever a region can undertake an impact assessment, the learnings from that will go back to the process and iterate back in the cycle of the RRI, giving valuable information to set the ground for the next round, to evaluate and design new adaptation pathways, to replicate and upscale solutions, to propose new NbS, etc.

In any case, the gathering of Lessons Learnt committed to be collected in the regions along the process of monitoring, will give feedback on the level of success of the process of monitoring, and generate useful recommendations that can be consulted by other regions that expect to go through similar processes.

3.11 Stakeholder engagement across the Monitoring Journey

Stakeholder engagement is a critical component of effective decision-making and project implementation. However, it is important to recognise that not all stakeholders need to be involved in every step of the process. Their participation should be guided by their expertise and relevance to the specific issue or activity at hand, rather than by a one-size-fits-all approach that assumes universal involvement. This targeted engagement ensures that the process remains efficient, focused, and meaningful, while also respecting the time and resources of those involved.

A key principle in stakeholder engagement is the distinction between responsibility and capacity. While stakeholders may be accountable for their role or contribution, the level of action they can realistically undertake is shaped by their resources, authority, and mandate. This means that while a stakeholder may have a duty to provide input or support a decision, the extent to which they can act on it may vary significantly.

Table 6: Overview of stakeholder involvement in the monitoring of NbS, outlining probable roles, level of participation and responsibilities of key stakeholder groups at each stage of the Monitoring Journey.

Step	Objective	Stakeholder Group	Role and Level of Involvement	Responsibility	Participation
1. Establish a Monitoring Team	Build the RMT, assign roles, and establish governance	Regional Authority	Lead process, appoint team, coordinate (High)	Provide political/financial support	Necessary
		Technical Partners / Consultants	Define framework/methodology (High)	Provide tools and expertise	Necessary
		Academic / Research Institutions	Advise on indicators, data (Medium)	Methodological support and validation	Optional
		Civil Society / NGOs	Represent community interests (Medium)	Ensure community needs are reflected	Optional
		Community Representatives	Provide local knowledge (Medium)	Validate local relevance	Optional
2. Understand the Baseline	Analyse existing data and establish a contextual baseline	Regional Authority	Provide access to data/policies (High)	Coordinate across departments	Necessary
		Technical Partners / Consultants	Analyse socio-economic/environmental data (High)	Support compilation and analysis	Necessary
		Academic / Research Institutions	Vulnerability assessments, modelling (Medium)	Interpret data and provide insights	Optional
		Civil Society / NGOs	Share local insights and issues (Medium)	Represent lived experiences	Optional

Step	Objective	Stakeholder Group	Role and Level of Involvement	Responsibility	Participation
		Community Representatives	Validate and identify local knowledge (Medium)	Reflect community realities	Optional
		IT/Data Specialists	Visualise and store data (High)	Enable accessibility and usability	Necessary
3. Establish a Vision for NbS Impacts	Define a shared, inclusive, and forward-looking vision for NbS impact.	Regional Authority	Facilitate multi-level dialogue and align the vision with strategic goals	Ensure the vision is integrated into policy and planning	Optional
		Technical Partners / Consultants	Moderate visioning sessions and support narrative framing	Translate technical and strategic challenges into impact	Necessary
		Academic / Research Institutions	Support scenario planning and identify key drivers and future trends	Provide foresight and systems thinking	Optional
		Civil Society / NGOs	Ensure diverse values and justice dimensions are included in the vision	Represent civil society and promote equity	Optional
		Community Representatives	Share community aspirations and define co-benefits of NbS	Ensure the vision reflects local needs and expectations	Optional
		Communications Experts	Draft and disseminate the vision statement and support storytelling formats	Ensure the vision is communicated clearly and widely	Optional
4. Select the NbS to be Implemented	Identify, assess, and prioritise Nature-based Solutions (NbS) that directly respond to the region's challenges and vision	Regional Authority	Provide strategic guidance, approve NbS, align with policy (High)	Oversee the selection process, ensure policy alignment	Necessary
		Technical Partners / Consultants	Evaluate NbS options, develop feasibility criteria (High)	Provide technical support and ensure evidence-based decisions	Necessary

Step	Objective	Stakeholder Group	Role and Level of Involvement	Responsibility	Participation
		Academic / Research Institutions	Support feasibility with models and data	Ensure the technical soundness of NbS	Optional
		Civil Society / NGOs	Participate in feasibility discussions	Ensure NbS are inclusive	Optional
		Community Representatives	Provide feedback on NbS and local relevance	Ensure NbS are meaningful locally	Optional
		IT/Data Specialists	Support data tools and visualisations	Ensure usability of decision-making tools	Optional
		Legal / Policy Experts	Assess legal feasibility	Ensure legal compliance of NbS	Optional
		Financial / Economic Experts	Conduct a cost-benefit analysis	Ensure economic feasibility	Optional
		Communications Experts	Support transparency and rationale for decisions	Ensure clear stakeholder communication	Optional
5. Define the set of KPIs	Define a set of relevant KPIs that align with the expected outcomes of the selected NbS, and develop a viable and actionable monitoring and evaluation strategy to effectively track and assess their implementation and impact over time.	Regional Authority	Define strategic goals, approve KPIs and plans	Ensure political commitment to monitoring	Necessary
		Technical Partners / Consultants	Develop ToC, suggest KPIs, design M&E strategy	Ensure KPIs are sound and data collection is feasible	Necessary
		Academic / Research Institutions	Contribute to ToC, validate indicators	Ensure scientific validity of KPIs	Optional
		Civil Society / NGOs	Define KPIs that reflect community needs	Ensure KPIs are socially inclusive	Optional
		Community Representatives	Validate community relevance of KPIs	Ensure KPIs reflect local realities	Optional
		IT/Data Specialists	Support tool/platform design for KPI tracking	Ensure data accessibility	Optional
		Legal / Policy Experts	Ensure legal compliance of the monitoring plan	Ensure regulatory compatibility	Optional

Step	Objective	Stakeholder Group	Role and Level of Involvement	Responsibility	Participation
		Financial / Economic Experts	Support the identification of economic KPIs	Ensure financial feasibility	Optional
		Communications Experts	Craft KPI communication strategies	Ensure stakeholder understanding	Optional
6. Pre-implementation Monitoring for NbS	Conduct a pre-implementation assessment of site or system conditions prior to deploying the NbS	Regional Authority	Approve baseline plan and align with goals	Ensure integration with planning	Necessary
		Technical Partners / Consultants	Design and implement baseline monitoring	Ensure quality and representativity	Necessary
		Academic / Research Institutions	Validate baseline indicators and support methodology	Ensure scientific rigour	Necessary
		Civil Society / NGOs	Participate in baseline collection	Ensure relevance to community concerns	Optional
		Community Representatives	Validate and contribute to baseline data	Ensure context relevance	Optional
		IT/Data Specialists	Support data tools and secure storage	Ensure data accessibility and security	Necessary
		Legal / Policy Experts	Check legal compliance in data collection	Ensure data protection adherence	Necessary
		Communications Experts	Share baseline results with stakeholders	Support transparency	Optional
7. Post-Implementation Monitoring	Assess whether expected outcomes are being achieved and track the operation and maintenance of NbS over time	Project Monitoring Team	Collect, analyse, and report on KPIs (High)	Ensure data consistency, accuracy, and continuity	Necessary
		Local Government / Municipal Authorities	Coordinate monitoring, allocate resources (High)	Integrate NbS monitoring into local systems and planning	Necessary
		Implementing Agencies / NbS Project Teams	Support data collection and maintenance tracking (Medium)	Provide access to NbS sites and maintenance records	Necessary

Step	Objective	Stakeholder Group	Role and Level of Involvement	Responsibility	Participation
		Academic Institutions / Research Partners	Provide technical support and analysis (Medium)	Assist in data interpretation and trend analysis	Optional
		NGOs / Civil Society Organisations	Engage with local communities and provide feedback (Medium)	Facilitate community-based monitoring and reporting	Optional
		Local Communities / Users	Provide qualitative feedback and report on NbS use (Low)	Participate in citizen science or surveys	Optional
		Funding Bodies / Donors	Review progress and outcomes (Medium)	Ensure accountability and use of resources	Optional
		Private Sector / Local Businesses	Provide input on economic impacts (Low)	Participate in impact assessments	Optional
8. Impact Assessment	Evaluate effectiveness of NbS, support adaptive management, and inform future planning	Project Monitoring / Evaluation Team	Conduct quantitative and qualitative analysis (High)	Lead the impact assessment and produce reports	Necessary
		Local Government / Municipal Authorities	Interpret findings and integrate into policy (High)	Use results for policy and planning decisions	Necessary
		Stakeholder Groups (Communities, NGOs)	Provide feedback and validate results (Medium)	Participate in discussions and co-interpretation	Necessary
		Implementing Agencies / NbS Project Teams	Provide implementation insights (Medium)	Share lessons learned and operational data	Necessary
		Academic Institutions / Research Partners	Support analysis and interpretation (Medium)	Offer expert insights and publish findings	Optional
		Funding Bodies / Donors	Review impact and ROI (Medium)	Use findings to inform future funding decisions	Optional
		Private Sector / Local Businesses	Provide feedback on economic and social benefits (Low)	Participate in impact discussions	Optional

4 Status of Monitoring in NBRACER Regions

This deliverable presents a Monitoring Journey Guide intended to support the NBRACER Regions, including a detailed methodology for one of the key tasks of the project: the definition of KPIs.

The experience gathered throughout this process is highly valuable and can be exchanged among regions to foster bench-learning. Success stories can inspire and guide other regions, serving as a foundation for replication and upscaling efforts. Likewise, challenges and setbacks offer important lessons that can be shared and addressed collaboratively.

The five NBRACER Demonstrating Regions are currently progressing through their respective Monitoring Journeys (WP2/WP3/WP4, focused on Coastal/Marine, Urban, and Rural Landscapes, respectively). Each region is at a different stage, reflecting the diversity of its teams, starting points, and contextual conditions. While not all regions follow the steps in the exact order or include every suggested element, this chapter aims to report on the status of monitoring across the Demonstrating Regions.

Although the NBRACER Replicating Regions are not required to monitor their NbS, they may still contribute valuable insights and recommendations based on any steps they have undertaken. These contributions are typically shared through workshops and tailored meetings, rather than through this document.

It is important to note that not all regions were able to contribute to this deliverable before the established deadline. As a result, some sections may appear incomplete or blank. Nevertheless, this is an ongoing process, and future updates will continue to enrich the content.

The following subchapters provide updates on the regional monitoring journeys, offering a comprehensive overview of progress made so far. This will serve as the foundation for compiling lessons learnt throughout the monitoring process, which will be documented in Deliverables D2.2/D3.2/D4.2 (*“Lessons learnt from monitoring in marine and coastal/urban/rural systems in local NbS demos”*) toward the end of the project.

4.1 KPIs and Monitoring Plans

The sessions of a typical NbS Monitoring Journey should encompass the whole process and present in detail how their monitoring plan will be implemented. The results after completing the final stage of the plan should allow the region to understand the evidence in terms of effectiveness and assess the impacts of the NbS. There is no formal format to present the plan, but instead, various possibilities, offering the regions enough flexibility to choose the most appropriate option to design their plan.

As a reference, Table 7 presents a suggestion of structure to cover the minimum required content of a Monitoring Plan, including its four separate elements: Monitoring per se, Data collection, Evaluation, and Data storage plans, and considering the KPI as the key unit. Besides those, there are additional details that may be added according to the regionally established plan or specific needs.

Table 7: Overview of stakeholder involvement in the monitoring of NbS, outlining probable roles, level of participation and responsibilities of key stakeholder groups at each stage of the Monitoring Journey.

Plan	General aspect	Specific aspect	Description
Monitoring Plan	Where	Region	<i>Indication of the region (if applicable)</i>
		Intervention	<i>The intervention to be monitored (with description when needed)</i>
	What	Outcome	<i>Vision and goal expected (for example, from a ToC visioning exercise)</i>
		KPI (key unit)	<i>The indicators to be measured</i>
		Societal challenge	<i>The societal challenge to which the indicator responds</i>
		Specific metric	<i>Specification of the metric to be calculated</i>
	Who	Data collection	<i>The person responsible for collecting the necessary data</i>
		Data analysis (institution in charge)	<i>The responsible institution/member for analysing the data</i>
	When	Pre-intervention monitoring period	<i>Period (years) in which the KPI is being measured</i>
		Frequency (pre-intervention)	<i>Frequency of the regular measurements</i>
		Post-intervention monitoring period	<i>Period (years) in which the KPI is planned to continue being measured</i>
		Frequency (post-intervention)	<i>Frequency of the regular measurements</i>
Data Collection Plan	How	Data collection source	<i>Indication of the source of the data to be collected</i>
		Data collection methods	<i>Which method is used for gathering data (e.g., sensors, citizen science, live database, questionnaires, manual measurement, modelling, ...)</i>
		Targeted sample	<i>By what means will the required information be gathered (sample of soil, specific group of people, specific set of data, ...)</i>
		Target respondent	<i>Who/What will provide the required information</i>
Evaluation Plan	Who	Data analysis	<i>Responsible for the evaluation</i>
	How	Data analysis method	<i>Evaluation method to be used</i>
Data Storage Plan	Who	Data access	<i>Responsible for gathering the data</i>
	How	Outputs	<i>Reference on how the outputs will be analysed, and connected to the expected impacts</i>

The presented structure must be taken as guidance and a suggestion on how the process could be, although other methodologies may be applied to reach the expected goals. In the following subsections, a brief status of the monitoring process is included for each NBRACER region, which contains (1) a brief introduction on the selected solution to be monitored in NBRACER, (2) goals and expected impacts, (3) a set of KPIs, and (4) challenges and opportunities encountered along the traced journey. The evolution presented is not intended to be linear or simultaneous, since regions have launched the process from different starting points.

4.1.1 Cantabria (Demonstrating Region)

In the Cantabria region, seven actions have been selected to address different climate-related hazards across the three types of landscapes (Marine & Coastal, Urban and Rural). Independent monitoring plans have been designed to assess the effectiveness of each of these actions, as Demonstrating NbS (DEMOS) through measurements of KPIs. Below, a summary of the main aspects related to the status of each of them is presented.

INTERVENTION CAN-1: Renaturalisation of Dr. Diego Madrazo Avenue (Urban)

Description

By re-naturalising a section of the Dr. Diego Madrazo Avenue in Santander, the risk of flooding (pluvial) and heat waves is intended to be reduced. Mainly, the plan is to add more diverse vegetation (trees and shrubs) and to improve the infiltration of rainwater into the ground. Civil works have started in June 2025 and will be completed in December 2025.

Goals and expected impact

To create a climate resilient road, under the umbrella project of Santander Capital Natural, that will not only reduce climate risks but also provide well-being to the population through other co-benefits (air quality regulation, aesthetic value, biodiversity, ...).

Set of KPIs

A Before-After-Control-Impact (BACI) approach will be applied based on a network of atmospheric sensors, whose expansion and strategic location are being planned, to measure mean radiant temperature and other weather parameters. Then, a micro-scale temperature model (for the avenue) and a macro-scale temperature model (for the whole city) will be developed. Both a typical day for current weather and the future weather scenario will be chosen to focus the results. For assessing the effectiveness in terms of flooding reduction, a runoff micro-scale model will be developed to compare the effect of the works undertaken with the previous situation. Main KPIs are linked to thermal comfort and the area exposed to flood risk.

Challenges and opportunities

The collaboration with TECNALIA to create both a temperature model and with FIHAC to create the runoff micro-scale model is a great opportunity.

INTERVENTION CAN-2: Restoration of natural tidal regime in Oyambre estuary (Coastal)

Description

This NbS is based on the restoration of the natural tidal dynamics in estuarine systems by the lowering of a dyke that restricted the tidal flow since approximately 1950. This solution was implemented in 2019 with the aim of recovering native saltmarsh communities. This action is expected to reduce erosion problems in the dune system at the mouth of the estuary (a highly valuable touristic and recreational resource in the region) as well as flooding risks at the inner sections of the estuary.

Goals and expected impact

The initial goal was to restore biodiversity. However, this action is also expected to reduce erosion of the beach and dune system and flooding risk in the inner sections of the estuary and to enhance other co-benefits (CO₂ storage and water quality).

Pre-definition of the set of KPIs

The monitoring of this NbS is based on the selection of KPIs to monitor flooding (e.g. through the development of flood maps for different CC scenarios) and erosion (e.g. through the analysis of the evolution of the surface area occupied by intertidal mudflats and the beach and dune systems at the estuary mouth; and sedimentation/erosional rates) and associated co-benefits of this action, including biodiversity recovery (e.g. vegetation species composition and distribution) and CO₂ sequestration (changes in sediment and biomass organic carbon stocks).

Challenges and opportunities

The replication of this NbS to other estuaries of the region that have also been largely modified by humans (through land reclamation, tidal restriction) is a challenge due, among other reasons, to the public contestation (e.g., users of claimed areas). Standardised processes for stakeholders' identification and for public dissemination and engagement are needed. Monitoring the impact of this NbS in social, economic or governance dimensions was also a challenge due to a lack of expertise among the regional partners.

On the other hand, a PhD candidate has joined the FIHAC team to deepen this study to develop her PhD on the benefits of restoring intertidal areas to increase coastal resilience to climate change. The monitoring plan of the Cantabria DEMO will be highly related to this study.

INTERVENTION CAN-3: Green filtering by riparian forest to reduce impacts of forestry and livestock activities (Rural)

Description

Development and restoration of riparian forests functioning as green filters. These vegetated buffers aim to control the delivery of sediments into the river network. The intervention is particularly relevant in landscapes dominated by productive land uses, where erosion is exacerbated by two major factors in the Cantabrian region: wildfires and logging in plantation forests. This action is currently in progress, and replication assessment will take place during 2025-2026.

Goals and expected impact

Mitigate soil degradation, soil erosion and the impact of forest fires by enhancing the landscape's natural filtering capacity. Other co-benefits: biodiversity enhancement, improvement of water quality and aesthetic and cultural landscape value.

Pre-definition of the set of KPIs

The design of the control-impact experiment to select river reaches for water sampling in the coming months and the selection of informative KPI are currently being studied.

Challenges and opportunities

One challenge is the limited formal engagement and the lack of a replicable framework. As an opportunity, we can mention the identification of success stories, low-cost interventions and lack of major legal or institutional barriers. Interestingly, the effectiveness and monitoring of this NbS are being developed in depth as a part of a PhD thesis.

INTERVENTION CAN-4: Conservation of hillside forest (Rural)

Description

Forests, in general, and hillside forests, in particular, constitute areas of provision of multiple ecosystem services, such as thermal regulation by temperature buffering through shading and erosion regulation. Thus, conservation of this habitat is crucial for maintaining an adequate temperature range in the air under the canopy, which is essential for many ecological processes.

Goals and expected impact

Reduce the climate risks of changing temperature, precipitation or hydrological variability, water stress, drought, flood, soil degradation and soil erosion, as well as to provide some co-benefits (biodiversity conservation and carbon sequestration).

Set of KPIs

The monitoring includes different indicators related to hydrological variability, extreme events such as floods and droughts, and temperature changes that will be measured in Cantabria (infiltration rate/infiltration capacity, moisture index, soil temperature, land surface temperature, rate of evapotranspiration, thermal storage score, daily temperature range).

Challenges and opportunities

Although the implementation of this NbS requires a low intervention degree, the inclusion of conservation areas in national and regional conservation planning requires the agreement of multiple environmental organisations operating at multiple scales. In this aspect, land management agreements are a very effective tool for promoting partnerships for the conservation of nature, landscape and cultural heritage, and the region (Cantabria) offers entities with experience in land stewardship. Interestingly, the effectiveness and monitoring of this NbS are being developed in depth as a part of a PhD thesis.

INTERVENTION CAN-5: Assisted natural regeneration of mountain wetlands in Picos de Europa (Rural)

Description

Seasonal livestock exclusion to restore aquatic habitats and improve the capacity of mountain wetlands to adapt to changing temperature, precipitation/hydrological variability, drought and soil degradation. This action has been carried out annually since 2023.

Goals and expected impact

This action avoids the soil and vegetation degradation caused by cattle grazing and trampling on raised bogs, mires and fens, declared Sites of Community Importance (SCI), so a positive effect is expected in terms of mitigating soil degradation, climate risk and other co-benefits (water quality

regulation, biological control, biodiversity conservation, habitat fragmentation and loss, carbon sequestration).

Set of KPIs

A control-impact experiment (fenced vs unfenced areas) in some protected wetlands in Picos de Europa National Park. Several informative KPIs have been selected related to water management, green space management, climate resilience and biodiversity enhancement. Monitoring has just started, and the first soil, water and vegetation measurements have been recorded.

Challenges and opportunities

Some opportunities: LIFE DIVAQUA project (provided the funding for the implementation of this measure), commitment of the Fundación Camino Lebaniego to collaborate from 2025 onwards in the context of a Steps for LIFE project, and previous botanical characterisation of the wetlands in 2021 and 2024. Some limitations: difficulty in carrying out certain field tests and measurements in the presence of livestock, in some wetlands, the fenced area may undergo some modification from one year to the next, and the places are very difficult to access during the winter period.

INTERVENTION CAN-6: Floodplain environmental restoration to reduce flood risk (Rural)

Description

Environmental recovery of a 6 km length of the Saja river by expanding the floodplain, reactivating historic secondary channels, planting native species and eliminating exotic species. It includes several social participation activities such as volunteering days, workshops and custody agreements for the maintenance of spaces. Civil works are in process and will be completed in December 2026.

Goals and expected impact

The project has the dual purpose of recovering and improving river habitats, as well as providing effective protection against flooding. Other co-benefits: biodiversity enhancement, control of erosion, improvement of water quality and aesthetic and cultural landscape value.

Set of KPIs

The effectiveness of these engineering works will be primarily assessed through a model-based approach rather than direct field monitoring. The Cantabrian River Basin Authority (*Confederación Hidrográfica del Cantábrico*), as the promoter and implementer of the intervention, has developed a hydrodynamic model of the site that will be used to evaluate the performance of the intervention. The monitoring will consist of pre- and post-intervention simulations using the same hydrological boundary conditions. These simulations will allow comparison of key hydrological variables to quantify the mitigation effect of the intervention on fluvial flood risk. The results still need to be analysed.

Challenges and opportunities

This monitoring strategy ensures a cost-effective yet robust assessment of the engineering works, focusing on its core objective: reducing flood hazard in a critical area with both high risk and high ecological degradation. The growing presence of some invasive plants poses a serious threat to the scope of this action (i.e., affecting the original design of the infrastructure to prevent its spread). Relating to the sustainability of the intervention and social engagement, a stewardship

agreement is being drawn up for the land on which the environmental recovery has been carried out. It is led by the *Confederación Hidrográfica del Cantábrico* and includes the municipality councils of *Cabezón de la Sal* and *Mazcuerras*, and the main relevant actors in the area. One of the regional partners (*Red Cambera*) has been invited to participate in the stewardship agreement. The aim of this agreement is to monitor and maintain the restoration works that have been carried out in the framework of the solution implemented.

4.1.2 Central Denmark (Demonstrating Region)

Central Denmark is an area in Denmark along the west coast of mainland Jutland. It goes across three administrative regions (north, central, and south) as well as 14 municipalities. To limit confusion with the administrative region of Denmark, we refer to the demonstration region in Denmark as Atlantic region.

INTERVENTION CDK-1: Climate Road (Urban)

Description

The Climate Road is focused on Sustainable Urban Drainage of road surfaces and has taken a specific focus on the use of Permeable Asphalt Pavements (PAP) as a sustainable stormwater management solution. PAP is, nonetheless, not an NbS as such. The Climate Road demonstrate, therefore, a focus on the connection between PAP and NbS, such as raingardens and bioswales.

The final locations and demonstration design will be finalised in the third quarter of 2025, when permissions are obtained from the relevant stakeholders (i.e., road owners, landowners, utility companies). No monitoring has been conducted so far, but we expect to initiate a baseline for the specific demonstrator locations in the third quarter of 2025.

Goals and expected impact

The Climate Road demonstrator expects to conduct testing in at least two locations under two scenarios.

- Scenario 1: The demonstrator consists of an urban PAP which has already been constructed in central Lemvig, Denmark, in which drainage/tiles have been integrated in the structural layer of the PAP, allowing the collection of polluted rainwater from the PAP. After the rainwater is collected, it will be transferred to another location where a rain garden will be constructed. The collected rainwater will then be drizzled on the rain garden over a specific period and recollected using subsurface drainage/tiles, integrated in the rain garden, which can then be tested. This allows for testing of the inherent abilities of PAP to clean rainwater, or remove pollutants, and to what degree. The demonstrator, furthermore, allows testing of how using an NbS in connection to PAP can contribute to water quality improvements, and to what degree use of vegetation can remove pollutants such as nutrients and heavy metals, which have been reported to contaminate soil and groundwater below PAP in other research projects. The demonstrator is, however, an open-circuit demonstrator in which water is transported between locations. Transporting water between locations, however, makes it possible to get as close to a real-world scenario as possible for testing PAP and NbS in unison, which is why this is the primary demonstrator of the Climate Road in the Danish Atlantic Region.

- Scenario 2: The demonstrator relies on being granted approval to use an already constructed living lab, located in a town outside of Lemvig. The living lab has been developed to test water inlets to a small area, in which the inlet water is led to a PAP test area, after which the water is collected again for testing. The tested water is then transferred to another test area, consisting of a nature-reminiscent site, after which water passing this area is collected again for testing of water quality. Contrary to the testing in scenario 1, this demonstrator is a closed-circuit demonstrator. The demonstrator is, however, closer to a laboratory than a real-world setting, which is why this demonstrator is not the primary demonstrator.

Set of KPIs

The set of KPIs selected for monitoring this intervention is listed in Table 8.

Table 8: Overview of stakeholder involvement in the monitoring of NbS, outlining probable roles, level of participation and responsibilities of key stakeholder groups at each stage of the Monitoring Journey.

	Challenge	Goal	Indicator	Variable
Climate Road	Flooding	Sustainable Urban Water Management	Volume, Reusable water	M3
	Recipient pollution	Improved Water Quality (before/after)	Acidity, Nutrients, Heavy Metals, Particles, Microplastics	Ph, Concentration of N, P, K, Cu, Ni, Pb and Zn.
	Soil pollution	Soil Content (before/after)		
	Groundwater pollution	Improved Water Quality (before/after)		
		Urban Greening	Biodiversity	Number.

INTERVENTION CDK-1: Nørre (Nr.) Nissum (Rural)

Description

It is a sewage NbS in combination with existing grey infrastructure.

Goals and expected impact

Decentralised capture and cleaning of rainwater in Nr. Nissum.

Set of KPIs

Under construction.

Challenges and opportunities

It is a clear opportunity to include improvements of Fjaltring NbS - financed outside NBRACER, but with a similar purpose.

NEXT STEPS:

The region is currently working on getting the necessary approval to initiate the construction and final development of test areas to begin monitoring. We will likewise follow the introduced steps in previous sections of this report, to ensure we are in line with the monitoring specifications for

the NBRACER project. This includes finalising our monitoring strategy and team, baseline, and vision for the Climate Road. We additionally need to develop the KPI's and ready the pre- and post-implementation of monitoring.

4.1.3 Nouvelle Aquitaine (Demonstrating Region)

The Nouvelle-Aquitaine is the largest region in France, making it a very rich region in terms of ecosystems. The regional economy is primarily driven by agriculture, viticulture, and tourism, making it a vital area for these sectors in France. Nevertheless, the impacts of climate change are present and have consequences such as drought, heat waves, flooding, etc. One of the main challenges for the regional government is the water availability and the different ways to preserve it. Some strategic initiatives have been addressed, like the 2018 regional strategy on water and the 2019 Néo Terra roadmap, which focuses on ecological and energetic transitions, including preserving natural resources and biodiversity.

This regional concern led the Nouvelle-Aquitaine Region to choose demonstrators who are related to water resources, implementing NbS.

Both demonstrators are in rural areas, the first one aims to remeander a river section in the Marais Poitevin and the second one, RAMAGE project, deals with water infiltration in an aquifer.

INTERVENTION NAQ-1: Marais Poitevin

Description

The Vendié river is a tributary of the Mignon river, itself a tributary of the Sèvre Niortaise river, which represents the main water axis in the Marais Poitevin wetland. The Vendié river is at the very head of the southern part of the Marais Poitevin watershed, and its riverbed is strongly rectified; thus, the channel is no longer located in the valley bottom. It partially explains why the river is drying out each year. The alluvial plain of the Vendié valley is used for livestock, crops or wood. The area is a wetland of interest for biodiversity as the downstream part of the river is located in the Marais Poitevin Natura 2000 site and RAMSAR protected area.

This demonstrator aims to reconnect the Vendié riverbed to its alluvial plain and dynamically slow down the water flow. The main expected effects of river restoration are to ensure a better ecological continuity by maintaining a longer water presence through summer, to optimise groundwater recharge, and to prevent or limit flooding downstream in winter.

Goals and expected impact

To better understand the reaction of the phreatic water table (connected to the river level) regarding the restoration works, it is essential to monitor the surface and groundwater dynamics. The objective of the monitoring program is to highlight the **effects of the NbS on the water table recharge and the reduction of flood peaks**.

Set of KPIs

Table 9: The set of KPIs for Marais Poitevin.

KPIs	Description and justification
KPI-1	Soil conductivity mapping on 10 ha of plots along the riverside

KPI-2	Groundwater levels in 6 piezometers (3 upstream and 3 downstream), monitoring only the superficial water table
KPI-3	Surface water levels
KPI-4	Waterflows
KPI-5	Biophysical KPIs of groundwater and surface water to better understand the relation between the two, and the biological health of the river and its associated wet area.
KPI-6	Chemical quality of ground water and surface water (several chemicals and metals concentrations)
KPI-7	Flood vulnerability, humidity indicators, and drought indicators derived from remote sensing analysis at the scale of the Marais Poitevin watershed
KPI-8	Diversity and abundance of macroinvertebrates, biological status of the river regarding this tax
KPI-9	Diversity and abundance of fish, and the biological status of the river regarding this tax
KPI-10	Landscape photographic observatory to observe the landscape evolution throughout the year and before/after restoration works.

Flood vulnerability, humidity indicators, and drought indicators will be derived from remote sensing analysis at the scale of the Marais Poitevin watershed, and will be monitored by NBRACER beneficiaries MEOSS and ATOS.

All these **water quality and quantity KPIs** will help supply models built by Bordeaux INP and Sorbonne Université to demonstrate the effectiveness of such restoration works in recharging water table reserves, ensuring longer water presence and preventing floods downstream.

PNR and SMBVSN (Syndicat Mixte du Bassin Versant de la Sèvre Niortaise) are also conducting several **ecological studies** to showcase the benefits of this NbS for biodiversity:

- fish's biodiversity monitoring before and after restoration works.
- macroinvertebrates biodiversity before and after restoration works.
- global biodiversity and habitats study before and after restoration works.

Challenges and opportunities

To collectively build monitoring protocols and organise field work, the PNR led or participated in several meetings reported below.

Table 10: The meetings that were held to build monitoring protocols and to organise field work for Marais Potevain.

Category	Sub-category	Partners involved	Number of meetings	Number of field trips with regional partners
Framing the subject and research questions for the demonstration site		ATOS, MEOSS, PNR du Marais Poitevin, Sorbonne University, SMEAG, Bordeaux INP, AcclimaTerra, SMBVSN	6 (28/10/2024; 04/11/2024; 05/11/2024; 08/11/2024 x 2; 11/02/2025) including 4 internal meetings with the PNR only	

Development of monitoring protocols	Hydrogeology, biophysics, chemistry, and geophysics	PNR MP, Bordeaux INP, SMBVSN	6 (21/11/2024; 02/12/2024; 17/01/2025; 04/03/2025; 17/04/2025; 20/06/2025)	2 (21/06/2024 and 11/01/2025)
	Biological monitoring	PNR MP, SMBVSN	3 (13/11/2024; 11/12/2024; 28/04/2025)	1 (21/02/2025)
	Satellite imagery - Remote sensing	ATOS, MEOSS, PNR du Marais Poitevin, Sorbonne University, SMEAG, SMBVSN	5 (09/04/2024; 04/12/2024; 22/01/2025; 28/01/2025; 20/02/2025)	
Monthly meetings with French partners in the NBRACER project		ATOS, MEOSS, PNR du Marais poitevin, Sorbonne University, SMEAG, Bordeaux INP, AcclimaTerra, SMBVSN	12 (24/01/2024; 07/02/2024; 29/02/2024; 09/04/2024; 30/10/2024; 12/12/2024; 09/01/2025; 06/02/2025 ; 13/03/2025; 10/04/2025; 15/05/2025; 12/06/2025)	1 (07/02/2024)
Historical study of streams in the Marais poitevin watershed		PNR MP, Poitiers University, SMBVSN, Acclimaterra	1 (14/04/2025)	2 (21/05/2025; 18/06/2025)
Collaborations with LIFE Maraisilience		PNR MP	9 (11/02/2025; 25/03/2025; 19/03/2025; 11/04/2025; 14/04/2025; 28/05/2025; 11/06/2025; 16/05/2025; 23/06/2025 x2)	1 (03/06/2025)

Apart from the field visits reported in the table above, between 14 October 2024 and 31 July 2025, the PNR agent went onsite more than 40 times for the following purposes:

- To meet with landowners and sign agreements for the installation of piezometers.
- Prospect the site with several partners to equip the study site appropriately.
- Install a meteorological station.
- Install piezometers.

- Install probes measuring conductivity, temperature and water levels inside the piezometers and in the riverbed.
- Measure the water flows of the Vendié upstream and downstream.
- Convey a photographic observatory of the landscape.
- Participate in macroinvertebrates inventory.
- Participate in fish inventory.
- Download probes' data once they were in place, and measure biophysical parameters in piezometers and in the riverbed.
- Prepare and carry out the geophysical monitoring.

Next Steps

In addition to conducting scientific monitoring on the demo site over the next year, which is expected to account for approximately one-third of the PNR's agent working time, several paths of research are being considered to meet the project's objectives:

- Analysis of piezometric and hydrometric data produced by the EPMP (public structure in charge of water levels management in the Marais Poitevin) in relation to other Nature-Based Solutions projects carried out by the PNR, its partners, the SMBVSN or other local stakeholders. This analysis could also be related to the satellite imagery analysis carried out by ATOS and MEOSS, partners associated with the project.
- Discussions and elaboration of a participatory sciences project with research partners, Acclimaterra, and PNR. One interesting lead for this subject would be the monitoring of water levels in the Marais Poitevin.
- Promote other Nature-based Solutions implemented in the Marais Poitevin region. This action could be carried out in collaboration with the LIFE ARTISAN project.
- Close collaboration with LIFE Maraisilience, whose coordinating beneficiary is the PNR:
 - Promote the results of an investigation with elected officials and citizens on perceptions of climate change
 - Promote the climate change vulnerability assessment conducted within the LIFE Maraisilience framework until August 2025
 - Share all data produced on the NBRACER demo site on large-scale platforms built for the LIFE Maraisilience project
- Co-supervision of an internship which focuses on the history of watercourses in the southern part of the watershed of the Marais Poitevin (such as the Vendié) to better understand the evolution of their course and hydromorphology. The results of this internship will be used by the NBRACER project and by the SMBVSN to foster community engagement.
- Convey a qualitative investigation with landowners, farmers and local citizens to better understand enablers and barriers of such projects.

Note: All these leads won't necessarily be explored completely, depending on the time available. Ensure the monitoring, data reporting, and management of the project remain the main tasks for the next year.

INTERVENTION NAQ-2: Ramage

Description

The Garonne basin experiences significantly low water levels every year. For +30 years, SMEAG has supported the Garonne's flow from hydroelectric dams in the Pyrenees and Massif Central to preserve the river's ecological, hydraulic, and landscape features while maintaining economic activity, including the irrigation of around 100,000 ha of farmland. In the context of climate change, solutions for artificial recharge are being explored. This hybrid solution combines NbS with human intervention to activate the recharging system.

The project focuses on the section of the river bordered by the Garonne Canal on the left bank. The three main study sectors were chosen by their geological characteristics, making the artificial recharge an effective strategy to support the river flow during low water periods.

Three test campaigns are planned to refine the model and select infiltration sites. The model will test different hydroclimatic scenarios to simulate recharge operations. This experiment aims to determine if this solution can support the Garonne's flow in summer and thus being replicated along the entire Garonne to achieve a greater impact on the river's flow rates.

Goals and expected impact

The objective is to monitor the impact of the recharge on the Garonne aquifer and use a model to observe the propagation of the recharge bubble from the infiltration site to the Garonne River. The hydrological model also estimates the impact of recharge on the Garonne River. Indicators on water quality and quantity are being measured, and data on soil properties are collected to feed the model and simulate the recharge bubble's propagation.

Set of KPIs

Table 11: The set of KPIs for Ramage.

KPIs	Indicators
KPI-1	Quantitative status of groundwater table levels in 40 wells or piezometers
KPI-2	Depth to groundwater
KPI-3	Trend in piezometric levels
KPI-4	Soil type, parameters, and percolation rate (infiltration site)
KPI-5	Rate of water infiltration into the soil
KPI-6	Level of groundwater table (Tonneins site on the Garonne River)
KPI-7	Chemical status of groundwater (Good or Poor)
KPI-8	Water quality: general urban (various)
KPI-9	Nitrogen concentration
KPI-10	Metal concentration (2 field campaigns/year for groundwater, canal water and surface water)
KPI-11	Water flow
KPI-12	Evolution of wet area (photographic campaign)
KPI-13	Net surface water availability
KPI-14	Soil water retention capacity
KPI-15	Drought index (through satellite imagery)
KPI-16	Precipitation index (through satellite imagery)
KPI-17	Floodings (through satellite imagery)
KPI-18	Soil humidity (through satellite imagery)
KPI-19	Vegetation (through satellite imagery)
KPI-20	Monitoring of stygofauna (aquatic fauna in groundwater) with limited existing data

KPI-21	Drought vulnerability and flood hazard (indicator not yet implemented)
KPI-22	Socio-economic KPIs to understand levers and barriers for replication and upscaling in the Garonne watershed (support needed from NBRACER consortium)

Next Steps

Over the next two years, in addition to the scientific monitoring requiring several days of fieldwork to collect all the data, the hydrogeological model developed for each study area will be consolidated and tested.

The experiments conducted in 2024 and 2025 made it possible to target sites and verify the feasibility of infiltration. In the coming years, it is planned to infiltrate a significant volume and compare the results between the modelling and the experiments. This model comparison should allow for the final calibration of the model. Calibrating the model should make it possible to select sites that are technically favourable for infiltration and that will support the low water level of the Garonne.

For 2026, it was decided to extend the experimental period to be less dependent on hydroclimatic conditions. The experiment must address issues related to volumes, transfer times, and monitoring of the recharge bubble.

A parallel is drawn with the second recharge project in the Garonne Valley, located further upstream in the basin.

Specifically, if possible, the following are planned for 2026:

- Continue to equip the probe sites, depending on the available budget
- Create a control piezometer for one of the experimental sites
- Implement the infiltration test with a significant volume. This test is highly dependent on hydroclimatic conditions
- Improve the sampling method for analysing water quality in wells and lakes.

Over the coming months, Atos and MEOSS (members of the consortium) plan to work on monitoring indicators via satellite images. The indicators being considered are:

- Soil moisture index
- The level of gravel pits present on the sites
- Leaf area index.

This work is being carried out within the framework of the partnership, and similar indicators will be produced for the second site in Nouvelle-Aquitaine (Marais Poitevin Regional Natural Park). The soil moisture and leaf area index indicators should make it possible to determine whether recharge can be monitored by satellite and measure the effects of this recharge on the wetlands present near the infiltration sites.

In parallel with this scientific monitoring work, local consultation work continues with annual meetings with municipal officials and meetings with various local partners to share the project and define favourable infiltration sites. The support of local partners is essential for the successful implementation of the experiments and then of the project.

In one of the areas studied, a collaborative effort has been carried out. A hydraulic study will be conducted to determine how to meet the objectives of:

- Our infiltration project to support low-water levels
- The river syndicate project aimed at restoring ecological continuity while limiting the risk of overflow and flooding
- The national reserve project on the site, which aims to maintain water in its pond to preserve this rare ecosystem in the Garonne Valley

4.1.4 Porto (Demonstrating Region)

INTERVENTION POR-1: Quinta do Salgueiro (Urban)

Description

The Porto demonstration site aims to transform Quinta de Salgueiros (a 6-hectare plot, with 3 hectares within the NBRACER timeframe) into an urban park-laboratory.

Goals and expected impact

This urban park is designed to enhance mobility, accessibility, and overall quality of life by providing sports and recreational spaces for the community. At the same time, it will serve as a living laboratory (following the BioLab concept) for conducting research across various fields such as engineering, biology, archaeology, and the arts. The site will be used to develop and showcase NbS, assess climate adaptation measures, and promote the communication and dissemination of these initiatives. Moreover, the project seeks to actively engage the local research community, students, private developers, and citizens, fostering a collaborative and innovative environment.

Set of KPIs

Therefore, a diverse set of KPIs will be selected to measure the performance in several domains, namely, environmental and social. The monitoring plan, as well as the KPIs definition, is still in development in collaboration with the University of Porto partners.

Currently, the following monitoring activities are underway, while others are still in the planning stage. Some categories to be monitored are biodiversity, habitats, soil quality, air quality, noise and thermal perception, temperature, humidity, water, and engagement with stakeholders.

Challenges and opportunities

Currently, the team is assessing the needs of monitoring of Quinta de Salgueiros, mainly with the FCUP group, which is also a partner in NBRACER, through meetings and review of the monitoring plan. The collaboration with TECNALIA is also useful to help us focus on what we want to achieve in the end, and, hence, what indicators are crucial to measure the accomplishments made in the project. We are now finishing our monitoring plan, which we estimate to have as soon as possible, after reviewing with all the teams involved. This document will serve as a baseline for Quinta de Salgueiros monitoring, but will still be in constant update with new upcoming opportunities that may arise (e.g., educational program, open visits to Quinta de Salgueiros, workshops, among others). KPIs, as referred to previously, are being defined.

Next Steps

The next step is to close the monitoring plan, including a baseline list of KPIs to measure and defining who is measuring, what and how they will be measured. Additionally, we will link the KPIs to specific goals we want to achieve by the end of NBRACER, to successfully monitor and evaluate the implementation of the pilot and all the satellite initiatives. In fact, this will be the main challenge of the monitoring plan: to integrate the software and hardware components of the Quinta de Salgueiros project while keeping the number of KPIs manageable to avoid monitoring issues.

4.1.5 West-Flanders (Demonstrating Region)

INTERVENTION WFL-1: Constructed wetlands for decentralised water treatment (Urban/Rural)

Description

In West-Flanders, about 15% of the households are not connected to a water purification system, such as a sewage system or KWZI (small-scale water purification system) or IBA (individual treatment for water purification). Most of this unpurified water runs towards the ditches and streams. Some of the streams in West-Flanders are even used to create drinking water, so a better water quality is of utmost importance. To improve water quality, it is important to purify the water from as many households as possible, for example, by installing reed fields / constructed wetlands. This demo gathers knowledge about these systems to improve TRL and to set the first steps towards a broader implementation of this NbS.

This demonstrator is focused on the implementation of constructed wetlands for treating wastewater from decentralised households that are not connected to the sewer network. We selected 5 constructed wetlands to be monitored: two in provincial domains, two 'KWZIs' (small-scale household water purification systems, purifying household water from dozens of households) and 1 small system purifying water from 1 household.

Goals and expected impact

The goal and expected impact are to improve water quality and reduce pollution in urban and rural areas.

Set of KPIs

As such, the pre-selected KPIs correspond to water quality parameters and pollutant reduction rates.

We are planning to follow up on the systems monthly for a whole year. A water sample is taken manually in the field, and water quality parameters are analysed in the lab. We are looking at the following parameters; pH, Temperature, Conductivity, TSS (total suspended solids), SS (suspended solids), DO (dissolved oxygen in mgO₂/L), DO-% (dissolved oxygen in %), BOD (biological oxygen demand), COD (chemical oxygen demands), TN (total nitrogen), NH₄, NO₂, NO₃, NO₃ + NO₂, TKN (Total Kjeldahl nitrogen), TP (total phosphorous), ortho-P.

In case it is clear, changes should be made to the constructed wetland to improve its water purification efficiency; we might alter the monitoring scheme.

We are also planning to measure flow rates in 1 system that doesn't function as well as it could. Knowing how much water goes in (influent) and out (effluent) of the system can help us to better understand how this system works, and where potential points of improvement are possible.

Challenges and opportunities

The main challenges are currently maintenance and the lack thereof, adapting existing (often older) systems that don't work well, as well as scalability and mainstreaming of this type of solution. For example, monitoring of the constructed wetlands began in December 2024, but several challenges have already emerged. One of the wetlands located in a provincial domain can no longer be followed up on due to practical constraints, requiring the search for a suitable replacement system. Additionally, the installation of flow meter sensors has proven more complex than initially anticipated, particularly due to the low flow rates, which make accurate measurements difficult.

Opportunities could include enhanced ecosystem services and combining water purification with other co-benefits such as recreational and educational value.

Next steps

From 2025 to 2026, the plan includes installing flow meters in 1 KWZI if feasible, continuing sample collection and analysis, and selecting a new state-of-the-art constructed wetland for follow-up. Data on non-NbS alternatives will be gathered for comparison. Monitoring frequency will be reviewed based on results, and potential system improvements will be discussed with managers. The initiative will also explore ways to promote wider implementation of constructed wetlands in West-Flanders.

INTERVENTION WFL-2: Constructed wetland for treatment of industrial concentrate – Koksijde (Urban/Rural)

Description

The constructed wetland in Koksijde is designed to treat industrial concentrate from membrane filtration for drinking water production.

Goals and expected impact

The main objective is to reduce nutrient loads before discharge into the local watercourse, improving water quality and supporting local ecosystems.

Set of KPIs

The selected KPIs are water quality parameters indicating nutrient removal efficiency and removal of micropollutants.

Challenges and opportunities

The main challenges are integration with existing infrastructure and maintaining effective monitoring schemes. Opportunities to be further explored are focused on mainstreaming this NbS through stakeholder engagement.

INTERVENTION WFL-3: Differentiated mowing of waterways (Rural)

Description

This demonstrator focuses on the application of different mowing schemes for the 2nd category (non-navigable) waterways (e.g. partial mowing, biannual mowing, etc). This practice is aimed at reducing maintenance and operation costs, while potentially improving ecosystem services, such as water purification and water retention and improving biodiversity (breeding birds). This NbS demonstrator includes a qualitative study to assess barriers and enablers, focused on socio-economic, legal and organisational aspects. One of the main challenges is to find a site where the effect of this measure can be effectively monitored without the influence of other externalities (due to this challenge, we will not perform a quantitative monitoring in NBRACER). Opportunities lie in facilitating better communication and assessing stakeholders' perceptions regarding these practices.

Goals and expected impact

This demonstrator is focused on the co-design process for identifying barriers and enablers, and establishing a process for mainstreaming this NbS.

As such, we will conduct qualitative research, focusing on:

- gathering opinions and perceptions of landowners and other key stakeholders, e.g., through questionnaires, interviews, surveys, etc.
- socio-economic, legal, organisational, and governance aspects

This demo will not focus on one specific NbS at one specific location, but it will cover multiple applications of this measure and assess aspects important for mainstreaming differentiated mowing practices.

Set of KPIs

We do not have a monitoring plan or KPIs for quantitative data, since we will not measure them.

Next Steps

- We are also planning to select other waterways to perform the qualitative research (interviews related to the perception of landowners on differentiated mowing on a stream bordering their land).
- Continue literature study.
- Analyse the two conducted exploratory interviews with key stakeholders of the water management department of the Province of West-Flanders.
- Create a plan for performing the rest of the qualitative research. It will depend on the information gathered during the literature study and interviews.

INTERVENTION WFL-4: Effect of raising water level on cropland agriculture (Rural)

Description

This demonstrator aims to study the effect of weirs on water levels and soil structure in agricultural fields.

Goals and expected impact

The aim of the placement of weirs is to reduce the risks for downstream flooding and to retain water to be used in periods of drought.

Set of KPIs

The placement of the weirs is planned for the earliest in the fall of 2025, if weather permits. Monitoring will start this September. The selected monitoring KPIs are soil parameters (e.g., bulk density, TAW, RAW, porosity, pF curves, soil compaction and infiltration speed). A survey about the experience of farmers with these weirs and their overall view on them is also planned.

Challenges and opportunities

The main challenge is ensuring farmer adoption and effective stakeholder collaboration. Farmers remain sceptical of these benefits. Opportunities lie in the combination of co-benefits such as improved biodiversity in agricultural landscapes and better crop yields.

INTERVENTION WFL-5: Renaturalisation of streams in West-Flanders (Rural)

Description

This demonstrator focuses mainly on re-meandering waterways and riparian zones.

Goals and expected impact

The main expected impacts are reduced flood risks, improved water quality, and enhanced biodiversity.

Set of KPIs

This NbS demonstrator includes a qualitative study to assess barriers and enablers, focused on socio-economic, legal and organisational topics.

Our key areas of focus include:

- aspects related to socio-economic, legal, organisational, administrative, and governance aspects.
- Interviewing and surveying stakeholders (one interview has already been conducted by VLM and VITO) to investigate the socio-economic and governmental aspects of re-meandering and other projects.
- Gathering opinions and perceptions of landowners, farmers, and other stakeholders.
- Exploring the usefulness of existing tools such as 'Oeverzoneverkenner.'

This demo will not focus on a single NbS in the field but will cover multiple NbS simultaneously, primarily examining aspects important for mainstreaming. For specific cases, Natuurwaardeverkenner.be (a free-to-use, online tool to calculate ecosystem services) will be tested to quantify the ecosystem services. Hence, we do not have a monitoring plan or KPIs for quantitative data.

With respect to the status of the work, we have celebrated a workshop where we gathered information from stakeholders professionally involved in stream renaturalisation (e.g. via a SWOT analysis). We also performed a stakeholder mapping exercise to identify key stakeholders for engagement.

Challenges and opportunities

The main challenge is stakeholder engagement and their perception of the benefits, especially in the cases of land use change. Opportunities can be the application of ecosystem services quantification tools, such as the online explorer for riparian zones ('Oeverzoneverkenner').

Next Steps

We will interview key stakeholders (project managers, waterway managers, biologists, hydrologists, landowners, surveyors, etc.) involved in renaturalisation projects to gather lessons learned, good examples, enablers, and barriers.

We are planning to select a few cases where remeandering was already performed. We will investigate where it is possible to interview landowners to determine their perspective related to this type of NbS.

We will test how 'Oeverzoneverkenner' (translated: riparian zone explorer), a new tool developed in Flanders, can be used for co-design with stakeholders. This tool helps policymakers explore various riparian zone management options for chosen locations. Most importantly, it enables farmers, landowners, and watercourse managers to make collaborative decisions, providing them with guidelines and checking which management options have which impact at the parcel scale (see case Machuit).

We will examine technical, administrative, financial, legal, and organisational information and assess existing tools and potential improvements.

We are planning to create an information sheet regarding the most important technical, organisational and socio-economic issues to consider when implementing the NBS, including barriers and enablers, and a list of recommendations.

INTERVENTION WFL-6: Riparian zones in agricultural areas - case Machuitvallei (Rural)

Description

This demonstrator is situated on a regional scale (basin level). Based on understanding the baseline (step 2) and establishing a vision together with many local actors (step 3), one of the NbS that was selected to implement is 'riparian zones in agricultural areas'. This demonstrator focuses on establishing riparian zones in agricultural areas as a means of renaturalization on an implementation site in the Machuit valley (linked to demo 5).

Goals and expected impact

Riparian zones are expected to improve water quality, reduce nutrient runoff, and enhance biodiversity in agricultural landscapes.

Set of KPIs

This NbS demonstrator includes a qualitative study to assess barriers and enablers, focused on socio-economic, legal and organisational KPIs.

The selected monitoring KPI's are water parameters: (1) Water quality assessment based on existing datasets for the area, and (theoretically) calculating the effects of possible designs on these parameters. (Nitrogen, Phosphorous, Protected species, Pesticides) and (2) Water quantity assessment based on literature and extra calculations for the research area, considering runoff coefficients, buffer volumes [m³/m] and infiltration rates (K-values of soil).

Other implementation-based KPI's we consider: (1) main barriers for implementation, (2) main enablers for implementation, (3) mean time to construct riparian zones, (4) efficiency rates (cost-benefits) of riparian zones (comparing different types), (5) maintenance costs and impact.

Remark: For East-Flanders, the case Flemish Ardennes, we will investigate the same NbS and the same KPI's. One extra KPI will be added, considering the sediment losses and erosion rates.

Challenges and opportunities

The main challenges are related to finance and resources, as well as governance and stakeholder engagement. Opportunities to mainstream this NbS involve a better understanding of its benefits, which can be explored with the application of ecosystem services quantification tools, such as the online explorer for riparian zones ([‘Oeverzoneverkenner’](#)).

Next Steps

Currently, we are defining the KPIs, although at the same time, we are going through the pre- and post-monitoring.

We will discuss the monitoring parameters with the regional team and decide in which case to monitor. (East- or West-Flanders). We will organise a meeting with local actors to discuss riparian zones and investigate opportunities for implementation.

INTERVENTION WFL-7: Agro-ecological soil improvement practices on arable lands for climate resilience in the IJzer catchment (Rural)

Description

This demonstrator is situated on a regional scale (basin level). Based on understanding the baseline (step 2) and establishing a vision together with many local actors (step 3), one of the NbS that was selected to implement is ‘agro-ecological soil improvement practices on arable lands’.

Goals and expected impact

This demonstrator focuses on implementing agro-ecological practices to improve soil health and climate resilience in arable lands in an implementation site on the IJzer catchment in the Machuit

valley (link to demos 6 and 8). Enhanced soil quality through practices as non-tillage and carbon farming can increase climate resilience and reduce agricultural runoff. When this is embedded in a holistic, sustainable system, it creates a leverage to embrace truly regenerative agricultural methods that base food production on a healthy natural system (NbS) rather than a traditional grey system with lots of technology and chemical inputs. It is therefore a key NbS for systemic change.

Set of KPIs

This NbS demonstrator includes a qualitative study to assess barriers and enablers, focused on socio-economic, legal and organisational KPIs.

Monitoring parameters: For this demo, we will only (with certainty) monitor soil-water parameters in the East-Flanders case of VLM and in the case of Inagro for the polder for this NbS.

The selected monitoring KPI's are soil-water parameters: (1) nutrient content (Nitrogen, Phosphorous, ...), (2) carbon content [SOM], physical resistance [MPa], earthworm activity, aggregate stability, soil-moisture

Other implementation-based KPI's we consider: (1) main barriers for implementation, (2) main enablers for implementation, (3) process recommendations to support behavioural change with farmers and municipalities, (4) efficiency rates (cost-benefits), (5) costs and impact for the farmer, (6) recommendations to support and promote this NbS as a government.

Challenges and opportunities

The main challenges are related to behavioural change and the adoption of new practices by farmers, as well as gathering data and knowledge about this NbS. Opportunities for implementation have been created by the launch of a subsidy call for farmers, in which they implement these measures at no charge on government-owned land, as well as in their own plots.

Next Steps

We are now busy with step 5 (defining KPI's), while also busy with step 6 – 7.

We will discuss the monitoring parameters with the regional team and decide in which case to monitor. (East- or West-Flanders). We will follow up on the call for farmers in Machuit and organise a workshop with other cases about this NbS in 2026 to exchange insights between regions. (to be confirmed by Inagro)

INTERVENTION WFL-8: Sustainable farming practices (Rural/Coastal)

Description

This demonstrator focuses on sustainable farming practices such as non-tillage in the polder and carbon farming.

Goals and expected impact

These NbS aim at a better and more natural soil management resulting in a more climate robust agriculture.



Set of KPIs

The selected monitoring KPIs are soil parameters (e.g., chemical soil analyses, bulk density, TAW, RAW, porosity, pF curves, soil compaction and infiltration speed) and crop parameters (e.g., crop yield, crop emergence). A survey is planned with farmers to identify the enablers and barriers to implementing these techniques.

Challenges and opportunities

The main challenges are related to functional adaptation to climate change and financially de-risking the transition. Opportunities are facilitated by allowing farmers to test these practices on demo sites as success stories to be later disseminated among the stakeholders.

Next Steps

Next steps will include continuing the monitoring campaign, taking surveys with farmers about the enablers and barriers around non-tillage in the polder and carbon farming and communicating the monitoring results.

INTERVENTION WFL-9: Water level management in Oudlandpolder: Uitkerkse Polder (Coastal)

Description

This case is situated on a regional scale. We focus on Oudlandpolder, Uitkerkse Polder. The Oudlandpolder and the Uitkerkse Polder are two polder areas in the Belgian coastal region, but they are not identical. The Oudlandpolder is a larger area to the northwest of Bruges, encompassing several municipalities, including parts of Bruges, Blankenberge, De Haan, Zuienkerke, Jabbeke, and Oudenburg. The Uitkerkse Polder is a specific nature reserve within the Oudlandpolder, located between Blankenberge, Wenduine, Nieuwmunster, and Zuienkerke, and is managed by Natuurpunt.

Goals and expected impact

This demonstrator focuses on managing water levels in the Oudlandpolder and Uitkerkse Polder to enhance flood resilience and support local ecosystems.

Set of KPIs

This NbS demonstrator includes a qualitative study to assess barriers and enablers, focused on socio-economic, legal and organisational KPIs.

Monitoring parameters: We would like to collect interviews for this case on barriers that (i) exist in the perception of local actors, slowing down or blocking the process; (ii) exist in reality and are an important aspect to improve the process and expertise concerning water level agreements before upscaling.

Challenges and opportunities

The main challenge is effective stakeholder collaboration, especially in the case of land use change. Opportunities are to understand better how the water level agreement can be an important enabler for the climate resilience of an area.

Next Steps

Understand and observe the process of water level agreements and support the region to combine the process with climate resilience strategies.

4.2 Regional insights on their Monitoring Journey

This chapter outlines the progress made by the NBRACER Demonstrating Regions in developing and implementing their Monitoring Journeys, with a particular emphasis on the definition and application of KPIs. Despite the diversity in landscapes, interventions, and regional contexts, the regions share several methodological and strategic commonalities that reflect a coherent and collaborative approach to monitoring the effectiveness of their NbS. Each region has adopted a structured yet flexible monitoring framework that includes a Monitoring Plan, Data Collection Plan, Evaluation Plan, and Data Storage Plan. These components are designed to capture the effectiveness of NbS interventions through clearly defined KPIs, while allowing for regional adaptation based on specific needs and capacities.

Across regions, KPIs serve as the central tool for assessing the performance of NbS. Commonly selected KPIs include water quality and quantity indicators (pH, nutrient levels, flow rates), climate resilience metrics (flood risk reduction and drought indicators), biodiversity measures (species abundance and diversity), and soil health parameters (such as erosion rates and carbon content). In addition to these quantitative indicators, some regions incorporate –or are planning to do so– qualitative assessments through stakeholder interviews, perception surveys, and participatory workshops to capture socioeconomic/governance dimensions.

The regions also face shared challenges in implementing their monitoring strategies. Stakeholder engagement remains a complex issue, particularly in cases involving land use changes or conservation planning. Technical constraints, such as limited access to sites, low flow rates affecting sensor accuracy, and gaps in expertise—especially in socio-economic impact monitoring—have also been reported. Furthermore, some regions are still in the process of defining their KPIs or awaiting permissions, which has led to delays in monitoring.

Despite these, the regions are leveraging several opportunities to enhance their monitoring efforts. Collaborative research initiatives, including PhD theses and partnerships with universities and research institutes, are contributing to the scientific robustness of the monitoring plans. The use of remote sensing and hydrodynamic modelling is enabling large-scale assessments of NbS impacts. Many interventions are designed with replication and scalability in mind, offering templates for other regions to follow. Additionally, the multi-functionality of NbS, combining ecological restoration with social, recreational, and educational benefits, is being increasingly recognised and promoted.

At the time of this deliverable, the conclusion is that NBRACER Demonstrating Regions have made substantial progress in defining KPIs and initiating monitoring activities. Nevertheless,

monitoring is an ongoing and evolving process, and future updates are expected to enrich the content and provide a more comprehensive picture of regional progress.

In conclusion, the Monitoring Journey across NBRACER regions demonstrates a rich diversity of approaches that converge on shared goals of climate resilience, ecological restoration, and inclusive stakeholder engagement. The iterative nature of the process, combined with cross-regional learning and collaboration, positions NBRACER to generate robust insights into the effectiveness of NbS across varied landscapes. This collective effort will culminate in the compilation of lessons learnt, which will be documented in future deliverables (D2.2, D3.2, D4.2) toward the end of the project.

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