DELIVERABLE 5.2

Replication Guidelines for climate-resilient NbS for the replicating regions

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Disclaimer

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Statement of originality

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Table of Content

Executive Summary

This deliverable aims to support replicating regions (RRs) in developing and applying climate adaptation approaches based on nature-based solutions (NbS). Building interactions between front-runner regions (FRRs) and RRs reflects lessons learned from workshops regarding stakeholder engagement, governance challenges, and implementation barriers, particularly in relation to private land. It underlines the importance of participatory processes, cross-regional learning, and tailored guidance to ensure the transferability and scalability of NbS.

Keywords

Knowledge transfer; Replication potential; Implementation barriers; upscaling

1. Introduction

Scope of Deliverable 5.2

Deliverable 5.2 represents a relevant step in the LAND4CLIMATE (L4C) replication cycle, bridging the front-runner implementation phase (WP4) with the replicating region co-design process (WP5).
It builds on the strategic frameworks and implementation models developed by the Front-Runner Regions (D4.1), where the operational experience of testing NbS was first consolidated into structured, transferable approaches.
The implementation plans developed both the technical basis for NbS replication, through WP2 modelling (feasibility assessments and evidence-based design of hydro-meteorological and ecological measures), and the institutional and land governance foundations developed under WP3, which addressed ownership structures, incentives and coordination mechanisms required for multi-actor implementation on private and public land.
Deliverable 5.2 translates these operational lessons into region-specific replication pathways, providing the methodological bridge between demonstration and upscaling.
Each Replicating Region (RR) receives a tailored replication framework, which serves two functions:

1. It provides a comprehensive analysis of local environmental challenges, socio-institutional conditions, and governance dynamics influencing NbS deployment.
2. It translates transferable components (e.g. technical designs, engagement strategies, financing mechanisms, and monitoring frameworks) from the Front-Runner Regions (FRRs) into context-sensitive guidelines applicable to each RR.

The resulting replication guidelines follow a common structure to ensure methodological consistency while allowing for local adaptation: it captures local needs, identifies enabling conditions, and defines tailored actions and responsibilities for implementing climate-resilient NbS. Deliverable 5.2 thus acts as a strategic synthesis and initial operational toolkit, to empower regional and local actors in implementing NbS, particularly in complex multi-actor and private-land contexts. By linking tested NbS solutions to place-based policy frameworks and funding mechanisms, it provides replicating partners with actionable guidance on how to move from pilot knowledge to territorial transformation.

Challenges and Lessons Learned in the Replication Process

Key Challenges Encountered

- Language barriers and reliance on English in technical exchanges
- Sensitivity and complexity of working with private landowners
- Institutional instability (e.g. closure of a replicator's department due to budget constraints)
- Uneven institutional capacity and staff continuity across regions

What proved effective

- Actively listening to the needs and constraints of regions, rather than strictly applying predefined templates
- Allowing the Replication Framework to adapt to regional priorities and institutional realities
- Working through trusted local intermediaries to strengthen engagement with landowners and municipalities

Implications for Future Replication

- Future replication frameworks should include minimum resource requirements for replication regions
- Replication timelines should account for the social complexity of engaging private landowners
- Working with private landowners requires longer trust-building timelines than technical NbS design

2. Methodological approach

Role of replicating regions: selection and engagement of replicating regions

The methodological approach adopted builds upon a continuous and iterative process of knowledge transfer, and adaptive replication between the six front-runner regions (FRRs) and their associated replicating regions (RRs). The approach has evolved over two years of project implementation (2023-2025), progressively linking technical, governance, and participatory processes across all work packages. The original German RR*, Vulkaneifel, withdrew following budget cuts that affected its environmental department early 2026. By the time Rheinisch-Bergischer Kreis joined LAND4CLIMATE as the new German RR, these guidelines had already been prepared. Replication and capacity-building activities are now being initiated with the new RR. As no replicating region associated with the county of Euskirchen participated in the replication activities, Section 3 presents the outcomes for the five actively engaged RRs and the reasoning behind the absence of the RR in Germany.

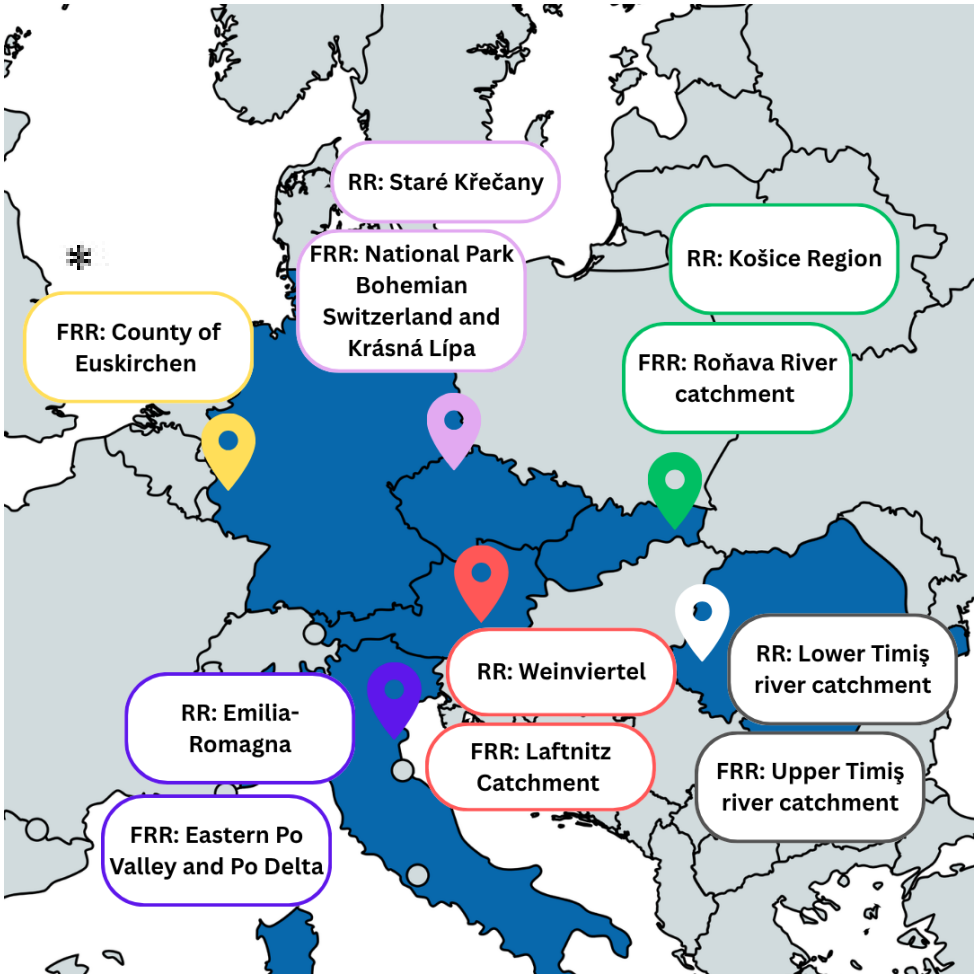


Image 1: FRR and RR within the LAND4CLIMATE Project. The original German RR*, Vulkaneifel, withdrew following budget cuts that affected its environmental department early 2026.

Framework definition and pairing (September 2023 – February 2024): The conceptual replication framework was established under WP1 (D1.2, D1.4, D1.6), defining the FRR–RR pairs and the structure for cross-learning activities. Each FRR identified and engaged a replicating region to ensure contextual relevance and alignment with replication objectives.

Knowledge exchange workshops (March – July 2024): Workshops enabled the transfer of core methodologies (CRA, cause-effect analysis, NbS design). They provided a first assessment of regional capacities, governance conditions, and learning needs, forming the baseline for replication planning.

Targeted exchanges between FRRs and RRs supported the contextualisation of replication pathways. Regions presented specific challenges and received tailored methodological guidance, contributing to the development of Template Action Plans. This initial phase was further consolidated by the Capacity Building and Trainings Strategy Workshop for FRRs and RRs (June 2025, online), which marked the transition from knowledge exchange to capacity development. The session allowed to identify priority knowledge gaps and align support modalities, including training, advisory services, and networking activities, with the needs of FRRs and RRs. It also contributed to integrating findings from the capacity needs assessment, leading to the co-definition of a first shared capacity-building strategy among project partners.

Joint synthesis at the Aachen meeting (October 2025): This in-person session enabled validation of findings, alignment of regional visions, and agreement on the methodological workflow for finalising Action Plans, through a roundtable, the peer-to-peer learning and a RRs gathering.

Targeted prioritisation and Theory of Change development (February 2026): A dedicated workshop with replicating regions focused on defining concrete priorities for scaling NbS on private land. This process was operationalised through the development and validation of region-specific Theory of Change (ToC) frameworks, linking barriers, enabling conditions and expected outcomes to structure replication and guide targeted support. ToC, originally developed in the 1990s in the fields of programme evaluation and philanthropy, provides a structured framework for explaining how a project is expected to create change by connecting inputs, activities, outputs, outcomes and long-term impacts. This approach helps clarify assumptions, align stakeholders and support more strategic decision-making for NbS replication (Connell & Kubisch, 1998).

Peer-to-peer exchange at the Košice meeting (March 2026): A collective in-person session enabled comparison across regions, identifying transferable lessons and context-specific constraints. The exchange supported alignment of approaches on NbS design, governance, financing and landowner engagement.

Replication Readiness and Replication Potential in D5.2

Building on existing frameworks in the NbS scaling literature (Frantzeskaki et al., 2019; Eggermont et al., 2015; Moore et al., 2015), this deliverable advances a conceptual contribution by operationalising two distinct but interrelated constructs — replication readiness and replication potential — specifically tailored to the challenge of upscaling NbS on private land in diverse regional contexts. While the broader literature has addressed scaling conditions, the LAND4CLIMATE framework refines

these concepts to account for the governance complexity, landowner dynamics, and institutional heterogeneity that characterise replication at the regional level.

Within this framework, replication readiness refers to the extent to which a region has the necessary conditions — technical, governance, financial and social — to implement NbS on private land, while replication potential reflects the scalability and transferability of these solutions within the regional context. Readiness is assessed through the development of region-specific Theories of Change (ToC), which allow for a structured identification of barriers, enabling factors and priority actions (cf. Connell & Kubisch, 1998). Replication potential is evaluated by analysing the applicability of NbS across different locations, the relevance of landowner groups, and the alignment with existing policy and planning frameworks. Together, these elements provide a practical basis to prioritise interventions and guide the definition of tailored implementation pathways.

Replication within LAND4CLIMATE is further conceptualised through two complementary dimensions: replication conditions and the replication process — a distinction that represents an original analytical contribution of this deliverable. Replication conditions refer to the inherent characteristics of each replicating region, primarily determined by their level of maturity in terms of governance structures, stakeholder engagement, data availability, and prior experience with nature-based solutions. These conditions shape the overall replication potential, influencing the feasibility and scalability of transferring approaches developed in front-runner regions. In contrast, the replication process reflects the dynamic and iterative interaction established with replicating regions throughout the project. Through workshops, bilateral exchanges, and continuous feedback loops, LAND4CLIMATE facilitates a co-development pathway where challenges and strengths emerge progressively — an approach aligned with learning-by-doing and adaptive co-management principles (Folke et al., 2005; Pahl-Wostl, 2009). This process-oriented dimension highlights both barriers — such as institutional fragmentation, limited engagement of private landowners, or regulatory constraints — and enabling factors, including growing stakeholder alignment, improved technical understanding, and increased ownership of NbS strategies.

Together, these two dimensions provide a comprehensive and original framework to interpret replication readiness, linking structural preconditions with the iterative, process-based methodology that underpins the project.

Key transferable lessons from Front-Runner Regions

The Front-Runner Regions demonstrate that successful NbS implementation on private land depends on combining **robust analysis**, **context-specific design**, and **strong stakeholder engagement**, supported by **enabling governance and financing conditions**. The following key lessons synthesise experience across regions and highlight the main factors for effective implementation and replication.

Build a strong analytical foundation

- Combine local knowledge with structured analysis (risk mapping, hydrological assessment)
- Use system-based approaches to identify risk dynamics, priority areas, and intervention needs

Design feasible and locally adapted NbS

- Tailor NbS to site-specific conditions, aligning the scale of the NbS (Debele et al., 2023) with the scale of the target climate risk
- Prioritise small-scale, low-maintenance, and cost-effective solutions
- Combine structural and nature-based measures where relevant
- Use expert input, feasibility assessments, and pilot projects to support design and replication

Engage landowners and build trust

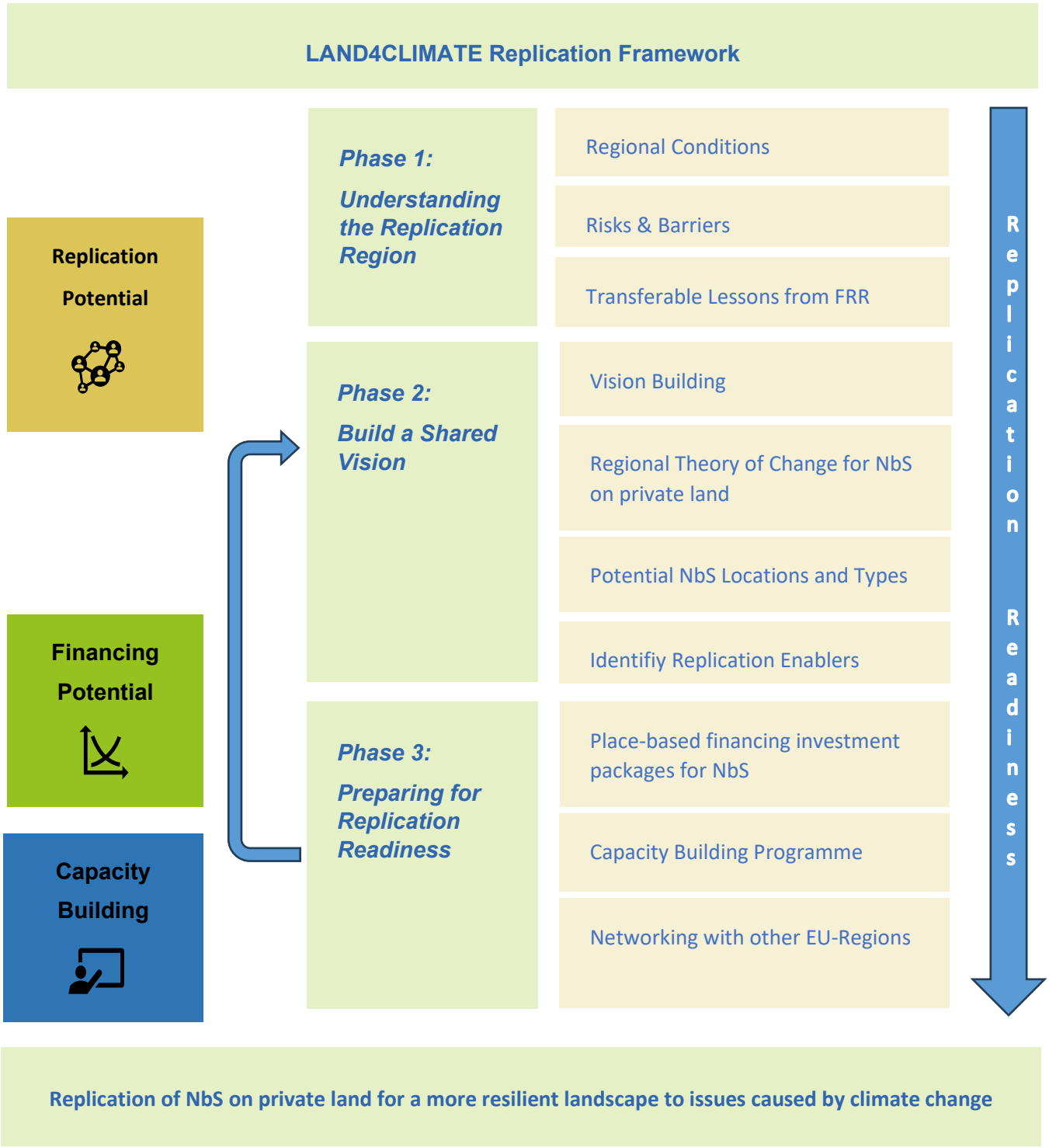
- Engage landowners early through clear, transparent, and continuous communication
- Recognise that trust-building takes time
- Focus on willing landowners and early adopters
- Speak “the language” of landowners, not of academics or technicians both linguistically and conceptually

Enable implementation and long-term sustainability

- Define clear agreements on roles, responsibilities, and land use
- Ensure permits, technical documentation, and agreements are in place before implementation
- Ensure cross-sector coordination and access to technical expertise, data, and guidance
- Establish monitoring systems and clarify long-term maintenance responsibilities
- Maintain flexibility to adapt NbS to local conditions and evolving constraints

3. Replication Guidelines per Region

The replication guidelines are structured according to the LAND4CLIMATE Replication Framework, which organises the content of this deliverable into three main phases. These phases provide a navigation structure for the reader, guiding the progression from regional assessment to the definition of tailored replication pathways for NbS on private land.



Phase 1 – Understanding the Replication Region

This phase presents the starting conditions of each region, providing the analytical basis for replication. This includes:

- a description of regional conditions and territorial context
- identification of key climate hazards
- analysis of risks and barriers, including governance and landowner-related constraints
- selection of transferable lessons from the Front-Runner Regions.

The objective of this phase is to clearly define the challenges and opportunities shaping NbS implementation in each region.

Phase 2 – Building a Shared Vision

This phase translates the initial assessment into a structured replication pathway, defining what each region aims to achieve and how. This includes:

- definition of a regional vision for NbS on private land
- development of a Theory of Change, linking barriers, actions and expected outcomes
- identification of potential NbS types and priority locations.

This phase represents the core of the replication logic model, where regions move from analysis to strategic orientation and define the basis for implementation.

Phase 3 – Preparing for Replication Readiness

This phase focuses on the conditions required to move towards implementation, building on the vision and priorities defined earlier. This phase identifies what is needed to reach implementation readiness and informs the development of further guidance (e.g. D5.3), including:

- identification of replication enablers, such as governance improvements, legal clarification, financing needs and landowner engagement mechanisms
- definition of priority actions and support needs to advance implementation
- assessment of replication readiness, based on the level of development of key elements (e.g. NbS identification, landowner engagement, financing considerations).

Together, these three phases guide the reader through the regional chapters in a logical sequence: from understanding the context, to defining a shared direction, to identifying what is needed for replication.

Emilia Romagna Region (Italy)

Agenzia Regionale per la Sicurezza Territoriale e la Protezione Civile dell'Emilia-Romagna - Ufficio Sicurezza territoriale e Protezione civile di Rimini
Emilia-Romagna Regional Agency for Territorial Security and Civil Protection - Rimini Office

Overview RR and FRR

The **Italian Replicating Region** focuses on coastal and peri-urban areas characterised by increasing exposure to climate hazards such as coastal flooding, erosion and heat stress. The region is characterised by a relatively strong institutional framework, existing planning instruments and experience in stakeholder engagement, but faces challenges in coordinating across governance levels and integrating NbS into existing land-use and sectoral policies.

The **Italian Front-Runner Region** implements NbS addressing coastal risks, flooding and ecosystem degradation through measures such as coastal restoration and ecosystem-based approaches. Activities focus on integrating NbS into ecological corridors, engaging stakeholders (including municipalities and landowner), and testing implementation pathways in real sites. Key challenges relate to governance complexity and coordination, while strengths include strong technical expertise and policy integration capacity.

Key Climate Hazards	Coastal flooding & erosion, Extreme precipitation, Heatwaves, saltwater intrusion
Spatial Scale Focus	Field scale – at the coastal interface
Key Landwoner Groups	Private (farmers/agricultural) landowners and coastal authorities
Priority locations	Selected coastal areas in the Rimini buffer zone
Most promising NbS	Coastal ecosystem restoration, buffer zones, nature-based coastal protection measures
Key Barriers	Governance complexity, coordination across levels, integration into planning instruments, financing mechanisms

Overview Replication Readiness

Key Climate Hazards Identified	Status: ■■■■■ *Advanced*
Vision and Goals	Status: ■■■■■ *Advanced*
NbS Porfolio for the Replication Region	Status: ■■■■□ *Advanced*
Landowners Identification	Status: ■■□□□ *Advanced*
Cost-Benefit Analysis on NbS	Status: ■■□□□ *Not Advanced*
Financing of NbS on Private Land	Status: □□□□□ *Not Advanced*

Phase 1: Understanding the Replication Region

Regional Conditions

The Emilia-Romagna Region, acting as the Italian replicating region, is in the northern Adriatic coastal plain, one of Europe's most climate-sensitive coastal zones. Regional vulnerability is strongly conditioned by the geomorphology of the Po Delta, an area historically affected by **subsidence, sea-level rise, saline intrusion and coastal erosion**. Over recent decades, these pressures have been intensified by anthropogenic factors such as river regulation, land reclamation and intensive agriculture, all of which have altered sediment flows and reduced the natural buffering capacity of coastal landscapes.

Climate risks identified in the region include:
- coastal flooding and storm surges affecting low-lying coastal and wetland areas
- saltwater intrusion and soil salinisation in coastal agricultural lands
- riverbank erosion and degradation of transitional ecosystems
- summer droughts affecting soil moisture, wetland ecosystems and salt-wedge intrusion
- heat stress exacerbating ecosystem degradation and water scarcity.

Municipalities report increasing pressure on coastal and wetland systems, with recurring risks to natural habitats and adjacent land uses. Coastal zones are particularly exposed to erosion and flooding events, while transitional areas (e.g. dune riverbanks) show signs of ecological degradation and reduced resilience.

The Italian region's hydro-climatic vulnerability is compounded by:

- high exposure of coastal and low-lying areas to sea-level rise and extreme events
- degradation of natural buffers such as dunes and riparian vegetation
- competing land uses in coastal zones (agriculture, infrastructure, tourism)
- dependence on engineered solutions with limited integration of NbS approaches
- challenges in long-term maintenance and governance of implemented measures.

Private Landowners

The region provides technical and institutional support to private landowners, **particularly beach operators**, whose activities take place in areas highly exposed to coastal hazards. These stakeholders are generally motivated by the need to protect their assets but express concerns regarding the costs, maintenance requirements and effectiveness of NbS.

Key Landowners

- Beach operators managing coastal concessions and directly exposed to erosion and flooding risks
- Private coastal landowners affected by coastal hazards
- Landowners managing transitional areas (e.g. wetlands and riverbanks)

Main challenges in working on private land consist of:

- legislative constraints
- limited knowledge of NbS
- fragmented ownership
- limited incentives
- mistrust in institutions
- legal restrictions and land-tenure uncertainties.

Opportunities for cooperation with private landowners include:

- education and awareness-raising
- potential for ecosystem service payments
- alignment of NbS with rural and coastal tourism.

Systemic Barriers

Several systemic barriers have been identified, such as:

- unclear responsibilities for long-term maintenance of NbS, particularly for measures located across public–private boundaries
- regulatory constraints limiting experimentation and co-design of NbS within protected coastal areas
- fragmented governance, with responsibilities divided among regional authorities, municipalities and basin agencies
- procedural delays and reduced accountability resulting from overlapping institutional competences
- limited direct support mechanisms to assist landowners and operators in accessing NbS-related funding schemes.

Nonetheless, several enabling factors support replication potential:

- existing regional experience in defining public funding guidelines relevant to coastal adaptation
- opportunities to strengthen cooperation through education and awareness-raising on ecosystem services
- potential integration of NbS with tourism-related activities in high-pressure coastal zones
- increasing recognition of the need for coordinated spatial planning and institutional alignment for adaptive coastal management.

Transferable Lessons from the Front-Runner

Climate Risk Identification

The Po Delta Front-Runner Region and the Emilia-Romagna replicating region share policy objectives, institutional collaboration and a common coastal context. Lessons learned from the FRR include:

- development of vulnerability profiles for low-lying coastal zones exposed to storm surges, erosion and saline intrusion
- use of integrated data and risk mapping to identify priority intervention areas
- strengthen its NbS planning by complementing strong local knowledge with more structured Climate Risk Assessment approaches.

NbS Planning and Implementation

The Po Delta case demonstrates how NbS can be effectively planned and designed to address coastal and ecosystem challenges, offering valuable insights for replication.

- NbS design is strongly based on local geomorphological conditions and site-specific characteristics
- Co-design processes and feasibility assessments support the definition of viable interventions
- Clearly defined expected impacts strengthen the transferability to replication contexts
- Specialized ecological and engineering expertise is required for effective design and implementation

Private Landowners Identification and Engagement

Transferable lessons highlight:

- active participation of local authorities, landowners and beach operators in co-design workshops and community meetings (approx. 100 participants across sessions)
- need for clear legal agreements (e.g., dune hosting agreements) to build trust and clarify roles
- addressing concerns related to costs, asset protection and legal uncertainty.

Replication Challenges

- Fragmented governance (at the land-sea interface) and administrative complexities affecting NbS implementation and long-term maintenance
- Long-term management, ownership responsibilities and continuity of NbS interventions
- Cross-cutting constraints such as limited time/capacity, knowledge gaps on NbS, and language barriers

Replication Strengths

- Availability of well-developed NbS planning and implementation approaches from the Front-Runner Region
- Strong technical and planning experience in NbS design, including site-specific and coastal solutions

Phase 2: Build a Shared Vision

Vision Development

Vision of the Region

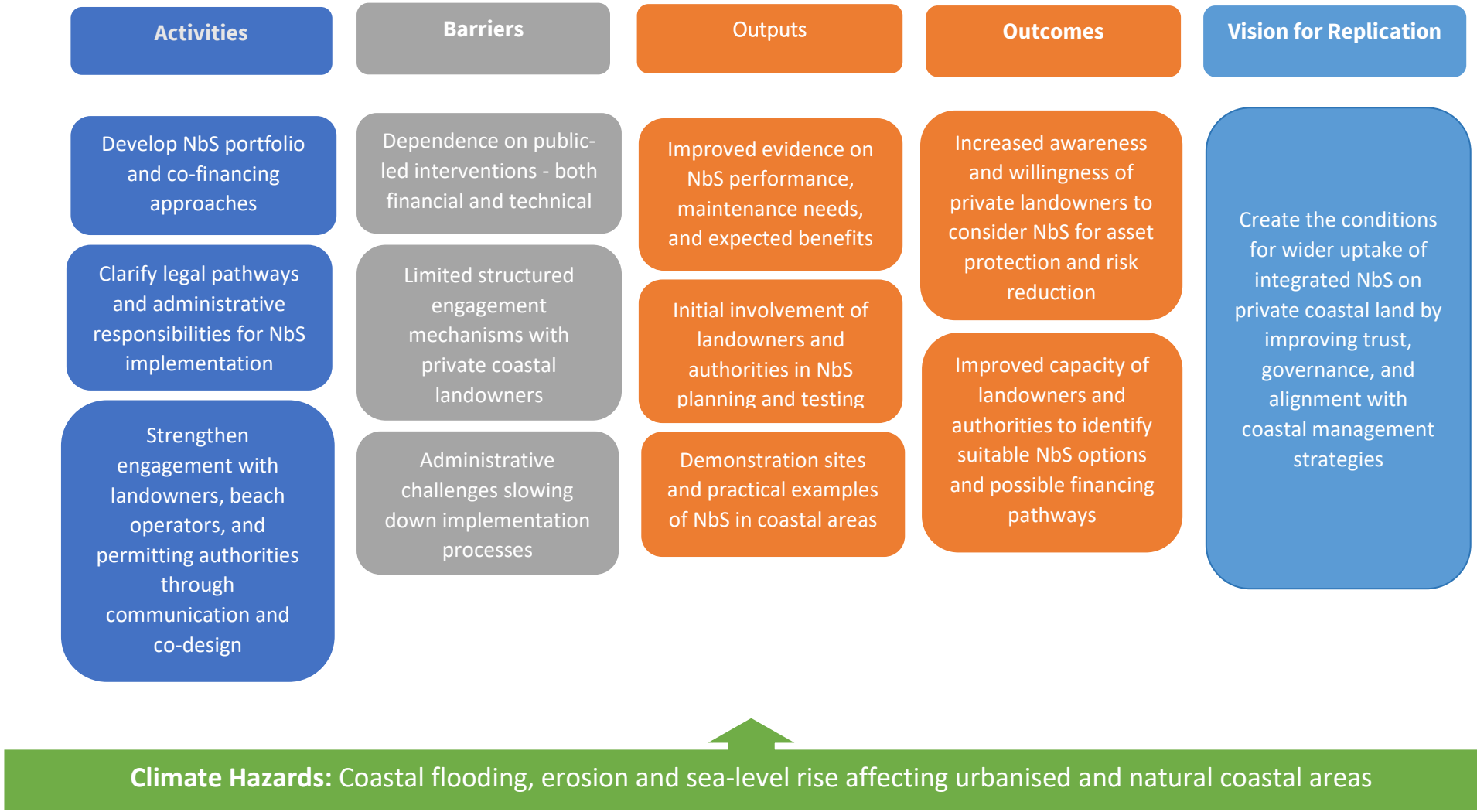
The regional vision focuses on the defence of urbanised areas and the planned retreat of natural areas as long-term strategies for coping with sea-level rise. The overarching aim is to reduce exposure to coastal hazards, protect strategic assets, and coordinate land-use decisions as part of an integrated adaptation strategy.

Vision of Working with Private Landowners

The region recognises the key role of private landowners in coastal areas, including beach operators, in enabling the implementation and long-term sustainability of NbS. In particular, the region aims to:

- explore co-financing schemes and incentive mechanisms to support NbS uptake
- develop shared strategies for reducing hydrogeological risks and managing ecosystem (at the coastal and river basin scale)
- clarify legal and administrative pathways for collaboration within existing frameworks
- strengthen communication and awareness of the benefits of NbS
- enhance monitoring and evaluation to demonstrate NbS effectiveness and support replication.

Regional Theory of Change for NbS on private land



Potential locations and NbS types

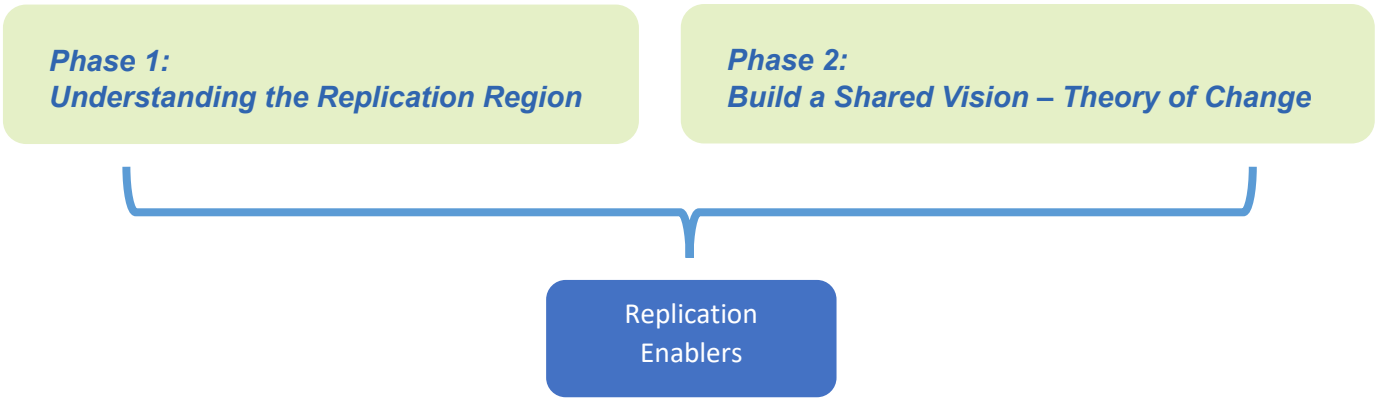
Main goals of implementing NbS in the Emilia-Romagna Replicating Region, based on lessons learned from the FFR:
to reduce exposure to coastal hazards and protect strategic assets through the application of site-specific NbS; enhance ecosystem resilience and integrate NbS into coastal defence planning; enable active involvement of private landowners in implementation and long-term management.

Identification of priority locations and NbS types in the RR:

Key Climate Hazard	Target Area	Potential NbS	Spatial Scale
Coastal flooding & storm surges	Urbanized coastal areas and concession beaches exposed to flooding	Dune restoration; vegetated buffers; hybrid NbS integrated with nourishment	Micro-catchment scale
Coastal erosion & shoreline retreat	Eroding coastal stretches, including densely urbanised areas (e.g. Rimini province)	Dune restoration; sediment management combined with vegetation; buffer systems	Field (coastal) scale
Degradation of transitional ecosystems	Wetlands, river mouths and coastal transition zones	Salicornia planting; restoration of coastal vegetation; wetland buffers	Landscape scale
Loss of biodiversity and natural protection systems	Areas with degraded or absent dunes and vegetation	Dune restoration; deep-rooted vegetation banks; restoration of natural buffers	Field (coastal) scale

Phase 3: Preparing for Replication Readiness

Replication Enablers



Replication Enablers for the Emilia-Romagna Region are:

- Design and adapt replicable NbS suited to coastal and concession-based private land contexts, ensuring applicability in urbanised coastal areas
- Clarify legal and administrative conditions for NbS implementation on private land, with a focus on responsibilities during and beyond concession periods
- Develop co-financing approaches that enable both implementation and long-term maintenance of NbS
- Strengthen education and communication to increase understanding of NbS benefits
- Provide practical guidance and peer-learning opportunities to support landowners in selecting suitable NbS for their land
- Improve monitoring and assessment of NbS performance, to demonstrate effectiveness and build confidence among stakeholders
- Ensure alignment of NbS with existing coastal management and defence practices, particularly in highly urbanised coastal segments

RESOURCES

The replication process in the Italian region draws upon relevant EU initiatives on NbS, providing practical tools, methodologies and case-specific insights to support implementation on private land. LAND4CLIMATE Project Results:

- NbS strategy and implementation plans for front-running regions
- Climate Risk Analysis Front Runner Regions
- **Configuration of local climate risk outcomes with climate-resilient NBS integration and permitting pathways**

- List of stakeholders preferred no-regret NbS measures – Frontrunning Regions
- Visualisation of cause-effect relations and potential systemic effects - FRR

Relevant EU projects on NbS, coastal protection and resilience include:

- **NBRACER**, exploring NbS for coastal risk reduction and adaptation pathways
- OPERANDUM; demonstrating NbS implementation and performance across multiple sites
- **CARDIMED**, supporting climate resilience in Mediterranean regions through NbS uptake
- **CoCliCo**, providing tools and data to support coastal risk assessment and adaptation planning
- **RESIST**, supporting regional climate resilience strategies and NbS implementation

Weinviertel Region (Austria)

Amt der Niederösterreichischen Landesregierung
Office of the Lower Austrian Provincial Government – Weinviertel Region

Overview RR and FRR

The **Replication Region** Weinviertel is a predominantly agricultural region facing increasing climate pressures, including heavy rainfall, soil erosion, surface runoff, and seasonal droughts. These challenges threaten soil fertility, infrastructure, and long-term productivity. Within the LAND4CLIMATE, the region focuses on replicating small-scale NbS on private land to enhance water retention, reduce erosion, and strengthen collaboration between farmers and municipalities.

The **Front-Runner Region** Lafnitz catchment serves as a Front-Runner Region addressing similar climate hazards such as droughts, intense rainfall, and soil erosion. LAND4CLIMATE actions focus on catchment-based NbS, including riparian buffers, adaptive land management, and landscape elements to reduce runoff and sediment transport. A key success lies in strong landowner engagement and co-design processes, demonstrating how tailored NbS and coordinated governance can enhance water retention, reduce flood risks, and support resilient agricultural systems.

Key Climate Hazards	Flooding & Extreme Precipitation, Drought, Heat stress, land degradation
Spatial Scale Focus	Field scale and Water Catchment scale
Key Landwoner Groups	Farmers & agricultural landowners
Priority locations	3-4 farmers in the region
Most promising NBS	Agroforestry, Hedges, Vegetated buffer stripes, green drainage paths
Key Barriers	Financing of NbS, Landowners attitude towards change, availability of land and land-use trade-offs

Overview Replication Readiness

Key Climate Hazards Identified	Status: Advanced
Vision and Goals	Status: Advanced
NbS Porfolio for the Replication Region	Status: Advanced
Landowners Identification	Status: Advanced
Cost-Benefit Analysis on NbS	Status: Not Advanced
Financing of NbS on Private Land	Status: Not Advanced

Phase 1: Understanding the Replication Region

Regional Conditions

The Weinviertel Region, located in the northeast of Lower Austria, is the Austrian Replicating Region. Characterised by extensive loess soils, open agricultural landscapes, and gentle rolling topography, the region is increasingly exposed to **intense convective rainfall**, **high runoff**, **severe soil erosion**, and **seasonal droughts**. These hazards interact to compromise soil fertility, reduce groundwater recharge, and increase sediment loads in rural drainage systems and settlements.

The most critical climate risks include:

- **heavy rainfall events** causing flash floods in micro-catchments
- **sheet and rill erosion** on loess slopes, especially on intensively cultivated fields
- **sediment deposition** blocking rural roads and drainage ditches
- **summer droughts** reducing crop yields and increasing soil compaction
- **temperature extremes** exacerbating soil degradation and evapotranspiration.

Municipalities report recurring damages to local infrastructures -rural roads, culverts, drainage lines- frequently requiring emergency maintenance. Erosion hotspots have been mapped in several cadastral areas, and multiple villages have recorded repeated stormwater overflows after extreme precipitation events.

Private Landowners

Agricultural stakeholders are at the core of regional land management, with the following actors identified:

- **Local farmers and/or their representatives** (District Chamber of Farmers and Chamber of Agriculture)
- **Municipalities** (responsible for local drainage, infrastructure and settlement protection)
- **Local water and soil associations** (Wasserverbände)
- **Regional agricultural chambers and advisory services**.

Challenges in working on private land include:

- reluctance to reduce productive area for buffer strips or retention features
- high variability of farming practices across small parcels
- limited incentives for long-term maintenance
- insufficient awareness of NbS co-benefits
- unclear procedures for cross-boundary cooperation
- perceived administrative burden linked to agri-environmental schemes.

Opportunities include:

- local recognition of soil erosion as a growing economic risk

- municipal interest in reducing road-damage and flooding costs
- potential integration of NbS into existing agri-environmental payments (ÖPUL)
- increasing demand for climate-resilient farming systems.

Systemic Barriers

Several systemic barriers have been identified, such as:

- fragmented governance: responsibilities for water, agriculture, land-use planning and biodiversity are distributed across different institutions
- lack of demonstration sites within Weinviertel showing NbS performance under loess soil conditions
- limited municipal technical capacity to evaluate NbS or redesign drainage systems
- absence of stable cooperation frameworks between farmers across cadastral boundaries
- financial uncertainties related to maintenance responsibilities and long-term agreements.

Nonetheless, several enabling factors support replication potential:

- Lower Austria's policy commitment to soil conservation and water retention
- municipal willingness to participate in knowledge exchange
- existing local programs targeting erosion mitigation
- increasing farmer interest in regenerative and conservation-based practices.

Transferable Lessons from the Front-Runner

Climate Risk Identification

The Lafnitz Front-Runner provides a practical reference for climate risk identification. Transferable insights include:

- the use of a catchment-based perspective to understand runoff dynamics and erosion processes
- the identification of erosion-prone areas based on slope characteristics, soil conditions and observed impacts
- the consideration of land-use practices and rainfall patterns when assessing hydro-meteorological risks
- the documentation of recurrent stormwater events and related damages to support the prioritisation of NbS measures.

NbS Planning and Implementation

The Lafnitz experience demonstrates that:

- NbS must be tailored to slope gradient, crop system and soil erosion dynamics
- maintenance needs must be clearly defined from the outset
- demonstration sites are critical for farmer acceptance.

Private landowners Identification & Engagement

The most transferable lessons learned from the Lafnitz region are:

- participatory co-design workflows involving landowners, municipal officials and advisors
- the role of local intermediaries, including the agricultural chamber and the practice-oriented organisations Humus+, acting as mediators
- strategies for addressing landowner concerns (e.g., loss of productive area, maintenance).

Replication Challenges

- Low capacity to attend in-person meetings and online meetings due to lack of resources in the project
- Working in English and with diverse legal systems across European countries in the context of landownership and private land policies

Replication Strengths

- Has developed a close relationship with the Front-runner regions in the past 12 months
- FRR developed **NBS Portfolio**, which contain many supporting ideas for the RR

Phase 2: Build a Shared Vision

Vision Development

Vision of the Region

Weinviertel's replication vision is to evolve towards a **water-resilient agricultural landscape** that retains water, reduces runoff, and enhances soil functions through a distributed system of NbS. The region seeks to reduce vulnerability to extreme rainfall while maintaining agricultural productivity and supporting long-term ecological regeneration.

Vision of Working with Private Landowners

Farmers are essential partners for any NbS-led transformation. The region aims to:

- develop mutual trust and shared ownership of NbS adaptation paths
- co-design solutions that fit local farming systems
- identify cost-sharing models for maintenance and to encourage cooperation
- support farmers in navigating ÖPUL and other incentive schemes.

Regional Theory of Change for NbS on private land

Activities	Barriers	Outputs	Outcomes	Vision for Replication
Explore potential for ecosystem service payments	The amount of land available for agricultural use is decreasing (business assets)	Tested NbS measures that improve water retention and reduce flood risks	Private landowners voluntarily establish compensated cultivation buffer strips along regulated waterways, supporting water retention, ecosystem restoration, and climate adaptation	Support the transition toward a water-resilient agricultural landscape that retains water, reduces runoff, and enhances soil functions
Connect landowners with funding opportunities	Limited willingness among landowners and farmers to adopt land-use changes	Cost-Benefit evaluation of NbS		
Understand cost evaluation, best practice examples, human resources	Limited financial incentives and uncertainty about long-term economic benefits			
Develop a local NbS Portfolio				

Climate Hazards: heatwaves and droughts followed by heavy rains leading to floods and soil degradation

Potential locations and NbS types

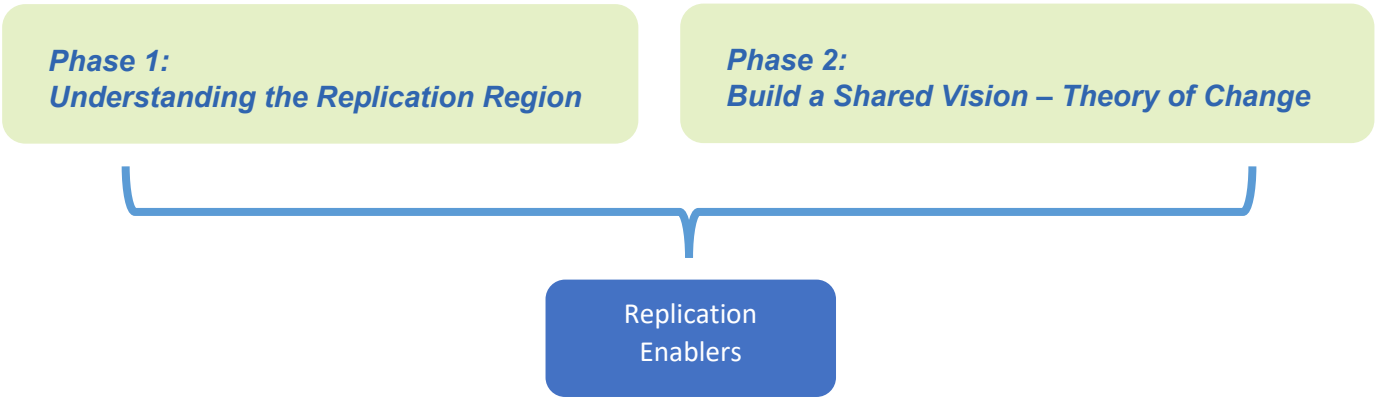
Main goals of implementing NbS in the Weinviertel Replication Region, based on lesson learned from the FRR: to reduce erosion and runoff in vulnerable micro-catchments; enhance water retention capacity of agricultural soils; strengthen municipal and regional capacity for NbS planning; facilitate cooperation across landowners and authorities. The region envisions a multiple small-scale NbS provide aiming at providing cumulative hydro-meteorological benefits.

Identification of priority locations and NbS types in the RR:

Key Climate Hazard	Target Area	Potential NbS	Spatial Scale
Flash floods from heavy rainfall	Micro-catchments draining into rural settlements	Small retention & sedimentation basins; infiltration trenches & swales	Micro-catchment scale
Sheet & rill erosion on loess slopes	Slopes with recurrent erosion	Vegetated contour buffer strips; agroforestry rows	Field scale
Sediment deposition blocking infrastructure	Drainage lines & road culverts	Re-vegetated field margins; green drainage paths; small sediment traps	Field to micro-catchment scale
Summer drought & low soil moisture	Fields with compacted soils & low organic matter	Agroforestry systems; hedgerows; soil cover enhancement	Field scale
Land degradation & biodiversity loss	Open agricultural landscapes with scarce vegetation	Hedgerows; micro-wetlands in depressions; diversified field margins	Landscape scale

Phase 3: Preparing for Replication Readiness

Replication Enablers



Replication Enablers for the Weinviertel Region are:

- **Strong institutional coordination and policy alignment:**
  Effective collaboration between agricultural, water management, and flood risk authorities (e.g. across CAP, WFD, and Floods Directive) enables coherent NbS planning and reduces regulatory conflicts.
- **Engagement of key intermediaries and advisory networks:**
  Actors such as the Landwirtschaftskammer, Maschinenring, BioAustria, and initiatives like Humus+ play a crucial role as "boundary spanners", facilitating communication, trust-building, and uptake among farmers.
- **Access to funding schemes and existing support instruments:**
  Availability of agri-environmental funding (e.g. ÖPUL) and cross-departmental financial support provides a foundation for implementing NbS, especially when combined with efforts to identify complementary funding sources.
- **Availability of established knowledge and measure catalogues:**
  Existing NbS portfolios and technical guidelines support faster implementation by providing tested measures adapted to local conditions.
- **Stakeholder engagement through demonstration and exchange formats:**
  Farm visits, excursions (e.g. to Styria), and workshops foster peer-to-peer learning, increase awareness, and strengthen acceptance among farmers and local authorities.
- **Integration of NbS into education and long-term capacity building:**
  Embedding NbS concepts into agricultural and forestry education systems helps ensure long-term uptake and supports a generational transition towards climate-resilient land management.

Resources

The replication process in Weinviertel draws upon European and Austrian experiences that explore water retention, soil protection, and NbS integration in rural landscapes. Relevant resources include:

- **FRAMWAT** tools for retention planning in agricultural catchments
- **CAMARO-D** governance models linking flood risk and spatial planning
- **ÖPUL**, offering potential alignment for incentive-based mechanisms
- **Wasserwirtschaftliche Rahmenplanung**, guiding water policy in Lower Austria.

Lower Timiș River Catchment (Romania)

Consiliul Județean Timiș
Timiș County Council

Overview RR and FRR

The **Replicating Region (RR)** is in the Lower Timiș River catchment and is coordinated by the Timiș County Council. It is characterised by an increasing exposure to climate-related hazards, such as flooding, droughts and heat stress. These hazards are exacerbated by fragmented land ownership, limited financial resources, and weak institutional frameworks for public–private cooperation. Current challenges include a lack of effective mechanisms to engage private landowners, legal restrictions on implementing measures on private land, and limited experience with NbS.

The **Front-Runner Region (FRR)** focuses on the Upper Timiș River catchment, where climate risks such as flooding, droughts and heatwaves are addressed by implementing NbS on public and private land. The identified measures aim to enhance water retention, reduce flood risks and improve ecosystem resilience. Implementation is concentrated in identified hotspots, such as Lugoj and the surrounding area, where combined NbS interventions target multiple hazards. A central element of the approach is the involvement of private landowners, though this remains challenging due to regulatory constraints, fragmented ownership and limited awareness.

Overview Replication Region

Key Climate Hazards	Flooding & Extreme Precipitation, Drought, Heat stress
Spatial Scale Focus	River basin and floodplain scale
Key Landwoner Groups	Private landowners, public authorities
Priority locations	River corridors and flood-prone areas
Most promising NBS	Floodplain reconnection, wetland restoration, riparian buffer zones, reforestation
Key Barriers	Legal restrictions for interventions on private land, lack of public–private cooperation frameworks, low landowner engagement, fragmented land ownership, limited financial resources

Overview Replication Readiness

Key Climate Hazards Identified	Status: Advanced
Vision and Goals	Status: Advanced
NbS Porfolio for the Replication Region	Status: Advanced
Landowners Identification	Status: Advanced
Cost-Benefit Analysis on NbS	Status: Not Advanced
Financing of NbS on Private Land	Status: Not Advanced

Phase 1: Understanding the Replication Region

Regional Conditions

The Lower Timiș River Catchment, situated downstream of the Upper Timiș Front-Runner, represents the Romanian Replicating Region. The area stretches across a complex mosaic of **agricultural lands, riparian systems, wetlands, and peri-urban zones**, influenced by the hydro-meteorological dynamics of the Timiș River and its tributaries.

The Lower Timiș Catchment is increasingly affected by:

- **flooding hazard** due to river overflow and flash floods
- **altered hydro-meteorological connectivity**, caused by dykes, drainage channels, and historical river straightening
- **loss of wetlands and floodplain retention capacity**, reducing natural buffering
- **sedimentation and channel clogging**, especially near agricultural areas
- **prolonged droughts**, impacting both ecosystems and agricultural production.

Municipalities report **recurring flood events** affecting rural villages, farmland and transport infrastructure, with high socio-economic impacts. In several locations, floodwaters are retained longer due to insufficient drainage capacity or disconnected floodplains; conditions aggravated by climate variability and legal restrictions on land-use change.

Private Landowners

The catchment is characterised by **mixed ownership structures**, which complicate the implementation and maintenance of NbS. Key stakeholders include:

- **private landowners and farmers** (including agricultural landowners)
- **municipalities** (partially responsible for local flood protection infrastructure)
- **A.B.A Banat** (regional water utility and basin manager and FRR lead)
- **environmental agencies** (Garda de Mediu, Apele Române)
- **local NGOs and community associations**.

Challenges in working on private land include:

- restrictions in national legislation on intervening in privately owned floodplain land
- limited awareness of NbS among rural landowners
- financial uncertainty around compensation or land-use changes
- absence of cooperative governance mechanisms between owners, farmers and authorities.

Opportunities include:

- growing recognition of recurring flood risks
- willingness of some municipalities to participate in NbS dialogues

- potential synergies between NbS and agricultural water management
- community support for ecological restoration in areas historically affected by floods.

Systemic Barriers

Several systemic barriers have been identified:

- institutional fragmentation between county-level authorities, basin administrators and municipalities
- lack of legal frameworks enabling public intervention on private land for flood risk reduction
- insufficient funding mechanisms for maintenance of natural interventions
- absence of long-term floodplain management plans
- dependence on traditional grey infrastructure solutions.

Despite these barriers, replication potential is strong due to:

- high interest from Timiș County Council in innovative flood risk management approaches
- growing attention to wetland restoration in Romania's national climate policies
- willingness of landowners to collaborate on modelling, planning and participatory mapping.

Transferable Lessons from the Front-Runner

Climate Risk Identification

Lessons learned for the identification of climate risks include:

- the importance of understanding hydro-meteorological connectivity
- use of flood extent and duration mapping to locate reconnection opportunities
- assessing sediment sources and transport routes
- identifying pinch-points where river flows accelerate or accumulate.

NbS Planning and Implementation

The Upper Timiș River catchment demonstrates that:

- effective NbS require ecological design tailored to hydro-meteorological patterns
- reconnecting lateral floodplains can significantly reduce peak flows
- wetlands act as multifunctional buffers, improving biodiversity and water quality
- sediment traps and riparian vegetation stabilize channels and reduce erosion.

Private landowners Identification & Engagement

The experience from the FRR shows:

- the necessity of engaging basin authorities, farmers and municipalities jointly
- the value of participatory mapping to identify flood-prone land

- the need of transparency in communication to overcome mistrust
- the importance of clear agreements which define roles and responsibilities.

Replication Challenges

- Legal and regulatory constraints limiting implementation of NbS on private land
- Limited engagement with private landowners, including low awareness of NbS
- Cross-cutting constraints such as limited time/capacity, knowledge gaps on NbS and water management, and language barriers

Replication Strengths

- Availability of tested NbS concepts and portfolio from the Front-Runner Region that can support replication
- Existing institutional structures and technical background that can support future implementation once enabling conditions are in place

Phase 2: Build a Shared Vision

Vision Development

Vision of the Region

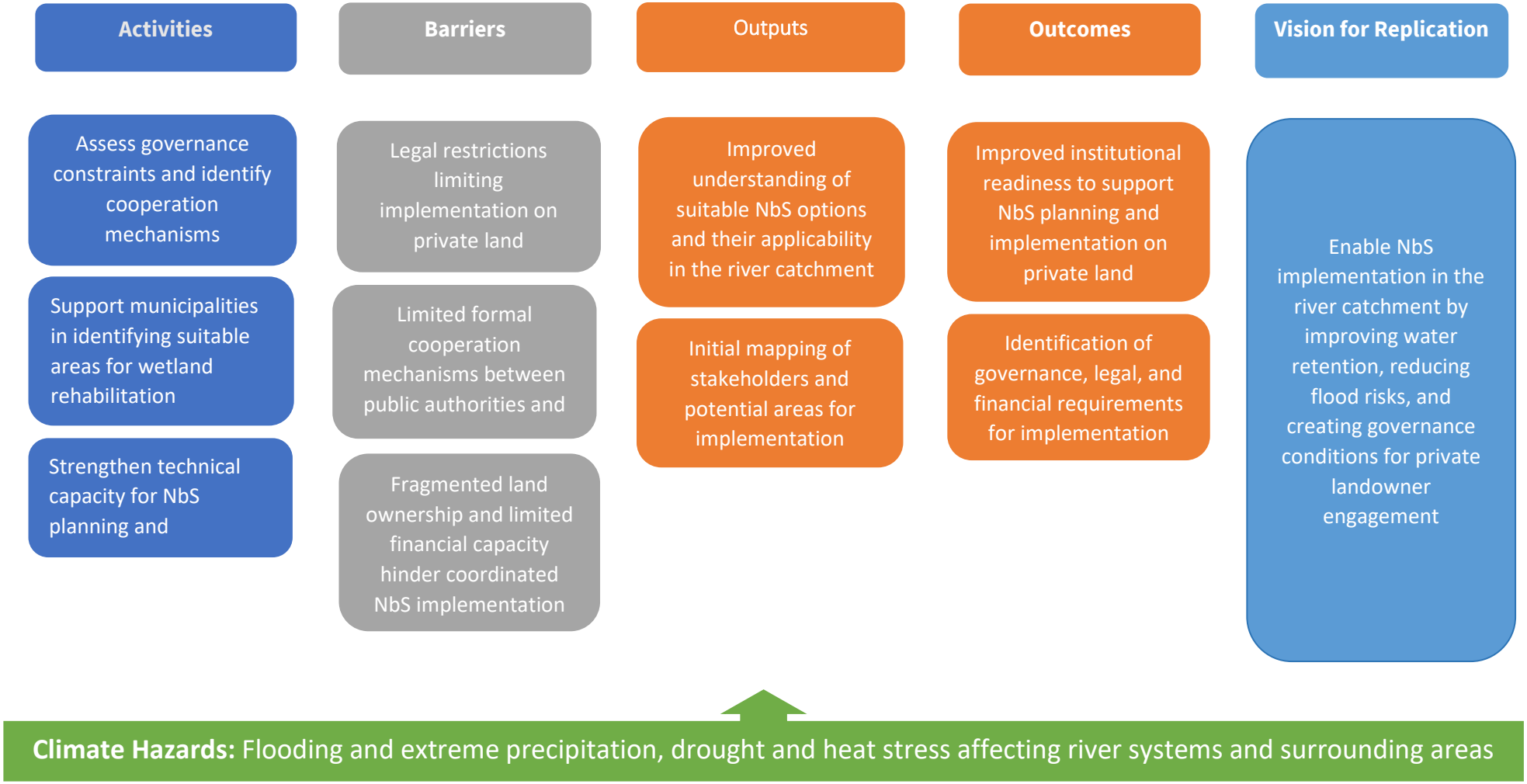
The replication vision for the Lower Timiș River Catchment is to restore natural hydro-meteorological functions, reconnecting floodplains, enhancing wetlands, and improving river–land interactions to reduce flood peaks, retain water during droughts, and strengthen biodiversity. This vision aims to shift from reactive flood protection toward nature-based and preventive adaptation, improving the resilience of rural communities and agricultural regions.

Vision of Working with Private Landowners

Given the predominance of private land in the floodplain, the region aims to:

- develop flexible cooperation schemes
- explore agreements and voluntary land management options
- support landowners in identifying opportunities for integrating riparian vegetation or wetland patches
- promote multi-actor governance structures for shared responsibilities.

Regional Theory of Change for NbS on private land



Potential locations and NbS types

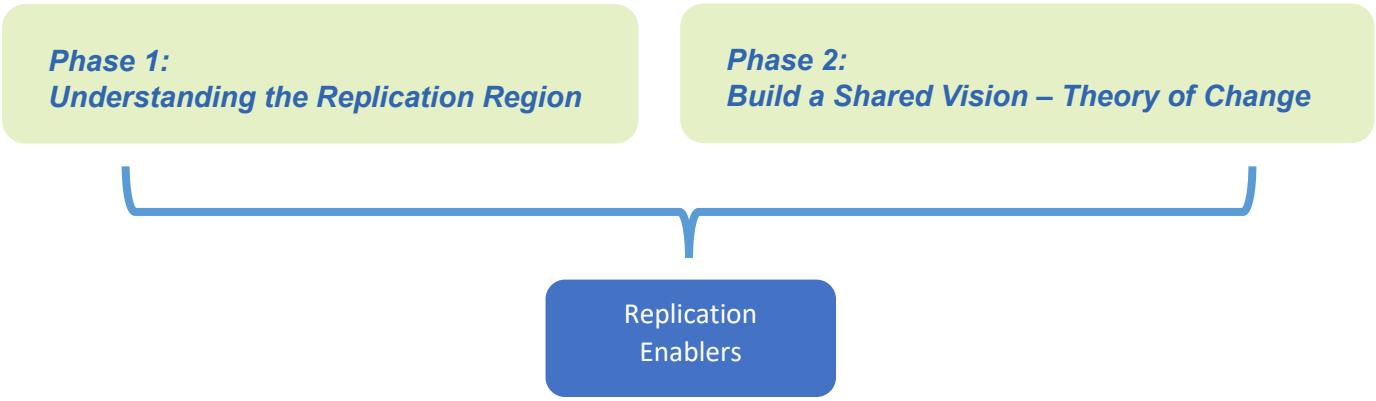
Main goals of implementing NbS in the Lower Timiș Replicating Region, based on lessons learned from the FFR:
to mitigate floods, droughts and heat stress through restoration of hydro-meteorological functions; improve water retention and regulation; enhance biodiversity and water quality; support multifunctional landscapes through wetland and floodplain restoration.

Identification of priority locations and NbS types in the RR:

Key Climate Hazard	Target Area	Potential NbS	Spatial Scale
Floods from heavy rainfall and river overflow	Flood-prone areas along the river and downstream settlements	Small retention areas; floodplain reconnection	Floodplain scale/ micro-catchment scale
Drought & seasonal water scarcity	Agricultural and peri-urban areas with low retention capacity	Wetland restoration (including reintroduction of gravel pits); retention areas	Landscape scale
Heat stress & reduced water availability	Urban and peri-urban hotspots in Lower Timiș basin	Riparian buffer zones; afforestation/reforestation	Field to landscape scale
Soil degradation & erosion	Agricultural and degraded land areas	Slope vegetation; reforestation	Field to landscape scale
Water quality degradation & biodiversity loss	River corridors and degraded ecosystems	Riparian buffers; wetlands reforestation; diversified field margins	Landscape scale

Phase 3: Preparing for Replication Readiness

Replication Enablers



Replication Enablers for the Lower Timiș Replicating Region are:

- Strengthen the analysis of regional context and climate vulnerabilities by adapting the Climate Risk Assessment developed in the Upper Timiș FRR to the Lower Timiș context, with a focus on floods, droughts and heat stress.
- Identify priority locations and NbS types by adapting the NbS portfolio from the FRR (e.g. floodplain reconnection, wetlands, riparian buffers, reforestation) to suitable areas in the Lower Timiș region.
- Support municipalities in identifying suitable areas for wetland rehabilitation.
- Develop an assessment of NbS efficiency by applying and simplifying existing methodologies from the FRR to evaluate environmental, hydro-meteorological and socio-economic benefits.
- Strengthen integration with land policies by addressing legal and regulatory barriers.
- Exploring mechanisms to enable cooperation with private landowners, increasing awareness of NbS and in turn, strengthened engagement.

Resources

Relevant projects and tools include:

- **DANUBE4all** (river restoration, governance of multi-actor floodplain systems)
- **REST-COAST** (large-scale coastal/wetland restoration approaches)
- **RESIST** (adaptation pathways for climate-vulnerable regions)
- Romanian national river-basin and flood management plans

Košice Region (Slovakia)

Košice Self-Governing Region (KSK)

Overview RR and FRR

The Replicating Region Košice is characterized by a diverse landscape including agricultural lowlands, forested uplands, and small micro-catchments that are increasingly exposed to climate-related hazards such as flash floods, soil erosion, and seasonal droughts. These risks are intensified by fragmented landownership, soil compaction, reduced water retention capacity, and rapid runoff from agricultural slopes. The region faces systemic challenges including unclear governance responsibilities, limited technical capacity at municipal level, and insufficient integration of NbS into planning frameworks. Additionally, engaging private landowners is hindered by complex cadastral structures, and weak incentive mechanisms.

The **Roňava River Catchment** serves as the Front-Runner Region, focusing on addressing flash floods, soil erosion, and drought through integrated NbS. The FRR has developed hydro-meteorological modelling approaches, participatory co-planning processes, and implemented measures such as retention ponds, vegetated buffers, and landscape-based water retention solutions. Key challenges include fragmented land ownership and financing constraints, while key successes involve stakeholder engagement and development of scalable NbS portfolios.

Overview Replication Region

Key Climate Hazards	Flooding and extreme rainfall, seasonal droughts, rapid runoff and soil erosion in hilly terrain
Spatial Scale Focus	Micro-catchment scale, small river basins, and slope-to-valley systems
Key Landwoner Groups	Small private landowners, farmers, forestry actors, municipalities, water authorities
Priority locations	Flood-prone rural valleys, erosion-prone agricultural slopes, upper catchments with retention potential
Most promising NbS	Infiltration belts, vegetated buffer stripes, small retention ponds, riparian and flood plain vegetation restoration, agroforestry elements
Key Barriers	Fragmented and unclear land ownership, difficulty identifying landowners, weak cross-sector governance, limited financing mechanisms, complex permitting processes

Overview Replication Readiness

Key Climate Hazards Identified	Status: Advanced
Vision and Goals	Status: Advanced
NbS Porfolio for the Replication Region	Status: Advanced
Landowners Identification	Status: Advanced
Cost-Benefit Analysis on NbS	Status: Not Advanced
Financing of NbS on Private Land	Status: Not Advanced

Phase 1: Understanding the Replication Region

Regional Conditions

The Košice Region represents a territorially diverse area including the Slovak Karst, the Eastern Slovak Lowlands, hilly agricultural landscapes and forested uplands. The region is characterized by multiple micro-catchments prone to flash flooding and rapid hydro-meteorological responses.

The most critical climate risks include:

- **increasingly intense rainfall events** caused by convective storms
- **seasonal droughts** prolonging soil desiccation
- **reduced infiltration due to soil compaction**, especially in intensively cultivated areas
- **rapid runoff** along agricultural slopes feeding into small watercourses
- **erosion in hilly terrains** affecting both agricultural and forest land
- **periodic flooding of rural settlements** located in narrow valleys or along small streams.

Climate hazards are strongly influenced by fragmented land ownership, land abandonment in some mountainous areas, poor soil structure in agricultural basins, and declining water retention capacity due to historical drainage and channel modifications.

Municipalities report recurring impacts including damage to infrastructure including roads, bridges and drainage systems, sediment deposition, insufficient local retention capacity and high runoff rates even during moderate rainfall events and challenges in maintaining riverbeds and ditches. These risks are expected to **intensify** under projected climate scenarios combining temperature rise, irregular precipitation, and seasonal drought–flood alternation.

Private Landowners

The region's land structure is **highly fragmented**, with the following stakeholders identified:

- Mid-sized farms and agricultural enterprises
- Forestry actors
- Private landowners engaged through voluntary participation and incentive schemes
- Water authorities responsible for small watercourses

Challenges in working on private lands include:

- complex cadastre and unclear parcel boundaries
- landowners difficult to identify or contact ("unknown owners" in cadastral registries)
- limited awareness of NbS and their benefits
- reluctance to engage without clear incentives
- maintenance responsibilities often disputed
- administrative and permitting barriers for NbS implementation.

Opportunities include:

- growing recognition of soil erosion and flood risks
- positive municipal experiences with small community-led water retention activities
- recent national focus on landscape restoration (e.g., Slovenský Vodohospodársky Plán)
- openness of regional departments to test governance innovations.

Systemic Barriers

Several systemic barriers have been identified, such as:

- fragmented governance between agriculture, spatial planning, water management and environment
- land ownership complexity preventing coordinated catchment actions
- insufficient integration of NbS into existing planning documents
- municipalities lacking technical capacity for hydro-meteorological assessment
- unclear division of responsibilities between state, region and municipalities for water retention
- absence of stable funding for implementation and long-term maintenance.

Nonetheless, several enabling factors support replication potential:

- Košice Region has multiple ongoing landscape programmes (**Landscape Restoration Programme**, **Climate Adaptation Strategy revision**)
- strong political interest in addressing flash flooding in rural communities
- existing pilot experiences from the Roňava Front-Runner offer directly transferable lessons
- the region expressed a clear strategic desire to develop an overarching Water-Resilient Territorial Model.

Transferable Lessons from the Front-Runner

Climate Risk Identification

The Roňava Front-Runner provides a practical reference for climate risk identification. Transferable insights include:

- the mapping of runoff pathways and identifying “accelerated flow” corridors
- the linkage of rainfall intensity data with erosion and flood hotspots
- the integration of soil erosion models with field observations
- the identification of opportunities for water retention in small depressions
- the assessment of stream channel modifications and their impact on peak flows.

NbS Planning and Implementation

The Roňava Front-Runner demonstrated the value of:

- combining structural and vegetative measures

- tailoring interventions to geomorphological conditions
- coordinating forestry and water management in upland areas
- designing measures requiring limited maintenance workloads
- using natural materials and low-cost solutions.

The Košice RR acknowledged that its current understanding is largely experiential, and that the application of Climate Risk Assessment (CRA) frameworks would enable systematic prioritization of high-risk micro-catchments, identification of feasible NbS locations, and more robust evidence-based planning.

Private landowners Identification & Engagement

The most transferable lesson learned from the Roňava experience are:

- municipalities must be engaged early to ensure acceptance
- The importance of multi-level governance, as competences related to water management agricultural practices, land ownership and funding instruments are distributed across municipal regional, national and EU levels
- participatory co-design workflows involving landowners and municipal officials

Enabling Conditions from the FRR

- strong coordination between planners, hydrologists and ecologists
- clear division of roles for maintenance
- integrated monitoring procedures
- long-term planning frameworks (Landscape Restoration Programme).

Replication Challenges

- Challenges in processing and integrating new information, tools and methodologies introduced within the project
- Cross-cutting constraints such as limited time/capacity, knowledge gaps on NbS, and language barriers

Replication Strengths

- Availability of tested approaches and practical experience from the Roňava Front-Runner Region
- Strong interest from regional institutions in addressing flood risks and landscape resilience
- Willingness of the FRR to engage in peer-to-peer learning approaches, including farmer-to-farmer exchange and sharing of landowner experiences;

Phase 2: Build a Shared Vision

Vision Development

Vision of the Region

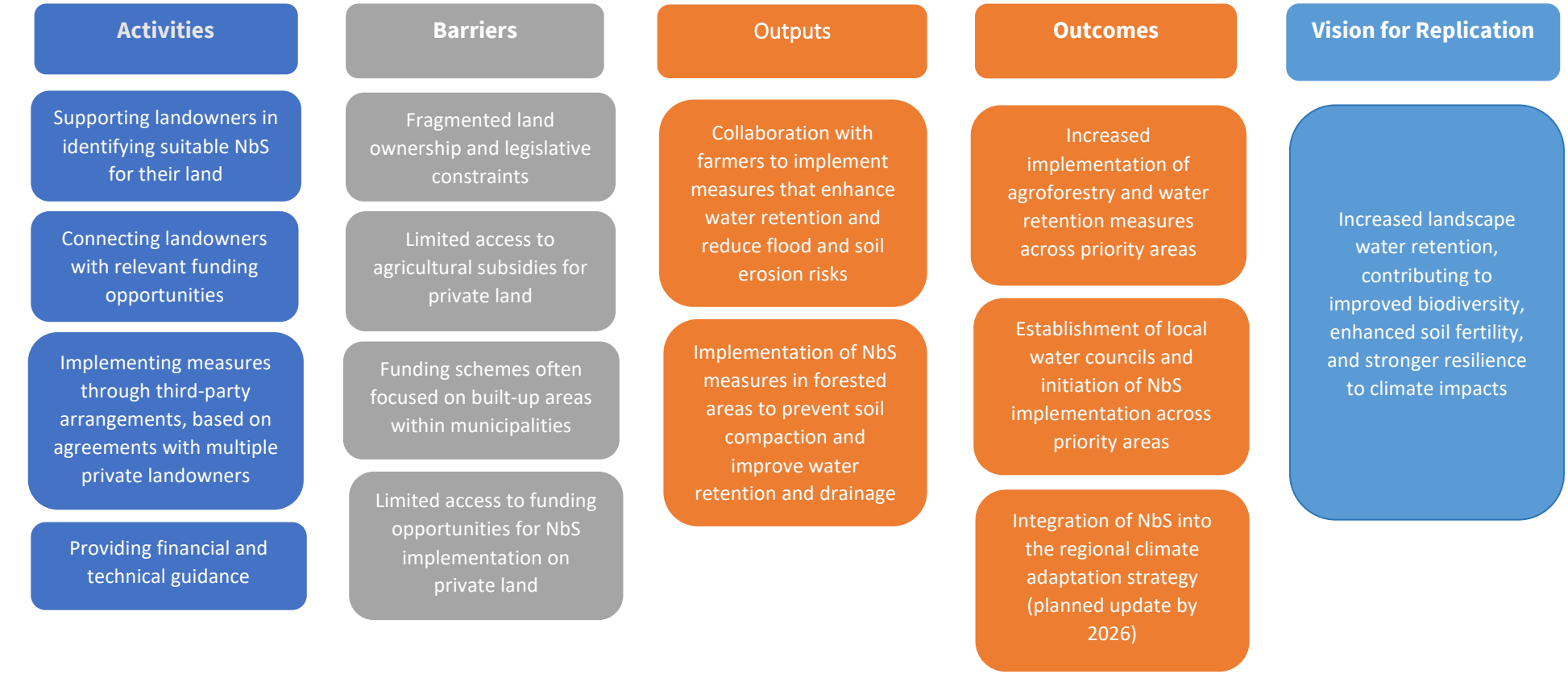
The replication vision for Košice Region is to create an integrated **Water-Resilient Territorial Model** that improves natural water retention, enhances soil functions, and reduces vulnerability to floods and droughts. This concept aims to unify water, soil, and landscape management into a cohesive approach supporting the region's long-term climate adaptation goals.

Vision of Working with Private Landowners

The region aims to:

- develop voluntary cooperation mechanisms
- create shared maintenance models
- increase awareness of NbS benefits
- promote cooperation across landowners
- explore incentive mechanisms through rural development programmes.

Regional Theory of Change for NbS on private land



Potential locations and NbS types

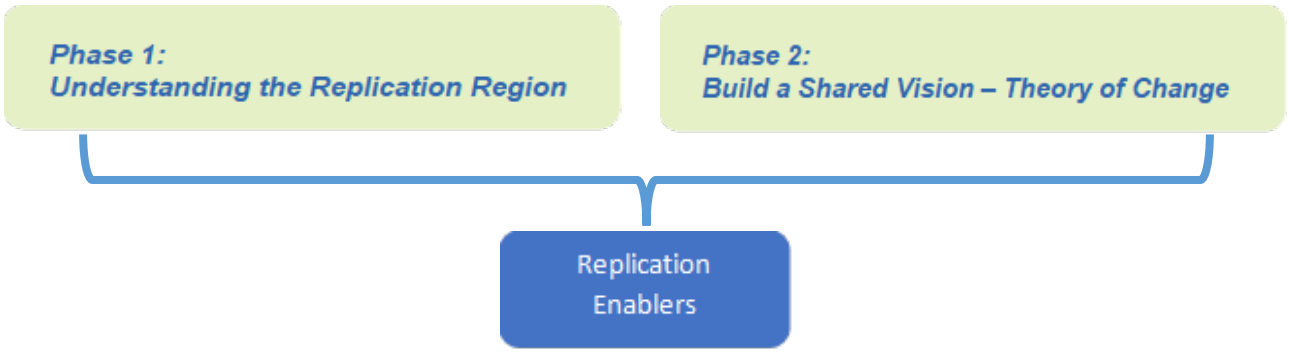
Main goals of implementing NbS in the Košice Replication Region, based on the lesson learned from the FRR:
to improve natural water retention and slow down runoff processes; enhance soil functions and hydro-meteorological balance; reduce flood risks in vulnerable micro-catchments; strengthen institutional and technical capacity for NbS planning; and promote cooperation across fragmented land ownership structures. The region envisions a combination of small-scale, distributed NbS that collectively contribute to improved landscape resilience.

Identification of priority locations and NbS types in the RR:

Key Climate Hazard	Target Area	Potential NbS	Spatial Scale
Flash floods from heavy rainfall	Micro-catchments draining into rural settlements and valleys	Small retention ponds and basins; micro-catchment retention measures	Local to micro-catchment scale
Rapid runoff and erosion	Agricultural slopes and hilly terrain	Infiltrated vegetated buffer stripes, agroforestry elements	Field scale to local scale
River flooding and bank erosion	River corridors and adjacent flood-prone areas	Riparian and floodplain vegetation restoration	Linear to floodplain scale
Sediment deposition affecting infrastructure	Road culverts, drainage lines	Vegetated margins, green drainage paths, sediment traps	Field to micro-catchment scale
Seasonal drought and reduced soil moisture	Agricultural land with degraded soil structure	Agroforestry systems; hedgerows; soil cover enhancement	Field scale
Land degradation and loss of retention capacity	Mixed agricultural and semi-natural landscape	Small wetlands; riparian vegetation restoration	Landscape scale

Phase 3: Preparing for Replication Readiness

Replication Enablers



Replication Enablers for the Košice Region are:

- strengthening Climate Risk Assessment (CRA) capacities to support evidence-based planning and prioritization of NbS locations
- improving coordination between municipalities, planners and landowners, including a clearer facilitating role of the region
- developing stakeholder engagement approaches tailored to fragmented ownership structures, including demonstration projects and communication of co-benefits
- establishing stable financing mechanisms for NbS, moving beyond one-off projects towards multiannual funding approaches
- integrating NbS into regional and sectoral planning frameworks
- providing technical support for NbS design and implementation, including hydro-meteorological assessments
- simplifying permitting procedures for small-scale water retention measures
- supporting scaling of successful pilot projects into structured programmes

RESOURCES

Relevant initiatives include:

- **Slovak Landscape Revitalisation Programme**
- National soil protection schemes
- **DANUBE4all** for river corridor restoration
- **RESTORE4Cs** for wetland carbon and hydrology functions.

Růžová and Staré Křečany Municipalities (Czech Republic)

Ústecký kraj
Local Municipalities of Růžová and Staré Křečany

Overview RR and FRR

The **Replicating Region (RR)** consists of the **municipalities of of Růžová and Staré Křečany,** located in the Ústí Region (Ústecký kraj) in the Czech Republic, within the Bohemian Switzerland landscape. The region is characterised by forested slopes, small agricultural areas and dispersed settlements, and is increasingly exposed to climate-related hazards such as flash floods, rapid runoff, soil erosion and drought. Key challenges include fragmented land ownership, limited municipal capacity and difficulties in coordinating NbS implementation across different landowners.

The **Front-Runner Region (FRR)** is in the **Bohemian Switzerland area**, with a focus on the municipality of Krásná Lípa. It addresses climate risks such as flooding, drought and water scarcity through NbS aimed at improving water retention, reducing runoff and restoring ecosystems. Key measures include small retention systems, watercourse restoration and vegetation-based interventions, implemented in pilot areas with involvement of municipalities and landowners. The FRR provides practical experience in NbS planning and stakeholder engagement that supports replication.

Key Climate Hazards	Flash floods from intense localised rainfall, rapid runoff, soil erosion, seasonal drought, declining groundwater recharge
Spatial Scale Focus	Field scale and micro-catchment scale
Key Landwoner Groups	Farmers, private forest landowners, municipalities, protected area administration
Priority locations	Small micro-catchments, forest–meadow interfaces, valley-bottom agricultural parcels, small streams and wet depressions
Most promising NbS	Small retention ponds and basins, vegetated swales and ditches, stream naturalisation and floodplain vegetation, micro-wetlands
Key Barriers	Fragmented land ownership, lack of incentives for landowners, limited technical capacity, regulatory constraints in protected areas, limited municipal budgets

Overview Replication Readiness

Key Climate Hazards Identified	Status: Advanced
Vision and Goals	Status: Advanced
NbS Porfolio for the Replication Region	Status: Advanced
Landowners Identification	Status: Advanced
Cost-Benefit Analysis on NbS	Status: Not Advanced
Financing of NbS on Private Land	Status: Not Advanced

Phase 1: Understanding the Replication Region

Regional Conditions

The regional landscape is characterized by forested slopes, small agricultural valleys and a dense network of small streams, wet depressions and seepage zones. The region is highly vulnerable to hydro-meteorological disturbances due to its terrain and soil conditions. The main climate risks include intense localized rainfall leading to **flash flooding**, **rapid runoff** on steep slopes, **soil erosion** and **declining groundwater recharge**. Seasonal droughts further affect soil moisture, springs and wet meadows.

These risks are amplified by forest dieback caused by drought and bark beetle infestations, which reduce canopy cover, soil stability and water retention capacity.

The most critical climate risks include:

- **intense localised rainfall events** leading to flash flooding
- **rapid runoff** due to steep slopes, degraded soils and forest disturbance
- **declining groundwater recharge** linked to altered infiltration
- **seasonal dry periods**, affecting local springs and wet meadows
- **soil erosion** in agricultural pockets and disturbed forest soils
- **channel incision** in smaller streams, reducing natural floodplain function.

The municipalities face significant impacts, including flooding of roads and private properties, waterlogging of small agricultural parcels in valley bottoms, increased sediment accumulation in drainage systems, reduced moisture retention in forest soils, and the loss of wet meadows that previously functioned as natural buffers. In addition, recurring stormwater surges in several micro-catchments have caused repeated damage to local infrastructure over the past decade.

Private Landowners

Land ownership in the region is fragmented and involves private agricultural and forest landowners, municipalities and protected area authorities.

- Forestry companies and land cooperatives
- A small number of major farmers owning significant portions of land
- Landowners willing to engage in water retention measures, including through land-exchange arrangements (e.g. municipal land in return for NbS implementation)

Challenges when working on private land include:

- hesitancy toward new interventions perceived as disrupting current practices
- lack of clear compensation or incentive mechanisms for NbS
- limited technical understanding of retention-oriented land management
- fragmented ownership patterns within small cadastral units

- regulatory constraints linked to conservation designations.

Opportunities include:

- strong local recognition of frequent water-related issues
- engaged municipal leadership motivated to reduce flood damage
- ongoing ecological restoration activities in surrounding protected areas
- openness to small-scale decentralised NbS that fit the local rural context.

Systemic Barriers

Several systemic barriers have been identified, such as:

- complex permitting procedures for interventions in protected areas
- lack of municipal budgets for long-term maintenance
- insufficient capacity for hydro-meteorological and soil assessment
- poor integration of NbS into municipal planning instruments
- limited technical support for small municipalities.

Nonetheless, several enabling factors support replication potential:

- strong alignment with regional and national goals for landscape water retention
- local appreciation for ecological integrity and landscape restoration
- political willingness at the municipal level to explore NbS-based approaches.

Transferable Lessons from the Front-Runner

Climate Risk Identification

The Front-Runner Region in the Bohemian Switzerland area provides practical reference for climate risk identification. Transferable insights include:

- systematic identification of runoff pathways
- mapping of hydro-meteorological pinch points in miniature catchments
- use of slope and soil data to locate infiltration deficits
- recognising the value of even very small retention features (micro-wetlands, ponds, swales)
- monitoring seasonal changes in soil moisture and stream discharge.

NbS Planning and Implementation

The experience of Bohemian Switzerland area demonstrates that:

- NbS must be **decentralised and numerous** in small rural catchments
- natural materials should be prioritised to reduce maintenance
- design must consider protected area regulations
- even small, vegetated interventions can significantly slow runoff

- co-design with landowners is a key enabling condition for acceptance and implementation of NbS on private land.

Private landowners Identification & Engagement

The most important transferable lessons learned from Krásná Lípa are:

- use of community-led workshops with residents, landowners and NGOs
- application of simple field demonstrations to illustrate NbS functioning
- encouraging volunteer involvement (fire brigades, local associations)
- use of participatory mapping conducted at the parcel level.

Enabling Conditions

- strong collaboration between municipalities and protected area managers
- access to local ecological expertise
- community support for conservation-oriented solutions
- simple monitoring tools to track NbS effectiveness.

Replication Challenges

- Challenges in maintaining engagement across municipalities and stakeholders
- Complex permitting procedures, especially in protected areas
- Cross-cutting constraints such as limited time/capacity, knowledge gaps on NbS, and language barriers

Replication Strengths

- Availability of experience and approaches from the Bohemian Switzerland Front-Runner Region
- Ongoing ecological restoration activities in surrounding protected areas
- Openness to small-scale decentralized NbS that fit the local rural context

Phase 2: Build a Shared Vision

Vision Development

Vision of the Region

The replication vision for Staré Křečany is to build a **network of small-scale water retention and infiltration structures** that collectively restore hydro-meteorological stability, reduce flooding, enhance groundwater recharge and revitalize landscape functions. Both municipalities express a

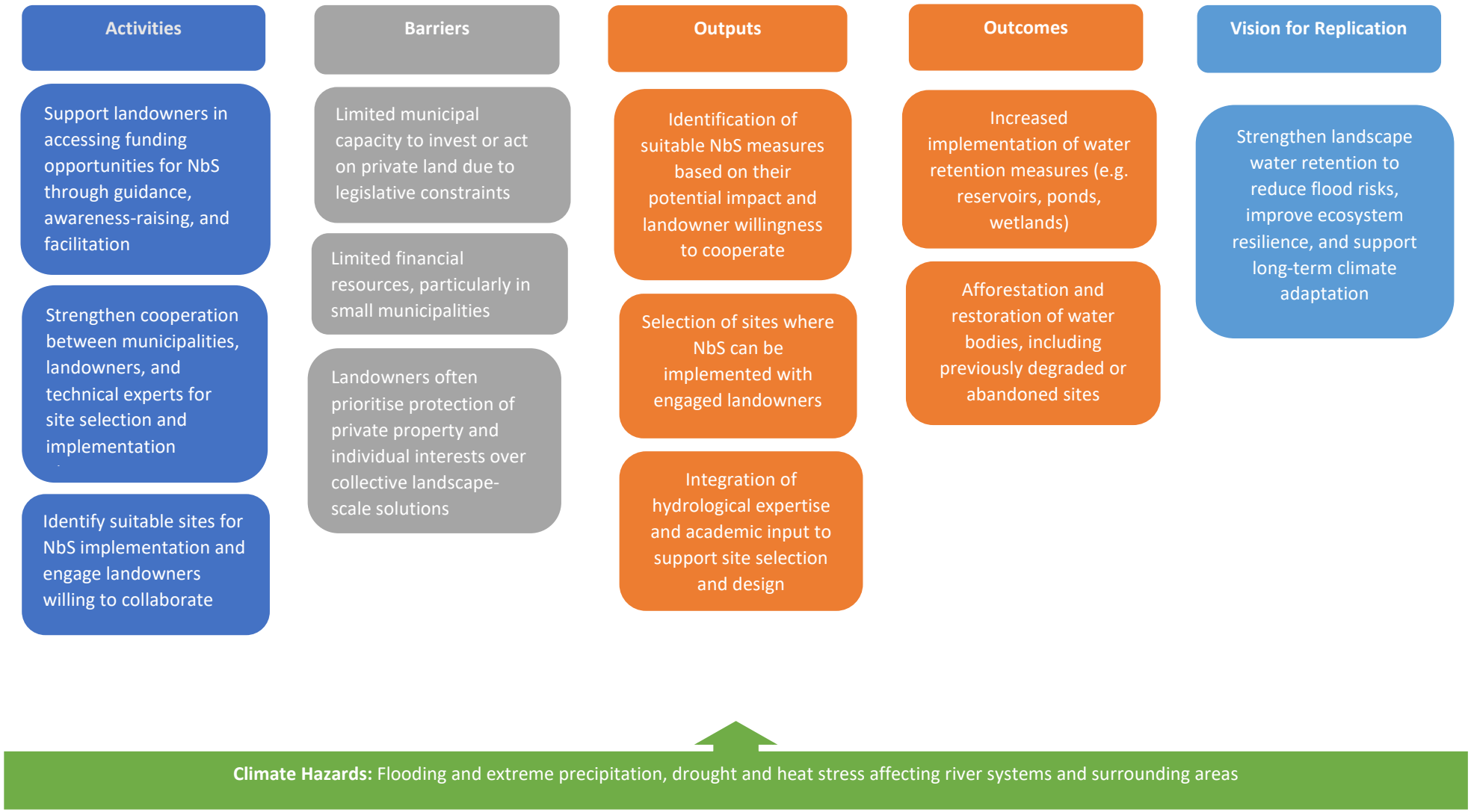
strong desire to become **model rural villages for climate adaptation**, demonstrating how distributed NbS can mitigate floods while improving the ecological and cultural value of the rural environment.

Vision of Working with Private Landowners

Private landowners are essential partners for NbS implementation. The municipalities aim to:

- engage landowners in co-design of practical, low-cost NbS
- establish voluntary cooperation mechanisms
- encourage adoption of measures with minimal impact on productive land
- promote visible local success stories to build trust
- gradually develop a community-based approach to landscape stewardship.

Regional Theory of Change for NbS on private land



Potential locations and NbS types

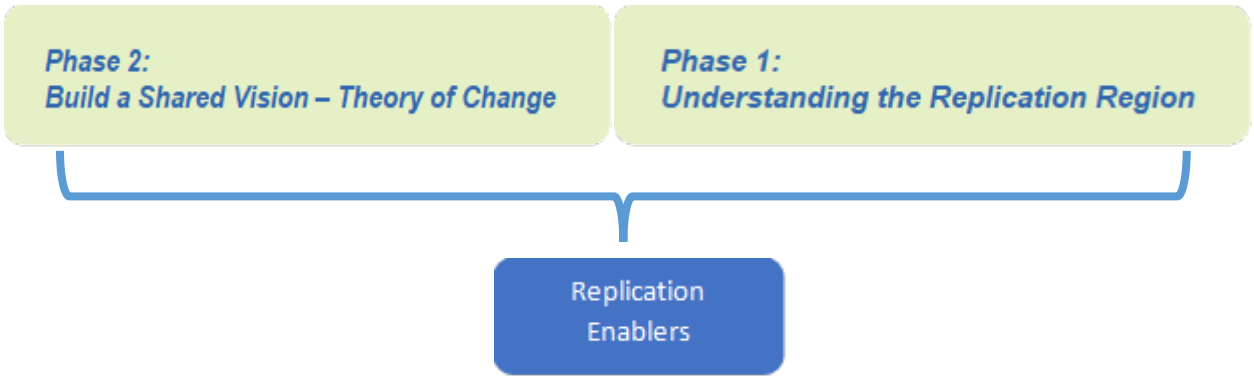
Main goals of implementing NbS in the Staré Křečany Replicating Region, based on the lesson learned from the FRR:
to reduce surface runoff and flood peaks in vulnerable micro-catchments, enhance water retention and groundwater recharge, restore hydro-meteorological stability in small streams and wet meadows, and strengthen municipal capacity for NbS planning and implementation. The region envisions a network of small-scale, decentralized NbS that together provide cumulative hydro-meteorological and ecological benefits across the landscape.

Identification of priority locations and NbS types in the RR:

Key Climate Hazard	Target Area	Potential NbS	Spatial Scale
Pluvial flooding and extreme rainfall events	Small rural catchments and low-lying agricultural areas	Small retention ponds, micro-wetlands, wet meadow restoration	Local to micro-catchment scale
Soil erosion and concentrated runoff	Agricultural land, road edges and drainage pathways	Vegetated swales and ditches, vegetated buffer strips, infiltration belts	Field-scale to local scale
River flooding and channel erosion	Small streams and adjacent flood-prone areas	Stream naturalisation, floodplain vegetation, wet meadow restoration	Linear stream reach to local floodplain scale

Phase 3: Preparing for Replication Readiness

Replication Enablers



Replication Enablers for the Czech Region are:

- Building on the experience and approaches developed in FRR
- Identifying suitable micro-catchments and priority locations for NbS using local knowledge and mapping approaches
- Strengthening capacity for hydro-meteorological and soil assessment at municipal level
- Developing simple design guidance for small-scale NbS such as ponds, swales and naturalized streams
- Supporting participatory processes with landowners, including co-design and parcel-level mapping
- Clarifying responsibilities for implementation and long-term maintenance between municipalities and landowners
- Aligning NbS planning with conservation regulations and existing ecological restoration programs
- Strengthening communication and awareness-raising at local level, including demonstration measures and community engagement
- Exploring opportunities for low-cost monitoring and citizen involvement in tracking NbS effectiveness
- Developing site-specific studies and NbS revitalization plans for priority locations.

Resources

- Czech National programmes for wet meadow restoration
- Monitoring tools for small stream hydrology
- Synergies with Bohemian Switzerland protected area management.

County of Euskirchen (Germany)

Kreisverwaltung Euskirchen
The County of Euskirchen

OVERVIEW FRR

The County of Euskirchen is the German Front-Running Region (FRR) in LAND4CLIMATE and represents a predominantly rural district in the southern part of North Rhine-Westphalia, bordering Rhineland-Palatinate and Belgium. Covering 1,248 km² and home to nearly 199,000 inhabitants, the region combines the forested landscapes of the Eifel with the fertile agricultural plains of the Zülpicher Börde. Euskirchen faces significant climate-related challenges, particularly flood risks, drought, heat stress, soil erosion, and biodiversity loss. The devastating flood event of July 2021 strongly highlighted the urgent need for climate adaptation measures in the region. Within LAND4CLIMATE, Euskirchen focuses on implementing NBS on both public and private land to strengthen climate resilience, improve water retention, restore ecosystems, and reduce urban heat. Key examples include the first Tiny Forest and Climate Park, developed in cooperation with the municipal housing company Eugebau and the de-sealing partnership on private households. These actions demonstrate how public-private collaboration can improve biodiversity, reduce flood risks, cool urban areas, and strengthen long-term regional resilience while highlighting the important role of private landowners in climate adaptation.

Vulkaneifel was initially the German Replicating Region (RR) in LAND4CLIMATE and is located in the state of Rhineland-Palatinate within the Eifel Mountain range. This predominantly rural region is characterised by its unique volcanic landscape, including crater lakes (maars), rolling hills, forests, grasslands, agricultural land, and dispersed settlements. Like many rural areas in continental Europe, Vulkaneifel is increasingly affected by climate change impacts, including stronger storms, prolonged droughts, heat stress, and intense rainfall events causing local flooding. These challenges create growing pressure for effective climate adaptation measures and highlight the need for NBS that improve water retention, landscape resilience, and ecosystem health.

However, during the development of these guidelines in December 2025, the regional position responsible for cooperation with LAND4CLIMATE was discontinued due to a lack of funding and limited institutional capacity to prioritise staff dedicated to NbS and climate adaptation. As a result, continued cooperation with Vulkaneifel was no longer possible. The project is therefore currently engaging with other regions for replication activities, and Vulkaneifel is no longer part of these guidelines.

4. Cross-Regional Insights and Emerging Replication Pathways

The analysis of the replicating regions shows that replication of NbS is shaped by a combination of enabling conditions that emerge directly from practical experience and that, in turn, structure distinct but converging replication pathways. A central factor across all regions is the **capacity to engage private landowners**, which remains both a key challenge and a prerequisite for implementation. Where progress has been achieved, it is largely based on negotiation, voluntary cooperation, and trust-building processes, rather than regulatory enforcement. For instance, in the Czech Republic, the municipalities relied on long-term collaboration with farmers and land exchanges to implement water retention measures, while in Austria (Weinviertel), flood management interventions depend on agreements, compensation schemes, and co-financing with landowners. In contrast, in Romania (Timiș County) and Slovakia (Košice Region), legal and institutional constraints limit interventions on private land, requiring alternative approaches or restricting implementation largely to public land.

Closely linked to this, **financial feasibility** determines the pace and scope of replication. While some regions benefit from rural development funding or co-financing mechanisms, as in Austria, others, such as Slovakia and Romania, face significant constraints, with funding often limited to planning rather than implementation. In the Czech Republic, incremental municipal investments in small-scale measures (e.g. ponds and stream restoration) demonstrate how replication can still progress through step-by-step approaches despite limited resources. These differences contribute to shaping distinct replication trajectories, ranging from incremental local interventions to wider programme-based approaches.

Another enabling condition concerns **institutional capacity and coordination**. Regions with clearer governance structures and stronger inter-institutional collaboration are better positioned to advance NbS implementation, while limited administrative capacity, particularly in smaller municipalities, and fragmented governance systems slow down progress. This is evident in the Czech case, where local capacity constraints affect engagement, and in Romania and Slovakia, where coordination challenges and unclear institutional roles hinder implementation.

In addition, **demonstration through small-scale, tangible interventions** emerges as a crucial enabler. Pilot actions, such as local water retention measures or restoration activities, help build confidence among stakeholders, making NbS more understandable and acceptable, particularly in contexts where awareness is still limited. This is particularly evident in the Czech Republic and Slovakia, where water retention measures and landscape restoration initiatives act as entry points, and in Italy (Emilia-Romagna), where NbS such as dune restoration and vegetation-based measures demonstrate context-specific adaptation to erosion and saline intrusion.

Finally, the importance of **continuous knowledge exchange and peer learning** is evident across all regions. The interaction between front-runner and replicating regions has supported the transfer of practical knowledge, helped identify feasible solutions, and enabled regions to adapt approaches to their own environmental, institutional, and socio-economic contexts. Overall, replication is not occurring through the transfer of fixed solutions, but through incremental, context-specific processes, supported by collaboration, learning, and progressive implementation.

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