POLICY BRIEF

Advancing Evidence-Based Prioritisation for Coastal Wetland Restoration in Europe: The RESTORE4Cs Spatial Decision-Support Toolbox

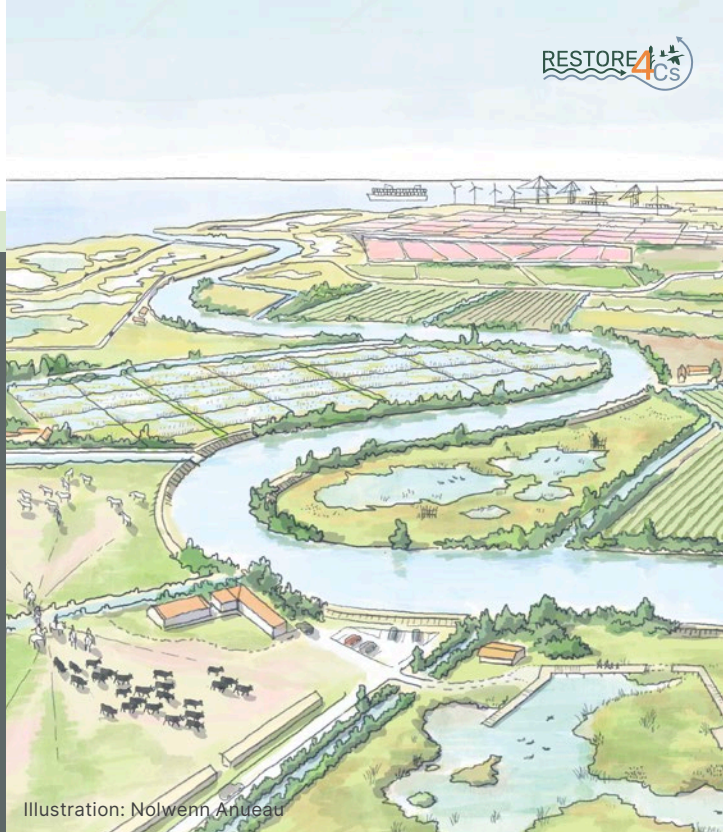

Illustration: Nolwenn Anueau

KEY MESSAGES

- Spatially explicit information about the status of wetlands is essential for prioritising areas for their restoration, as requested under the Nature Restoration Regulation (NRR), and for developing well-defined restoration measures. The **RESTORE4Cs Spatial Decision-Support Toolbox** offers a harmonised, science-based and user-friendly solution by integrating ecological, climatic and socio-economic data into a single decision-support system.
- Through **interactive spatial analysis**, the Toolbox identifies where restoration is most needed, most feasible and most beneficial, enabling national authorities, regional planners and site managers to design targeted and effective restoration pathways.
- **The Toolbox supports evidence-based decision-making** aligned with EU and international commitments, enhancing the efficiency and impact of large-scale coastal wetland restoration efforts.

Introduction

Coastal wetlands are among the most valuable ecosystems in Europe, providing essential climate regulation, biodiversity support and socio-economic benefits. Despite their importance, they have been extensively degraded or converted over the past centuries, with significant losses of habitat integrity, ecological function and resilience.

In response, the EU NNR introduces legally binding restoration targets for ecosystems including wetlands, requiring Member States to restore at least 30% of degraded ecosystems by 2030, rising to 60% by 2040 and 90% by 2050. Achieving these targets demands transparent, replicable and spatially explicit methods to identify priority areas for restoration and guide resource allocation. Yet many countries still lack harmonised tools to systematically evaluate restoration options or compare scenarios across multiple ecological and socio-economic dimensions.

The RESTORE4Cs project has developed a Spatial Decision-Support Toolbox that fills this gap and offers an integrated, interactive and scalable solution to support restoration planning from EU to local levels.

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What is the RESTORE4Cs Toolbox?

The RESTORE4Cs Toolbox is a geo-analytical platform designed to help users identify, evaluate and prioritise wetland restoration opportunities. It is freely accessible online at: Coastal Wetlands – Decision-support Toolbox

The Toolbox integrates harmonised spatial datasets and is developed as an interactive online environment, which enable users to visualise and explore restoration potential through maps, filters, statistics and comparative analyses. It supports both strategic planning and site-level scenario assessment, making it adaptable to multiple governance contexts, from EU-wide assessments to local co-design processes.

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How does the Toolbox work?

The RESTORE4Cs Toolbox is grounded in a **structured, spatially explicit workflow** that supports evidence-based restoration prioritisation. It puts into place a dual-pillar methodology that captures both lost wetlands that could be regenerated and existing wetlands requiring ecological rehabilitation, enabling a comprehensive understanding of restorability across European coastal landscapes (Figure 1).

The first pillar identifies wetlands lost through past land-use conversion, using harmonised maps of Potential Wetland Areas (PWA) to approximate the historical footprint of wetlands. By overlaying these PWA baselines with current land-use and land-cover datasets, the Toolbox distinguishes where wetlands have been drained, reclaimed or transformed. It then evaluates their potential for regeneration based on hydrological feasibility, land-use reversibility, soil and topographic conditions, and the estimated effort needed to recover wetland functions. **This step results in a delineation of Potentially Restorable Wetlands (PRW), representing areas where wetland habitat and hydrological processes could be restored**.

The second pillar evaluates the condition and degradation of wetlands that still exist today. Many wetlands retain their nominal status but have undergone substantial ecological decline due to altered hydrology, pollution, fragmentation, land management changes or climate-related pressures. The Toolbox integrates indicators on habitat condition, anthropogenic pressures, water dynamics, and landscape context to identify where existing wetlands require rehabilitation. **This assessment helps locate zones where restoration interventions**, such as rewetting, tidal reconnection, habitat re-establishment, or management changes, **are most needed**.

These two analytical strands combine to create a layered and integrated understanding of restorability potential. The Toolbox then incorporates additional spatial layers, including protection status, connectivity with Natura 2000 and Key Biodiversity Areas, exposure to sea-level rise and coastal erosion, carbon storage and sequestration potential, and socio-economic considerations, to evaluate the strategic relevance of restoring each area.

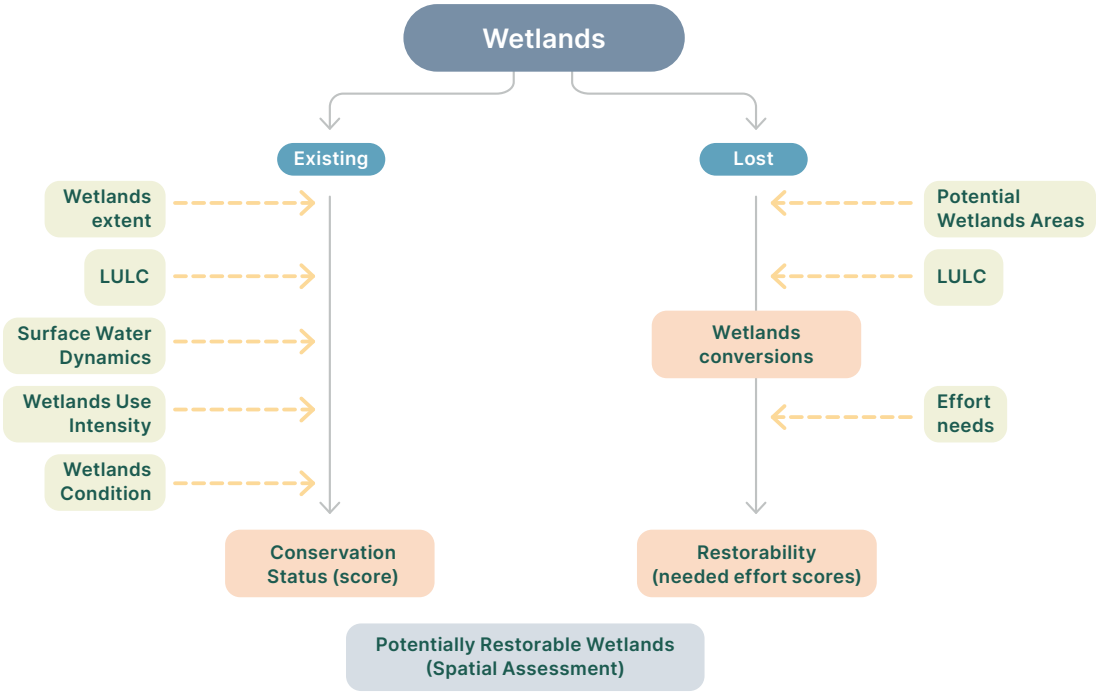

Figure 1: Conceptual framework of the two pillars underpinning the RESTORE4Cs Spatial Decision-Support Toolbox.

The final output consists of spatially explicit priority maps (Figure 2) that identify where restoration of wetlands can achieve the greatest benefits for biodiversity, climate mitigation, water cycle regulation, and socio-economic resilience. Through the interactive interface, users can examine underlying datasets, adjust weighting criteria, explore alternative prioritisation pathways, and visualise how selected restoration strategies shift across space. This flexibility allows the Toolbox to support iterative, evidence-based decision-making from national planning to site-specific implementation.

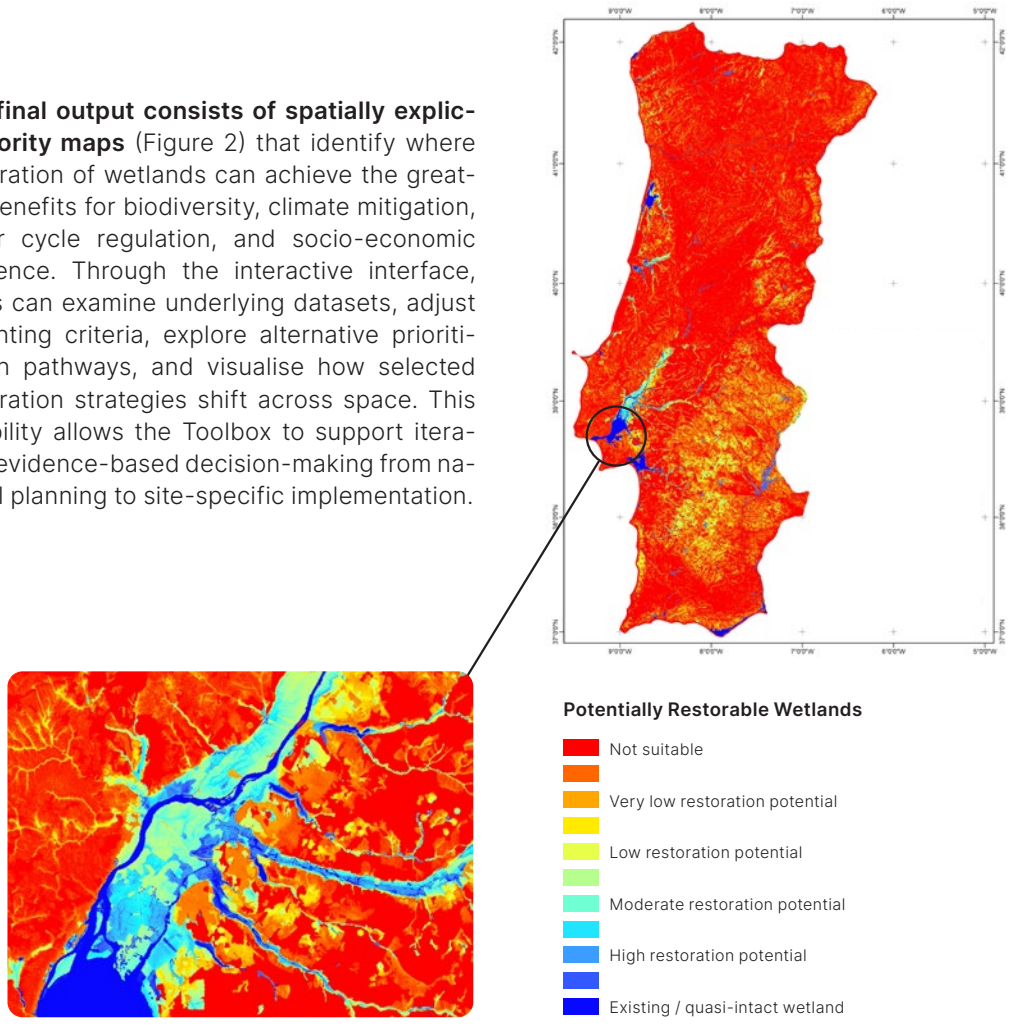

Figure 2: Potentially Restorable Wetlands (PRW) in Portugal used as baseline spatial input for the RESTORE4Cs Toolbox.

Ria di Aveiro, Portugal © University of Salento-LIFEWatch ERIC

Relevance of the Toolbox to legislative and strategic frameworks

Restoring coastal wetlands at scale requires alignment across biodiversity, climate, agriculture, water management and spatial planning **sectors**. **The Toolbox helps bridge these domains** by providing common evidence base and a harmonised assessment approach, directly supporting the implementation of major EU policy frameworks.

The **Toolbox is particularly relevant for the following policies**:

- **EU Nature Restoration Regulation**: Requires Member States to identify degraded and lost ecosystems, map restoration potential, design measures, and track progress. The Toolbox supports this by providing a transparent, science-based method to select priority areas for coastal wetland restoration and estimate expected restoration benefits.
- **EU Biodiversity Strategy for 2030**: Aims to enhance ecological connectivity, achieve favourable conservation status, and strengthen nature-based solutions. The Toolbox helps identify zones where restoration delivers the greatest ecological and societal returns.
- **EU Climate Law**, **Land Use**, **Land-Use Change and Forestry (LULUCF) Regulation**, **and carbon removal frameworks**: Set targets for greenhouse gas reductions and carbon sequestration. The Toolbox integrates carbon modelling outputs to pinpoint areas where coastal wetland restoration can achieve maximum carbon gains.
- **Water Framework Directive and Floods Directive**: Focus on hydrological restoration, water retention, and flood regulation. The Toolbox provides indicators and spatial insights to guide implementation and enhance these ecosystem services.
- **Regional and global frameworks (Ramsar Convention**, **Convention on Biological Diversity**, **SDGs**, **Regional Sea Conventions)**: These require improved wetland inventories, priority site identification, and strategic planning. The Toolbox enhances reporting, identifies key restoration sites, and provides a replicable spatial framework for coastal wetland management.

Policy recommendations

The **RESTORE4Cs Spatial Decision-Support Toolbox** provides a robust, transparent and science-based foundation for guiding wetland restoration across Europe. By integrating diverse datasets into a structured decision-support environment, the Toolbox supports Member States and regional authorities in designing targeted, efficient and impactful restoration pathways.

To enhance uptake and maximise the contribution of the Toolbox to European restoration efforts, this Policy **Brief recommends that policymakers and practitioners**:

- **Integrate the Toolbox outputs into National Restoration Plans**, ensuring restoration priorities are grounded in spatially explicit, evidence-based assessments.
- **Use the Toolbox to identify high-impact restoration zones**, where ecological, climatic and socio-economic co-benefits align.
- **Leverage the platform for cross-sectoral coordination**, bringing together biodiversity, climate, water and land-use authorities around a shared spatial framework.

By helping decision-makers determine where restoration should occur and why, the RESTORE4Cs Toolbox offers a timely and essential contribution to Europe's transition toward healthier, more resilient and more sustainable coastal wetlands.

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References

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RESTORE4Cs is a Horizon Europe project that aims to evaluate the effects of restoration actions on wetlands' ability to mitigate climate change and deliver a range of ecosystem services, using an integrative socio-ecological systems approach. More information is available at: https://www.restore4cs.eu/

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PARTNERS