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Nature-based Coastal Restoration holistically contributing to climate change adaptation

How nature-based coastal restoration leads to sustainable climate-resilient restoration

To address increasing climate and human pressures, coastal protection methods need to shift towards nature-based solutions, implemented in stages along adaptation pathways.

Key Learnings

- **Connecting engineering, politics and finance:** While the project investigates innovative engineering solutions in their biophysical framework, it also shows the importance of enablers, like stakeholder consensus, to overcome political and financial barriers for solutions to be implemented.
- **Stakeholder engagement:** The project team organised coastal restoration platforms ([CORE-PLATs](#)) with regular joint meetings between researchers, technicians, stakeholders, and the general public to achieve a consensus on coastal restoration and pathways to reduce risks for natural and socio-economic values. A mobile phone application maximises stakeholder and visitor engagement and their understanding of the challenges.
- **Upscaling efforts and impacts:** Small spatial analysis units support harmonising local adaptation efforts across large-scale landscapes. The holistic approach demonstrates methods to link rivers and coastal areas, benefiting humans and coastal ecosystems.

About the region

The pilot sites in [REST-COAST](#) contribute to climate change adaptation with tailored hands-on restoration actions. They demonstrate how coastal risks can be reduced with limited costs and a reduced carbon footprint compared to traditional coastal protection. The regions involved are the Baltic Sea, the North Sea, the Atlantic Sea and the Mediterranean. They all are of special societal importance – either because of their natural value, tourism, agriculture, or general economic value. Nevertheless, each site features specific socio-economic (for example increased tourism pressure or a lack of funding sources for restoration) and engineering challenges (for example coastal erosion or water quality).

Climate Hazards

Sea Level Rise, Storms, Droughts

Sector

Coastal Areas, Water Management, Tourism,

Buildings, Biodiversity

Key systems

Ecosystems and Nature Based Solutions

Water Management



Climate Threats

Coastal areas are increasingly vulnerable to climate change due to rising sea levels, changing storm patterns, and droughts that reduce sediment delivery, leading to increased erosion. These changes threaten vital ecosystems and their services – such as flood risk reduction, erosion protection, and water purification – potentially triggering cascading risks that jeopardize the stability of coastal zones and human interests. Key sectors at risk include tourism, infrastructure, and biodiversity.

Nature-based Solutions Building Blocks for Adaptation

There is a growing interest in Nature-based Solutions for coastal engineering and management, leveraging natural processes for sustainable outcomes. However, the complexity of ecosystems and the diverse needs of various stakeholders often hinder large-scale implementation. Balancing ecological functions with human interests presents significant challenges in applying these solutions effectively.

The "Nature-based Solutions-Building Blocks" approach simplifies coastal restoration by dividing the process into smaller, manageable units. The project team evaluates each unit's environmental and economic conditions to determine restoration potential. They select the most effective Nature-based Solutions for each unit, incorporating local stakeholders' knowledge and preferences through outcome simulations. The overall aim is to mainstream climate change adaptation by restoring smaller coastal areas, ultimately contributing to healthier ecosystems.

The project includes nine geographically diverse pilot sites, including a cross-border one, which contribute to the systematic upscaling of coastal adaptation. These sites facilitate the identification of synergies and trade-offs among various Nature-based Solutions Building Blocks, serving as a foundation for pilot implementations. Regular meetings with local stakeholders, known as COastal REStoration PLATforms (CORE-PLATs), allow for discussions on challenges and solutions, ensuring that local knowledge is integrated into the project, aligning researchers' theoretical approaches with practical stakeholder needs.

Assessing Nature-based Solutions Performance with Numerical Modelling

Numerical models have been essential in simulating real-world environments at the pilot sites to assess their adaptation potential with Nature-based Solutions. These simulations analysed river-to-sea and coastal connectivity for risk reduction. Results indicate that Nature-based Solutions provide a more sustainable and resilient alternative to traditional engineering methods. By integrating data from nautical charts, digital elevation models, and LiDAR scans, the project team designed and tested various solutions, such as embryo dune systems, seagrass transplantation, and wetland construction, with further simulations to evaluate their performance under future climates.



Figure 1: An innovative Nature-Based Solutions approach using embryonic dunes against coastal erosion and flooding in the Ebro Delta pilot site (North-West Mediterranean Spanish coast). Image Credit: Vicente Gracia.

Innovative Finance to Make Solutions Become a Reality

European coastlines need urgent ecosystem restoration, but public funding alone is insufficient for implementing necessary Nature-Based Solutions. The REST-COAST project is exploring innovative business models to attract private investments in coastal restoration.

At Arcachon Bay, alternative carbon crediting schemes are tested, focusing on seagrass transplantation, while at Nahal Dalia, a sequenced restoration plan is developed to align ecological and commercial goals through public-private co-financing. Aligning stakeholder interests and providing continued support to maintain the proposed Nature-based Solutions enables to create financially sustainable long-term coastal resilience. Extending these financial models beyond the pilots, fosters long-term coastal resilience through coordinated efforts.

A Playful Way to Maximise Stakeholder Engagement

The project has developed an interactive mobile app to inform locals, tourists, and stakeholders about coastal restoration strategies, such as carbon sequestration, biodiversity restoration, and Nature-based Solutions. The app allows users to explore each pilot area's challenges and solutions, apply different measures, and see their expected outcomes, fostering eco-friendly decision-making and raising awareness about coastal adaptation. The app also includes comprehensive educational materials on the importance of coastal restoration to raise awareness and educate users on how their actions can support coastal adaptation and restoration. The app is currently further developed and tested¹.

*“The aim of decarbonising coastal protection while maintaining acceptable risk levels and contributing to healthier coastal ecosystems must be included in policies at national and EU levels”,
Project Coordinator, Prof. Agustin Sanchez-Arcilla.*

¹ Please note that an update of this section will be provided once the app development is completed.

Summary

The project illustrates effective strategies for upscaling coastal restoration and enhancing biodiversity in vulnerable ecosystems while mitigating risks. By addressing technical, social, economic, and governance challenges, it promotes large-scale connectivity and expands coastal ecosystem services. Engaging citizens, stakeholders, and policymakers is essential for sustainable restoration, supported by innovative governance and financial frameworks. This systemic approach aligns with the EU Green Deal, merging technical and management innovations to drive transformative changes in governance and ensure lasting commitment to coastal ecosystem health.

Further information

The work presented in this adaptation story is part of the [REST-COAST](#) project.

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Contact

Agustin Sanchez-Arcilla, as Project coordinator

Mail address: agustin.arcilla@upc.edu

Ivan Caceres, as Project assistant coordinator

Mail address: i.caceres@upc.edu

Daniel Gonzalez Marco, as Project manager

Mail address: daniel.gonzalez-marco@upc.edu

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