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CASE STUDY

Environmental Rehabilitation of the Limonetes River (Spain)



Project full title: Enhancing Technical and Vocational Skills for Implementing Nature-Based Solutions (NbS) to Combat Land Degradation

Project acronym: NbS4LD

Project number: 2025-1-TR01-KA220-VET-000357096

Project activity: WP2 Developing Educational Resources on NbS for Combating Land Degradation

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1. INTRODUCTION

This case study has been analysed by [MIXTURA AMBIENTAL](#), a partner organisation of the NbS4LD project. It is a Spanish non-profit association composed of 20 renowned natural and social science researchers, artists, and local agents (particularly women and vulnerable groups) that promotes sustainable transitions, especially in rural areas and the Global South. Mixtura aims to contribute to sustainable development by combining natural and social sciences, traditional knowledge, and cultural expressions. The association works to create conditions that allow communities and vulnerable populations to find solutions to current socio-environmental challenges, such as desertification and land degradation. It promotes the preservation of cultural diversity, which is associated with higher biological diversity.

The Limonetes River restoration project, started in 2023 and still ongoing, is located in Talavera la Real (Badajoz, Spain), within the Guadiana River basin. The project aims to reduce flood risks, restore the river ecosystem, and improve the resilience of the landscape to erosion and climate impacts. The works combine nature-based solutions and engineering measures, including riverbank restoration, slope stabilization, hydroseeding, protective structures, and the recovery of native vegetation. The intervention includes planting 33,658 trees, 39,232 shrubs, and 19,800 cuttings, together with hydroseeding 39,658 m² of slopes and 320,803 m³ of earthworks. The project improves soil stability, reduces erosion and sedimentation, enhances biodiversity, and strengthens ecosystem services such as flood regulation. It is led by the Guadiana River Basin Authority in cooperation with regional, local, and private partners.

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[Site before the intervention. Source: Guadiana River Basin Authority - Confederación Hidrográfica del Guadiana]



[Slope reduction and installation of a coir erosion-control network for soil retention. Source: Guadiana River Basin Authority - Confederación Hidrográfica del Guadiana]

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[Hydroseeding for slope stabilization. Source: Guadiana River Basin Authority - Confederación Hidrográfica del Guadiana]



[Protective breakwater construction. Source: Guadiana River Basin Authority - Confederación Hidrográfica del Guadiana]

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[Site after the intervention. Tree planting: 33,658 units. Shrub planting: 39,232 units. Cutting installation: 19,800 units. Hydroseeding on slopes: 39,658 m². Earthworks: 320,803 m³. Source: Guadiana River Basin Authority - Confederación Hidrográfica del Guadiana]

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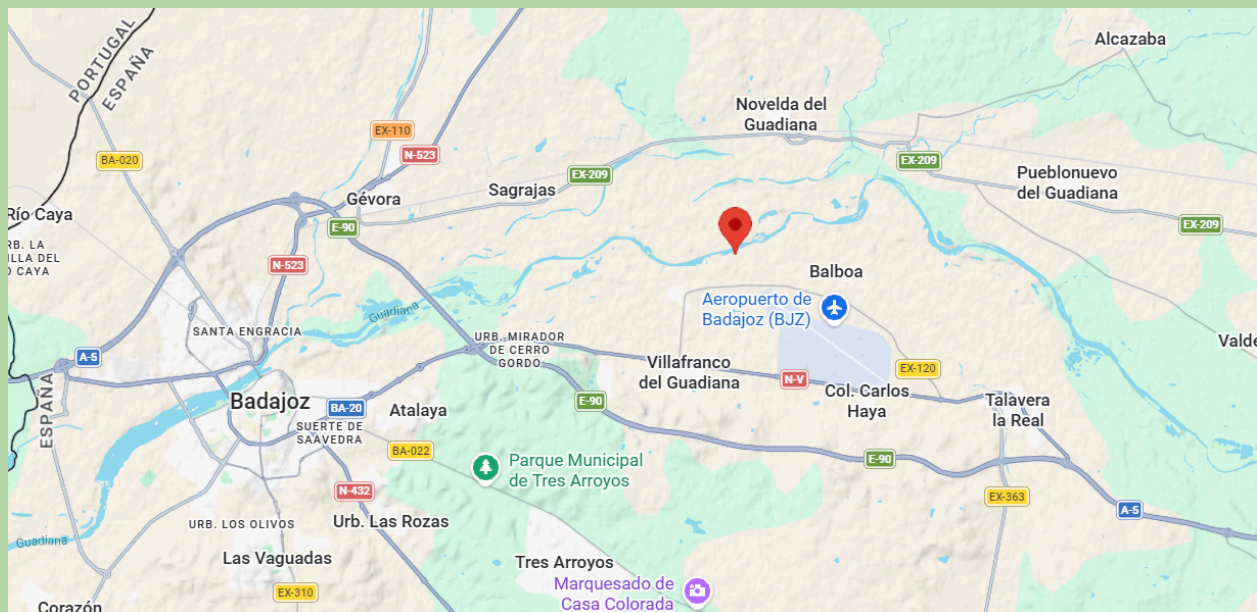


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2. CONTEXT

2.1 LOCATION

Country: Spain. Region: Extremadura. Province: Badajoz. Municipality: Talavera la Real.
Approximate GPS coordinates: Latitude 38.878° N - Longitude 6.769° W (-6.769).



2.3 LANDSCAPE TYPE

Forests.

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2.4 LAND DEGRADATION CHALLENGE

Soil erosion. Poor land management. Climate change.

2.5 BASELINE DATA

Land condition	• Site: tributary of the Guadiana River basin and part of a protected Natura 2000 area. • Soil: soil condition is delicate due to nutrient-laden waters received from nearby irrigated agricultural areas with highly fertilized crops. Soil is affected by erosion and landslide risks on some river margins. • Vegetation cover: tree and shrub cover are important to preserve soil and reduce erosion and flooding risks. The area is affected by invasive exotic species such as water hyacinth and Mexican water lily. • Erosion status: some river margins are eroded due to slope and high-intensity (torrential) rains. Erosion increases the risks of landslides and flooding. Sedimentation and erosion issues are present.
Environmental context	• Climate: high-intensity (torrential) rainfall events occur in the area. • Hydrology: the river receives nutrient-laden waters from nearby irrigated agricultural areas with highly fertilized crops. The Guadiana River is the final recipient of the Limonetes River. • Biodiversity: the site has biodiversity value and is designated as a Special Conservation Area (ZEC) and Special Protection Area for Birds (ZEPA). • Environmental pressures: degraded fluvial morphology, high flood risk, invasive vegetation, sedimentation and erosion issues, ecological degradation, nutrient inputs from agriculture, and invasive exotic species.
Socioeconomic context	• Population: low-income rural area. • Livelihoods: agriculture, forest ecosystem services, and hunting-related activities are important for local inhabitants. Land management: the area includes agricultural land, forest resources, and river ecosystems that provide ecosystem services to local communities. • Resource dependency: local inhabitants depend on forest ecosystem services including collection of fungus, asparagus, rockrose, pinecones, resin, and hunting species such as rabbits, hare, and partridge.

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Policy and governance	• Institutional framework: governance is divided across three levels and is dominated by the national level. River basins in Spain are public domain under the Ministry of Environment. The Limonetes River is managed by the Guadiana River Authority in cooperation with the regional environmental agency (Junta de Extremadura) and the municipality of Talavera la Real. The ZEC and ZEPA protected areas are managed by the regional authority (Extremadura region).
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3. INTERVENTION

3.1 TIMEFRAME

Intervention initiation: 2023 - ongoing implementation.

3.2 TYPE OF INTERVENTION

Reforestation. Soil restoration / erosion control. Integrated landscape management.

3.3 IMPLEMENTING ORGANISATIONS

Guadiana River Water Authority (national level), regional environmental agency, municipalities, and GTA Engineering (private business and mixed partner).

3.4 FUNDING SOURCES

Regional and EU funds (€ 9.4 million).

3.5 IMPLEMENTATION ACTIONS AND MEASURES

River restoration is a process aimed at recovering the structure and functions of a degraded river system in order to improve its ecological status.

This intervention defines a series of actions to improve the hydraulic behaviour of the Limonetes River in order to mitigate the effects of flooding affecting the town of Balboa and the surrounding area of Talavera la Real, which are exposed to a medium probability of flooding for a return period of ≥ 100 years.

The river section targeted by these actions is located along the Limonetes River, which belongs to the middle basin of the Guadiana River, in the vicinity of Talavera la Real (Badajoz). The section begins at kilometre marker 13 of the EX-363 highway and ends at the confluence of the Limonetes and Guadiana rivers. The total length of the intervention section is 26.60 km, and the intervention area covers 259 hectares.

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The objectives of the planned actions include:

- Flood protection for the towns of Talavera la Real, Balboa, and their riparian areas, mitigating flood impacts and reducing both flood magnitude and frequency.
- Expansion of the river corridor, providing the river with its own space to maintain natural flow dynamics without causing damage to people or property. This will allow natural processes of erosion and sedimentation to occur, while providing sufficient space for flood energy dissipation.
- Restoration of flow continuity and habitat connectivity along the river corridor by removing barriers and reducing restrictions on flooding, allowing the recovery of the three spatial dimensions of the river system.
- Restoration of the hydrological and ecological functions of riverbanks, promoting the natural regeneration of riparian vegetation.
- Restoration of the natural/reference morphology of the river channel.
- Control of diffuse pollution and reduction of riparian zone encroachment risks through the creation of riparian buffer zones and restoration of riparian forests.
- Improvement of the environmental functionality of the riverbed and river corridor to enhance hydraulic performance through riverbank cleaning, removal of dead trees, removal of unhealthy vegetation, and promotion of native riparian species.

The environmental rehabilitation of the Limonetes River involves a comprehensive set of river restoration actions aimed at improving hydraulic performance, reducing flood risk, and restoring ecological functions. Key measures include the removal of invasive vegetation, regrading of riverbanks, expansion of the floodplain, and restoration of riparian vegetation using native species.

The project also improves longitudinal and lateral connectivity, allowing natural geomorphological processes such as erosion and sediment transport to occur. Eco-engineering solutions, including hydroseeding, protective rock structures, and bioengineering techniques, are used to stabilise soils and enhance habitat diversity.

Primary sources from the Guadiana River Basin Authority and GTA Engineering, which is implementing the project, report that the restoration works were carried out along three sections of the river, covering a total length of 26.6 km and an area of 259 ha, with the following interventions:



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4. IMPACT

4.1 ENVIRONMENTAL IMPACT

☑ Improved soil health or reduced soil erosion. ☑ Increased vegetation cover or habitat restoration. ☑ Improved biodiversity (species richness, abundance, habitat quality). ☑ Improved ecosystem services (e.g., flood regulation). ☑ Reduced land degradation.

The intervention improved hydraulic capacity, reduced sediment accumulation, and restored natural river dynamics. Riparian vegetation has recovered, increasing biodiversity and stabilizing soils. River corridor connectivity has improved, supporting ecosystem functionality. Ecosystem services such as flood regulation and habitat provision have been enhanced. The project also contributes to reducing land degradation through erosion control and riparian restoration.

4.2 COMMUNITY IMPACT

☑ Job creation or new livelihood opportunities. ☑ Strengthened community resilience.

The main socioeconomic benefit is flood risk reduction, protecting communities, infrastructure, and agricultural land. The intervention reduces potential economic losses caused by flooding and contributes to job creation during implementation. It also provides opportunities for environmental education and recreational use of the river corridor.

4.3 INSTITUTIONAL IMPACT

☑ Strengthened institutional coordination. ☑ Establishment of new management structures or partnerships. ☑ Integration into local or national planning.

The project strengthened coordination between public authorities, environmental agencies, municipalities, and private partners. It promotes integrated river basin management and supports the adoption of nature-based solutions in policy and planning. Stakeholder collaboration improved governance effectiveness and long-term environmental management.

4.4 SUSTAINABILITY OF THE RESULTS

☑ Institutional support or partnerships. ☑ Monitoring and adaptive management systems.

The project supports sustainability through long-term monitoring, institutional support, and ecological self-regulation. Restored natural processes reduce maintenance needs and increase resilience to climate change. Long-term monitoring supports the maintenance of restored ecosystem functions.

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5. CONCLUSION

- **Community relevance:** mostly.
The intervention addresses real flood risks affecting local communities. It also recovers the river and river margins for recreational and educational purposes through flood risk reduction actions and restoration of the river corridor.
- **Technical effectiveness:** fully.
The intervention restores the river system and improves ecosystem conditions through a combination of nature-based and eco-engineering solutions, including river restoration actions, vegetation recovery, improved connectivity, and reduction of erosion and sedimentation issues.
- **Economic efficiency:** mostly.
The intervention is co-funded by regional and EU funding. Long-term socio-environmental benefits outweigh initial costs by reducing flood impacts and improving ecosystem services.
- **Institutional support:** fully.
Strong governance and coordination exist at local, regional, and national levels, involving public and private partners. Through cooperation between the Guadiana River Authority, regional environmental agency, municipalities, and GTA Engineering.
- **Innovation:** fully.
The intervention introduces a combination of nature-based solutions and engineering-based solutions. Through synergetic actions between nature-based and engineering-based approaches.
- **Replication & Scaling Potential:** mostly.
The intervention can be adapted to similar river systems. Through the application of similar river restoration approaches in other contexts while maintaining NbS principles.



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