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CASE STUDY

The Almonaster post-fire restoration (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 Almonaster post-fire restoration project was implemented between 2020 and 2022 in Almonaster la Real (Huelva, Andalusia, Spain) following a major wildfire that affected Mediterranean forests dominated by pine and eucalyptus stands. The intervention aimed to reduce soil erosion, stabilize slopes, restore ecosystem functions, and support vegetation recovery in an area increasingly vulnerable to drought, climate change, and wildfires. This combined nature-based solutions and eco-engineering measures, including contour barriers (fajinas) built from burned trunks, check dams (albarradas), selective removal of burned trees, biomass mulching, and subsoiling along contour lines to improve infiltration. These measures reduced runoff and sediment transport, improved soil stability, enhanced water retention, promoted natural regeneration, and supported biodiversity recovery. The project was coordinated by the Junta de Andalucía with technical support from GTA Ingeniería and serves as a replicable model for post-fire restoration in Mediterranean landscapes.

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[Pine forest site before the wildfire in Almonaster - Author: Guillermo González de Castro]

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[Burned tree collection (left) and removal of biomass residues (right) - Source: GTA Ingenieria]



[Eucalyptus-made check dam (albarrada) - Source: GTA Ingenieria]

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[Shredded biomass residues. Pine-made contour barrier (fajina) - Source: GTA Ingenieria]

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[Subsoiling - Source: GTA Ingenieria]

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[Check dams (albarradas) on hill slopes - Source: GTA Ingenieria]

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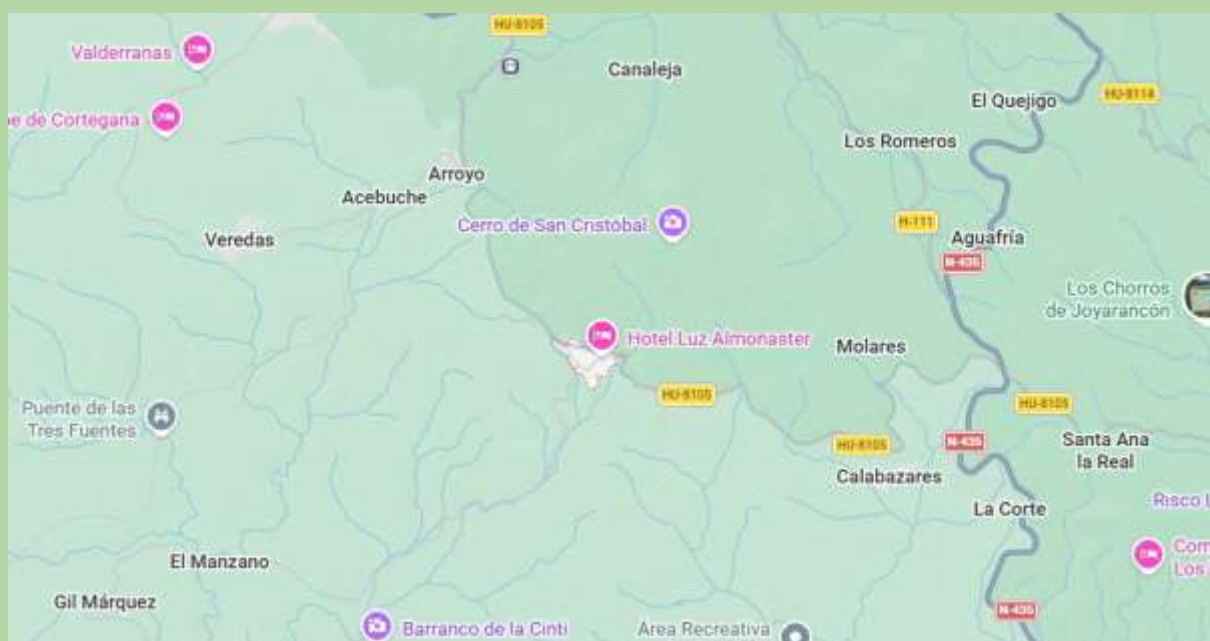


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2. CONTEXT

2.1 LOCATION

Country: Spain. Region: Andalusia (Andalucía). Province: Huelva. Municipality: Almonaster la Real. Approximate GPS coordinates: Latitude 37.870° N - Longitude 6.790° W (–6.790).



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2.3 LANDSCAPE TYPE

Forests.

2.4 LAND DEGRADATION CHALLENGE

Soil erosion. Poor land management. Climate change. Deforestation

2.5 BASELINE DATA

Land condition	• Site: Almonaster area, Huelva, Andalusia, Spain. The area consisted of Mediterranean forest landscapes dominated by pine and eucalyptus stands. • Soil: forest soils with vegetation cover before the wildfire. • Vegetation cover: Mediterranean forest vegetation dominated by pine and eucalyptus stands. • Erosion status: vegetation cover provided soil protection before the wildfire. After the wildfire, vegetation loss increased soil exposure and erosion risk.
Environmental context	• Climate: Mediterranean climate conditions in a region affected by increasing dryness and temperatures linked to climate change impacts. • Hydrology: before the wildfire, vegetation cover helped maintain soil protection. After vegetation loss, runoff increased and the risk of sediment transport increased. • Biodiversity: Mediterranean forest landscapes supporting biodiversity and ecosystem functions. • Environmental pressures: climate change impacts, increasing dryness, higher temperatures, and wildfire vulnerability.
Socioeconomic context	• Population: rural communities. • Livelihoods: communities dependent on forestry and ecosystem services, including wood, fungus collection, pine fruits, and resin. • Land management: forest landscapes requiring management to maintain ecosystem functions and reduce risks after disturbance. • Resource dependency: local communities depend on forest resources and ecosystem services.
Policy and governance	• Institutional framework: regional authorities and local management structures are responsible for forest management and ecosystem service protection.

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3. INTERVENTION

3.1 TIMEFRAME

Emergency actions began in October 2020 following the Almonaster wildfire and continued from 2020 to 2022 as part of post-fire restoration and erosion control measures.

3.2 TYPE OF INTERVENTION

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

3.3 IMPLEMENTING ORGANISATIONS

The intervention was implemented under the coordination of the regional administration (Junta de Andalucía), with technical support and delegated management by Gabinete Técnico Ambiental S.L.U. (GTA Ingeniería), a private environmental engineering company specialized in forestry and land restoration and a partner of MiXtura.

3.4 FUNDING SOURCES

Regional funding for post-disaster land restoration.

3.5 IMPLEMENTATION ACTIONS AND MEASURES

The Almonaster post-fire restoration program consists of the deployment of hydrotechnical soil conservation structures and targeted forestry management actions. Fajinas (contour barriers) made from burned eucalyptus and pine trunks are installed along hillslopes to reduce runoff velocity and trap sediments, while albarradas (check dams) are placed in drainage channels to slow water flow and minimize gully erosion.

Burned trees were selectively removed to reduce safety risks and pest propagation. Biomass from burned trees is shredded and applied as organic mulch to improve soil organic matter and promote natural regeneration. Subsoiling along contour lines is also used to improve infiltration in areas lacking vegetation. These practices are designed to rapidly stabilize soils, prevent sediment transport to reservoirs, and create suitable conditions for vegetation recovery and reforestation after severe wildfire disturbance. The intervention followed adaptive management principles commonly applied in post-fire ecosystem restoration.

The case study combined physical and biological measures typical of Nature-based Solutions (NbS). Key measures included the construction of contour barriers (fajinas), check dams (albarradas), removal of burned trees, biomass reuse, and subsoiling along contour lines to reduce runoff and improve water infiltration.

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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. Improved water quality or water availability. ☒ Increased carbon sequestration or storage.

The intervention reduced soil erosion and sediment transport, stabilized slopes, and improved conditions for natural vegetation regeneration. The use of contour structures reduced runoff velocity and increased infiltration. Early monitoring indicated improved soil stability and reduced sediment deposition in drainage channels. Co-benefits include biodiversity recovery, carbon cycle stabilization, and water quality protection.

4.2 COMMUNITY IMPACT

☒ Improved food security. Improved water access. ☒ Strengthened community resilience.

The project contributed to local employment during restoration works and reduced risks to rural infrastructure and communities from flooding and falling burned trees. It also supported the long-term recovery of ecosystem services, such as forestry productivity, landscape resilience, and other recreational uses (romerías, traditional countryside festivities).

4.3 INSTITUTIONAL IMPACT

☒ Strengthened institutional coordination. ☒ Establishment of new management structures or partnership.

The intervention strengthened collaboration between regional authorities and private technical organizations. It demonstrated the role of emergency environmental engineering actions in post-fire land governance frameworks.

4.4 SUSTAINABILITY OF THE RESULTS

☒ Institutional support or partnerships.

The use of local materials and natural regeneration processes increases ecological sustainability. Long-term impact depends on continued monitoring, reforestation actions, and integration into regional forest management plans, including the maintenance of forests to reduce fire risks.

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5. CONCLUSION

- **Community relevance:** mostly.

The intervention addressed wildfire impacts affecting rural ecosystems and infrastructure. Through post-fire restoration actions that reduced erosion risks, stabilized soils, and protected rural areas from flash floods and landslides. The program generated employment for local forestry workers and contributed to safeguarding rural infrastructure and ecosystem services.

- **Technical effectiveness:** fully.

The intervention restored ecosystem functions and improved environmental conditions after the wildfire. Through a combination of nature-based and eco-engineering solutions, including contour barriers (fajinas), check dams (albarradas), biomass reuse, and subsoiling to reduce runoff and erosion. Soil stabilization and erosion control measures showed positive early results. Early vegetation regeneration was observed, contributing to the re-establishment of plant cover and habitat quality.

- **Economic efficiency:** mostly.

The intervention was cost-effective and financially viable. By using local materials and natural regeneration processes, which reduced implementation costs while supporting ecosystem recovery. Low implementation costs combined with long-term environmental benefits increase the overall value of the intervention.

- **Institutional support:** mostly.

The intervention was supported by coordinated governance structures involving public and private actors. Through collaboration between regional and local authorities and private technical organizations. The restoration strengthened cooperation between government agencies and technical forestry organizations, demonstrating the value of coordinated disaster response.

- **Innovation:** fully.

The intervention combined traditional restoration techniques with a Nature-based Solutions approach. By integrating hydrotechnical soil conservation structures, biomass reuse, natural regeneration processes, and adaptive management practices. The combination of traditional techniques and NbS principles improved ecosystem recovery and supported adaptive post-fire restoration.

- **Replication & Scaling Potential:** fully.

The intervention can be adapted and replicated in other fire-prone landscapes. Through the application of simple and transferable restoration techniques such as contour barriers, check dams, biomass reuse, and soil stabilization measures. The techniques

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are widely applicable across Mediterranean fire-prone landscapes and have already been replicated successfully in the Sierra Bermeja wildfire restoration.

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