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CASE STUDY

Use of Log Erosion Barriers (LEBs) for Slope Stabilisation and Post-Fire Ecosystem Recovery in a Mediterranean Forest Ecosystem (Italy)



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 the [European Research Institute Foundation ETS \(ERI\)](#), a partner organisation of the NbS4LD project. ERI is a non-profit organization founded in 2011 in Turin, Italy, dedicated to research, innovation, and sustainable development. ERI works to improve social, economic, and cultural conditions by promoting inclusion, equity, cultural diversity, and respect for the environment. The organization focuses on environmental protection, biodiversity conservation, climate change mitigation, and sustainable management of urban, peri-urban, rural, and natural areas. ERI collaborates with public institutions, businesses, start-ups, and local communities, combining expertise in research, project planning, communication, and implementation. With offices across Italy and a branch in Hungary, ERI has developed significant experience in managing European-funded projects. ERI specializes in environmental education, stakeholder engagement, and scientific communication, supporting communities, authorities, and organizations in developing sustainable solutions. Through research, awareness activities, and innovative approaches, ERI contributes to biodiversity protection, climate resilience, and the transition toward sustainable development.

This case study focuses on the use of Log Erosion Barriers (LEBs) as a Nature-Based Solution for post-fire ecosystem recovery in the Aspromonte Massif, Calabria, Italy. The intervention site, located in Roccaforte del Greco, experienced severe degradation after a 2021 wildfire in a dense *Pinus radiata* plantation. The fire caused vegetation loss, soil exposure, increased runoff, sediment transport, and reduced ecosystem resilience due to previous poor forest management and climate pressures. Implemented immediately after the wildfire in September 2021, the intervention consisted of manually placing burnt logs along contour lines to stabilize slopes, slow runoff, and trap sediments. Using local materials avoided heavy machinery and supported natural regeneration. Monitoring over 17 months showed reduced erosion, increased sediment accumulation behind barriers, improved soil moisture retention, and early vegetation recovery.

The project involved research institutions, local forestry operators, public authorities, and protected area managers, supported by national research funding. The intervention strengthened local capacity and demonstrated an effective, low-cost restoration approach compatible with forest regulations.

The LEB technique improved soil stability, reduced land degradation, and enhanced ecosystem recovery while providing a replicable solution for Mediterranean forests affected by wildfire. Its use of available biomass, simple implementation, and long-term ecological benefits make it suitable for scaling across similar post-fire landscapes.

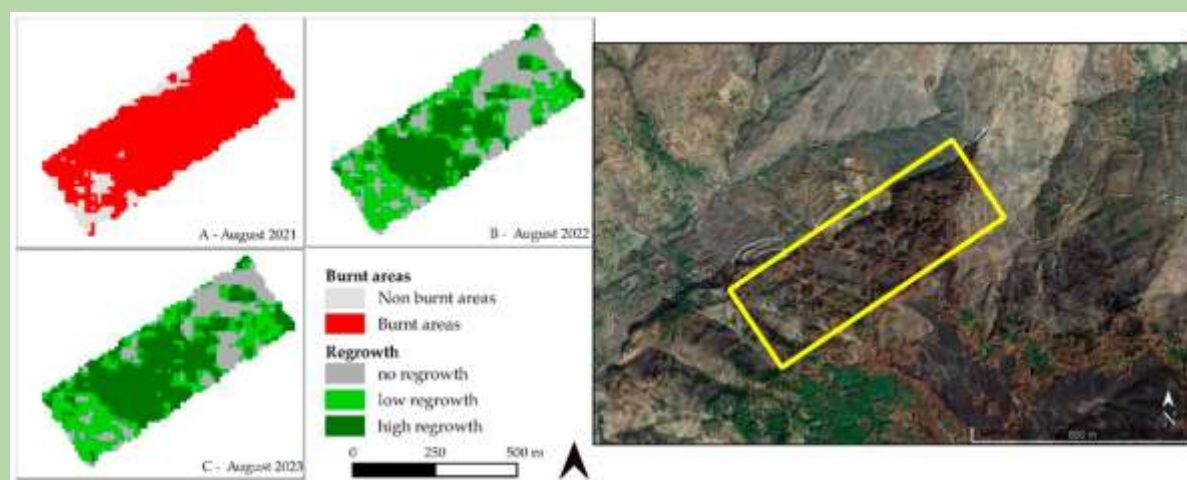
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[Representative photos of (a) the Aspromonte areas affected by the wildfires of summer 2021 and (b) the high density of *Pinus radiata* forest in Aspromonte - Source: MDPI]

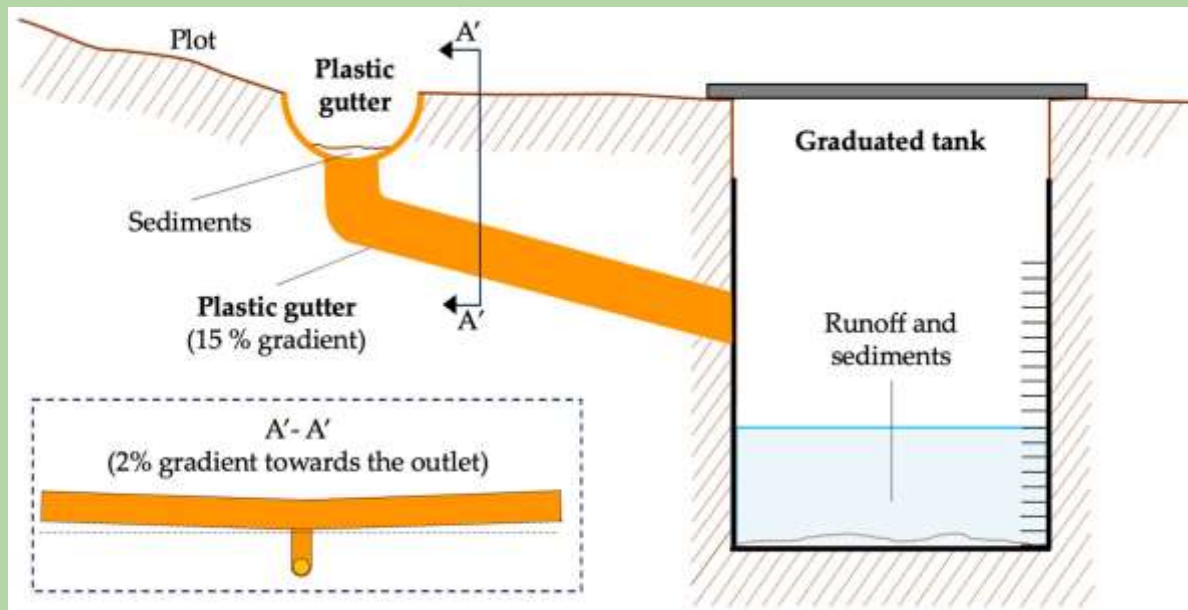


[Maps of regrowth dynamics at one and two years after the fire event (2021) using satellite - Source: MDPI]

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[Scheme of the collection system, for runoff and sediment, placed at the bottom of each sub-plot - Source: MDPI]



[View of (a) newly installed log barrier subplot, (b) pioneer plants growing above the logs after a few months, (c) young pine seedlings, and (d) spreading vegetation cover - Source: MDPI]

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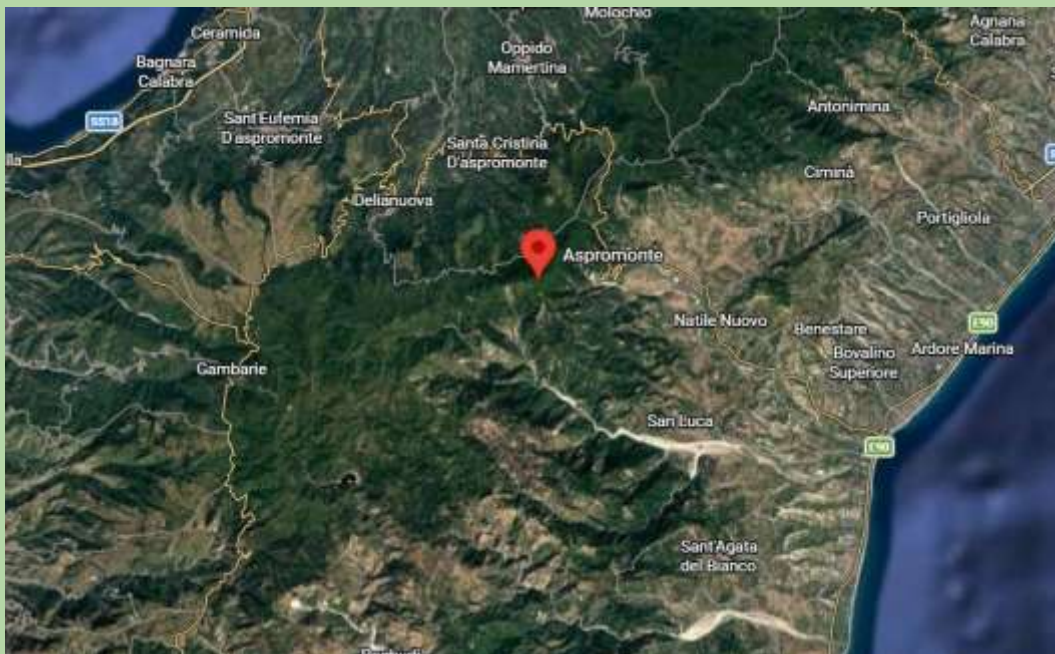
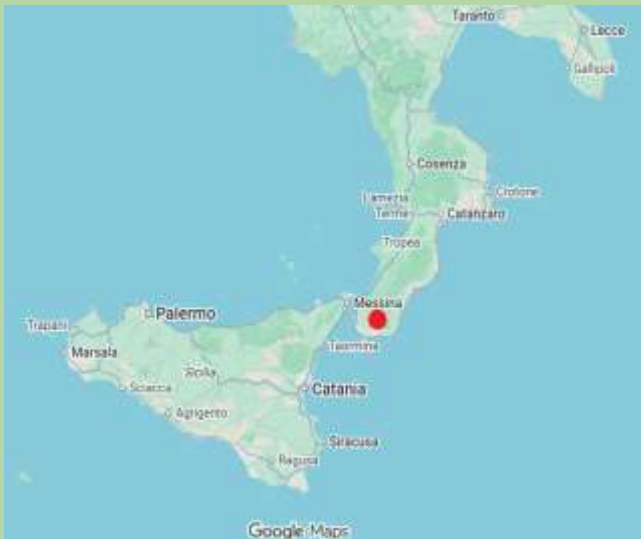


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2. CONTEXT

2.1 LOCATION

Country: Italy. Region: Calabria Region. Province: Reggio Calabria. Site: Aspromonte Massif, Municipality: Roccaforte del Greco. Approximate GPS coordinates: Latitude 38.03° N - Longitude 15.54° E



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2.3 LANDSCAPE TYPE

Forests.

2.4 LAND DEGRADATION CHALLENGE

Deforestation. Poor land management. Climate change.

2.5 BASELINE DATA

Land condition	• Site: dense monoculture of <i>Pinus radiata</i> (800–1000 trees/ha). • Soil: sandy-loamy, acidic, low organic matter • Vegetation cover: near-total loss after fire • Erosion status: strong increase in runoff and sediment production. Bare soil exposed to early erosion processes
Environmental context	• Climate: Mediterranean semi-arid. Dry summers and intense rainfall events in autumn. Increasing frequency and intensity of extreme wildfires and high-intensity rainfall events are key drivers of post-fire degradation in Mediterranean regions. • Hydrology: post-fire soil hydrophobicity reducing infiltration. Increased runoff connectivity • Biodiversity: artificial pine forests with limited ecological resilience (pre-fire). Strong disruption of vegetation and soil biota (post-fire). Abandoned, dense monoculture pine plantations (<i>Pinus radiata</i>) increased fire vulnerability and reduced ecosystem resilience. • Ecological pressures: the site showed hydrogeological instability. Erosion and sediment transport Increased vulnerability to extreme rainfalls.
Socioeconomic context	• Population: very low population density (rural mountain area with dispersed settlements). • Livelihoods: limited local activities, mainly forestry and pastoral use. • Land management: forest and protected areas within Aspromonte National Park. • Resource dependency: indirect; the area provides ecosystem services such as soil conservation, slope stabilization, and downstream sediment control.
Policy and governance	• Institutional framework: under the constraints imposed by the Italian Forest Fire Law No. 353/2000, post-fire interventions are strictly regulated to prevent land-use change and speculative practices. These legal restrictions limit the use of conventional restoration measures such as large-scale

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	reforestation or heavy engineering works, thereby requiring approaches that respect natural regeneration processes.
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3. INTERVENTION

3.1 TIMEFRAME

Wildfire event: Summer 2021. Intervention: September 2021 (immediate post-fire phase).
Monitoring: September 2021 - January 2023 (17 months, ongoing extensions).

3.2 TYPE OF INTERVENTION

Erosion Barriers (LEBs) using in situ burnt wood arranged along contour lines.

3.3 IMPLEMENTING ORGANISATIONS

The intervention was implemented through collaboration between research institutions, local operators, and public authorities. University-based research teams led the experimental design, monitoring, and evaluation of the Nature-Based Solution, while local land managers and forestry operators, including the Saccà farm, supported site access, logistics, and field implementation. Coordination with Aspromonte National Park and local forestry authorities ensured regulatory compliance and effective site management. The project was funded under national research frameworks, including the Tech4You project.

3.4 FUNDING SOURCES

The project was financed through national research programs, including initiatives under the Italian NRRP framework such as the Tech4You project, which provided funding for research, field implementation, and monitoring activities. Additional support came from local authorities and partner organizations contributing in-kind resources, ensuring the continuity and sustainability of the intervention.

3.5 IMPLEMENTATION ACTIONS AND MEASURES

- 1) The intervention began immediately after the wildfire, with site selection and plot establishment in September 2021, one month after the fire and before autumn rains.
- 2) Burnt logs present on site were used and manually repositioned along contour lines from September to October 2021, with partial soil embedding and no heavy machinery.
- 3) Nine experimental plots were set up in this period to represent forest control, burned random logs, and burned contour logs. Monitoring ran from September 2021 through January 2023, covering 30 rainfall event groups and including measurements of runoff and sediment yields, vegetation recovery, and wood durability tests. Site selection: slopes affected by recent fire with visible erosion were selected for intervention.

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4. IMPACT

4.1 ENVIRONMENTAL IMPACT

☒ Improved soil health or reduced soil erosion. ☒ Increased vegetation cover or habitat restoration. ☒ Reduced land degradation.

The installation of burnt logs along contour lines created sediment accumulation zones (5–15 cm thick) upslope of the barriers, effectively interrupting runoff pathways and reducing the development of rills compared to untreated areas. This led to a 20–30% reduction in soil erosion, increased soil moisture retention in depositional areas, and early vegetation regrowth concentrated near the logs. Untreated slopes continued to experience active erosion and sediment transport, demonstrating that the intervention effectively supported natural regeneration and slope stabilization.

4.2 COMMUNITY IMPACT

☒ Strengthened community resilience. ☒ Increased local capacity or skills.

By reducing downstream sediment-related risks and promoting ecosystem service protection, the project enhanced local capacity and knowledge transfer. Land managers gained practical experience with low-cost, nature-based solutions, strengthening skills applicable to post-fire restoration.

4.3 INSTITUTIONAL IMPACT

☒ Strengthened institutional coordination. ☒ Capacity building for institutions or communities. ☒ Integration into local or national planning.

The intervention reinforced collaboration between research teams and forest management authorities, providing a demonstration site within the NBFC framework. It contributed to the integration of Nature-Based Solutions into post-fire management strategies and fostered institutional coordination and capacity building..

4.4 SUSTAINABILITY OF THE RESULTS

☒ Institutional support or partnerships. ☒ Local technical capacity for maintenance. ☒ Monitoring and adaptive management systems.

Burnt logs are effective for 10-15 years with minimal maintenance and support long-term vegetation-driven slope stabilization. Sustainability is ensured through the use of local materials, incorporation into forest management practices, and ongoing monitoring under the NBFC program, enabling adaptive management and continued ecosystem recovery over time.

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5. CONCLUSION

- **Community relevance:** mostly.
Post-fire soil erosion creates risks for slope stability, water quality, and ecosystem services that affect local communities. The intervention reduced runoff and sediment transport using a practical and accessible restoration method based on locally available materials.
- **Technical effectiveness:** fully
Contour-aligned Log Erosion Barriers effectively reduced surface runoff and sediment loss, stabilized burned slopes, and supported natural vegetation recovery by creating micro-habitats and improving soil conditions.
- **Economic efficiency:** fully.
The approach is low-cost and uses existing burnt wood resources, reducing the need for transportation, heavy machinery, and expensive engineering structures while achieving effective erosion control.
- **Institutional support:** mostly
The intervention is supported through research initiatives and public land management frameworks, with collaboration between scientific institutions and local authorities for implementation and monitoring.
- **Innovation:** mostly
The method combines traditional use of woody materials with scientific design and monitoring, transforming post-fire debris into an effective Nature-Based Solution for ecosystem recovery.
- **Replication & Scaling Potential:** fully
The technique is highly adaptable to Mediterranean post-fire landscapes because it relies on local biomass, simple installation methods, and can be applied across different degraded slopes while maintaining NbS principles.

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