

# LIFE REFOREST RECOMMENDATIONS FOR LEGISLATORS



LIFE REFOREST - LIFE17 ENV/ES/000248  
WITH THE CONTRIBUTION OF THE LIFE FINANCIAL INSTRUMENT  
OF THE EUROPEAN COMMISSION



**LIFE REFOREST**  
RECOVERING ECOSYSTEMS

**Title of the project:** Erosion prevention and flora Restoration of burnt FOREST areas through innovative fungal-technosol solution

**Code:** LIFE17 ENV/ES/000248

**Duration:** 01/07/2018 – 31/03/2022

**Total budget:** 1.577.648 €

**EU contribution:** 937,037 €

# 1. Executive summary

LIFE REFOREST is a project funded by the European Commission under the LIFE programme and led by the Multisectoral Research Technology Centre (Centro Tecnológico de Investigación Multisectorial - CETIM), whose main aim is to mitigate the impact caused by erosion and soil loss in areas affected by forest fires, through the application of a new system based on technosoils made from organic waste that is stabilised and inoculated with fungal species.

The project developed a system of tubular mycotechnosoil sleeves that were installed in 3 pilot areas (> 400m<sup>2</sup>) in Galicia and Portugal, two of the regions most affected by forest fires in the European Union.

The three pilot areas were assessed between 2019 and 2022, monitoring the erosion produced and the characteristics of the eroded sediments and run-off water. The evolution of the affected areas was also monitored. The results obtained showed a rapid regeneration of the vegetation cover, significantly reducing the run-off water generated and reducing erosion by 75%-80% compared to untreated areas.



## 2. The problem

Forest fires annually affect 350M ha worldwide, generating 50% of CO<sub>2</sub> emissions compared to those caused by the burning of fossil fuels<sup>1</sup>. The data are particularly important in Mediterranean areas, where 80% of the burned area in Europe is concentrated, causing a great economic and environmental impact<sup>2</sup>.

### Situation in Portugal and Spain

Portugal is the most affected country, with an average of 138,000 ha burned in the last decade, due, partly to large fires, one of the most important being the one that occurred in 2017 in its central area, which razed 53,000 ha and caused 66 fatalities<sup>3</sup>. Its cost was estimated at between €200M and €1,000M, which would represent between 20% and 80% of the economic benefit of forestry production. The loss and subsequent recovery was estimated at €3,500/ha<sup>4</sup>.

In Spain, although forests account for 10% of the territory<sup>5</sup> there is an average affected area of more than 108,000 ha, with Galicia (North-west Spain) being one of the most relevant areas, where fires already represent an average economic loss of €330,000/year with a cost of post-fire work ranging between €1,500 and €2,000 /ha<sup>6</sup>.

The frequency of large-scale forest fires is undermining the ability of ecosystems to regenerate naturally. Soil erosion, water scarcity and loss of biodiversity threaten the ecological stability of large areas.

---

<sup>1</sup> Jolly et al. (2015). Nat. Commun. 6:7537

<sup>2</sup> Viegas (2009). JRC Sci. Tech. Rep.

<sup>3</sup> Alberti, B. M. (2018, 15 junio). Portugal's wildfire that broke a community. BBC News. <https://www.bbc.com/news/world-europe-44438505>

<sup>4</sup> Mateu & Fernandes (2014). Forest fires in Portugal: dynamics, causes and policies.

<sup>5</sup> Barreiro et al. (2016). Soil Biol. & Biochem. 97: 102-111.

<sup>6</sup> Salas (2014). Aproximación a la consideración de los problemas ambientales más relevantes de la Península Ibérica: incendios forestales

## Mitigation techniques

Post-fire recovery time in the Mediterranean is estimated at 5 to 10 years<sup>7</sup>. At present, there is a lack of highly efficient solutions to cope with rainfall triggered ash entrainment, so mitigation techniques are the first line of defence against erosion. These should be applied urgently after the fire, since most losses occur during the first months after the fire.

### The main mitigation techniques used are:

**Sowing:** This is the oldest and most common treatment. Aerial seeding of annual or perennial grasses is used to provide ground cover until native plants are re-established.

**Mulching:** Mulch is any organic material spread on the soil surface that increases soil cover and reduces the impact of raindrops and overland flow.

**Erosion barriers:** They can be made of straw, level felled logs or other natural barriers. Engineering structures are also used to provide mechanical barriers to overland flow, to promote infiltration and trap sediment on burned slopes.

**Polyacrylamides (PAM):** Mitigation technique in the form of dry granules consisting of the use of flocculating agents.



---

<sup>7</sup> Inbar et al. (1998). Geomorphology 24: 17–33

### 3. The solution

LIFE REFOREST aims to mitigate the impact caused by forest fires, reducing erosion, recovering organic matter and the ecosystem and, consequently, minimising the serious socio-economic and environmental impacts caused by fires.

The application of an artificial soil (technosoil) made from stabilised organic residues and by-products, inoculated with different species of fungi (mycotechnosoil), is proposed for the above, in order to mitigate soil loss and favour the natural regeneration of the burned areas.

This solution is applied in the form of biodegradable tubular netting sleeves that are easy to transport and place in terrain that is difficult to access. They function as a bioactive barrier, slowing surface run-off and favouring infiltration and sedimentation of particles carried upstream. Meanwhile, the development of the mycelium of the fungus gives structure to the soil, recovering its environmental and productive functions.

In addition, the mycotechnosoil provides organic matter and nutrients, and includes seeds of local plants to encourage rapid development of vegetative cover, promoting water retention and minimising downstream contamination from ash entrainment.



## 4. Consortium

The LIFE REFOREST consortium is composed of the Multisectoral Research Technology Centre (Centro Tecnológico de Investigación Multisectorial - CETIM) as coordinator and the following entities involved in the development and technical execution of the project: the Galician Forestry Association (AFG), the Portuguese Forestry Association (FORESTIS), the Galician companies TEN Tecnosuelos, Hifas da Terra (HdT), INDUTEC Ingenieros and the Environmental and Marine Research Centre (Centro de Investigación Medioambiental y Marina - CESAM) of the University of Aveiro (UAVR).

## 5. Project Results

### LIFE REFOREST Pilots

The LIFE REFOREST project has three pilots installed in Galicia and Northern Portugal.

**In October 2019, the consortium installed 2 pilot areas of approximately 200 m<sup>2</sup>:**

- 1. Commonly owned mountain land of Nespereira, in Pazos de Borbén (Pontevedra, Galicia)** after a 10 ha fire in a pine plantation on 14 and 15 September.
- 2. Albergaria Mountains (Aveiro, Portugal)** (Figure 1), following a fire from 5 to 7 September 2019 that burned 1,492 ha of a eucalyptus plantation.

**Action: Both areas were randomly divided into 9 subplots:**

- 3 plots: Installation of barriers developed in the LIFE REFOREST project with 2 geotubes placed in the middle and lower section of the plot.
- 3 plots: Mulching application (at an application rate of approximately 250 g m<sup>-2</sup> with pine needles and ground eucalyptus bark for pilots 1 and 2,

respectively).

- 3 remaining plots: No treatment was applied as a control.



*Zona de instalación del piloto LIFE REFOREST en Nespereira (Pontevedra, Galicia)*



*Zona de instalación del piloto LIFE REFOREST en Nespereira (Pontevedra, Galicia)*

**3. Penouços** (Sever do Vouga – Aveiro), following a fire in September 2020 of 2,149 ha. It had already suffered a fire in 2016.

#### **Actuación:**

Installation of 2 geotubes placed at the base of the plot.

Incorporation of seeds of native tree species, in addition to the herbaceous species included in the previous pilots.

Mulching was carried out with shredded Acacia debris at application rates of approximately 250 g m<sup>2</sup>.



*Installation area of the LIFE REFOREST pilot in Nespereira (Pontevedra, Galicia)*



*LIFE REFOREST pilot installation area in Albergaria (Portugal)*

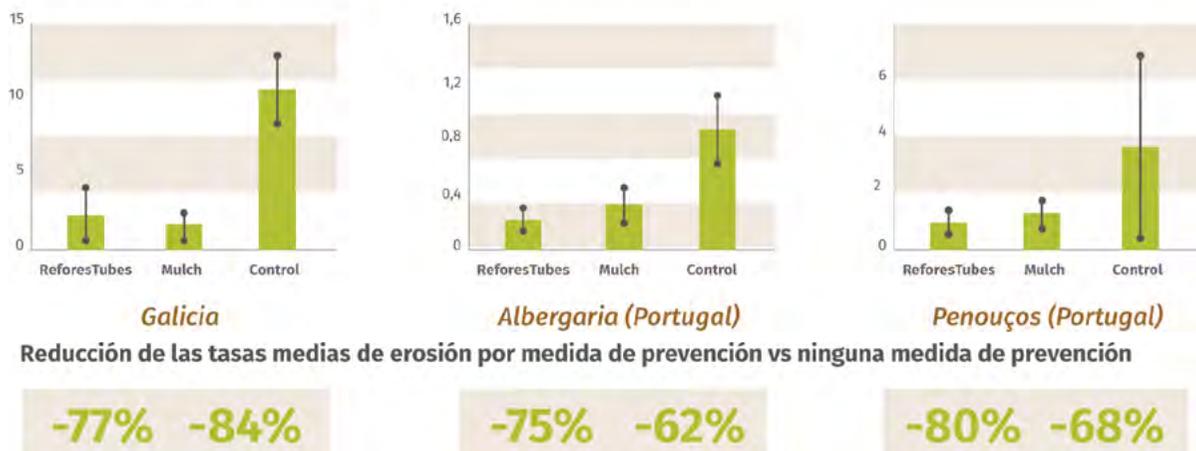


*Installation area of the third LIFE REFOREST pilot in Oliveira de Frades, Portugal (above) and detail of the installation on the selected hillside (below).*

## Results obtained

The REFOREST solution has been able to reduce soil losses during the first post-fire year by 75%-85%. In addition to achieving similar efficiency to traditional full surface coverage treatments, geotubes have also proven to be effective barriers to surface run-off. This is especially relevant when promoting the sedimentation of soil eroded on the hillsides at the very top. Another aspect to highlight is that the composition of the technosoil and the inclusion of seeds have facilitated the development of vegetation cover in its areas of application.

**Tasas de erosión durante el primer año hidrológico posterior al incendio**  
(Mg suelo perdido por hectárea por año)



## Other actions:

- Analysis of the environmental and economic impact of the solution.
- Guidelines for the application and transfer of the model to other areas of Europe

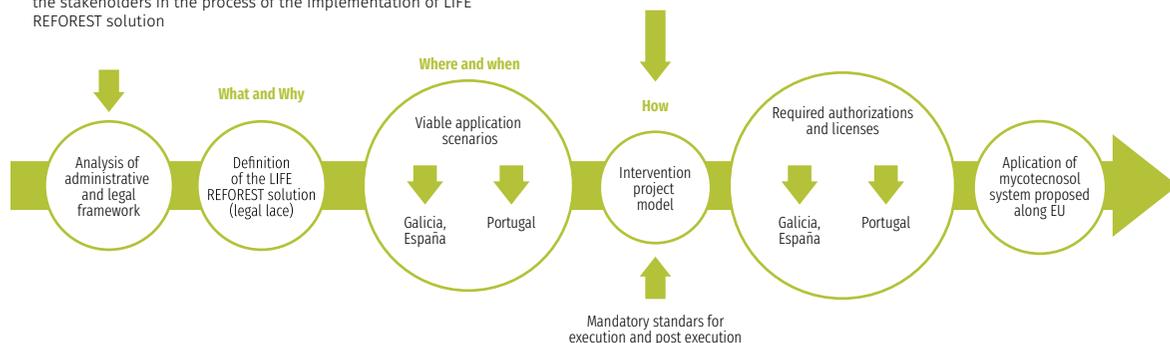
## Recomendations for legislators

### Road map development LIFE REFOREST SOLUTION

The information obtained in the analysis of administrative and legal framework will be used to elaborate a Road Map to guide the stakeholders in the process of the implementation of LIFE REFOREST solution

### Potential Policy Recommendations

Consultation of stakeholders and identification of policy makers



## Recommendations for national policies

- Develop a national legal framework on technosoils.
- Clarify the legal framework of the product designed in the Life Reforest solution.
- Improve the legal regulation of restoration actions on burned forest lands.
- Establish regional protocols for urgent actions to mitigate hydrological and erosive risk.
- Improve collaboration between the forest Administration, landowners, managers, the local population and environmental associations.
- Establish a fast, agile administrative response system to requests for emergency stabilization treatments for soils affected by forest fires.
- Strengthen financial mechanisms for emergency stabilization treatments of vulnerable soils affected by forest fires.
- Establish training programmes for forest managers specialised in the restoration of burned forest lands.

## Recommendations for European policies

- Include a reference to the concept of technosoils as artificial soils made from organic and inorganic residues or other synthetic materials in the European soil classification, which meet environmental and productive functions and improve the situation of the degraded or contaminated soil on which they are applied.
- Include the production of technosoils and mycotechnosoils derived from waste and their use to improve, restore and rehabilitate degraded and/or contaminated soils in EU regulations.
- Consider urgent actions to stabilise soils and watercourses in the management policies for burned areas after forest fires, in order to minimise erosion risks and promote restoration and natural regeneration measures.
- Promote, through the Common Agricultural Policy (CAP) and cohesion policy funds, the implementation of urgent actions to minimise the erosive hydrological risk following forest fires as actions prior to reforestation.
- Include forest fires as one of the causes of forest soil degradation in the European legislation on soil protection, and consider the consequent need to apply good practices in their restoration.
- Promote public-private collaboration for the restoration of burned forest lands through participatory measures involving forest owners and managers.
- Facilitate access to administrative procedures to request financial aid for urgent actions to minimise post-fire erosive hydrological risk.
- Support research and technological innovation projects related to the restoration of soils affected by forest fires.
- Encourage the development of maps that identify strategic zones by level of severity of environmental and economic damage that the forest fire may cause, and by level of vulnerability to erosion, in order to detect urgent and medium to long-term restoration needs.
- Motivate, through European Funds, training and capacity building actions for the integrated management of forest fire prevention, extinction and restoration, as well as other activities for the transfer of knowledge and information on the subject.