

Innovative nature-based solutions to restore ecosystems services of areas degraded by Picões large wildfire, Portugal – SOILING

EEA and Norwegian Financial Mechanisms 2014-2020

Programa "Ambiente, Alterações Climáticas e Economia de Baixo Carbono"

Aviso#5 – Projetos de preparação para condições meteorológicas extremas e de gestão de riscos no contexto das alterações climáticas

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State of the art

Picões' hillslopes, which are an extensive source of sediments to Baixo-Sabor reservoir, **were largely affected by a large wildfire in 2013** (14.912 ha).

In this context, a restoration strategy should focus on the protection of the most relevant surfaces in terms of hydrologic and vegetation cover parameters.

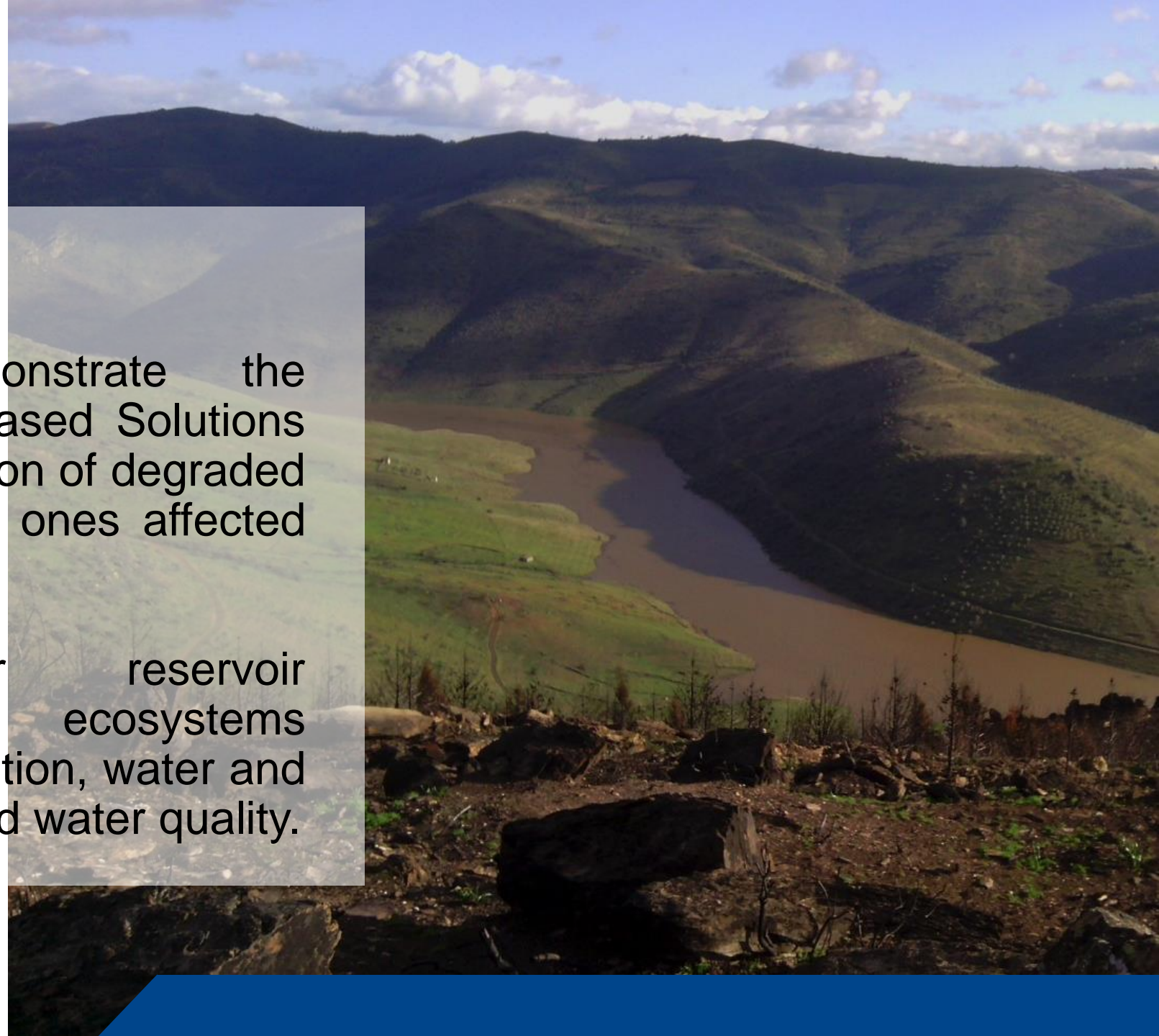
The adoption of these measures promotes in locus infiltrations, the increasement of water and carbon stocks, stimulates the biological activity of soils and consequentially, plant recolonization.



Aims

The proposal aims to:

- ✓ Implement and demonstrate the effectiveness of Nature based Solutions (SbN) towards the protection of degraded soils (85 ha), namely the ones affected by the fire event of Picões;
- ✓ Promote Baixo-Sabor reservoir restoration regarding ecosystems services such as soil retention, water and carbon contents on soil and water quality.





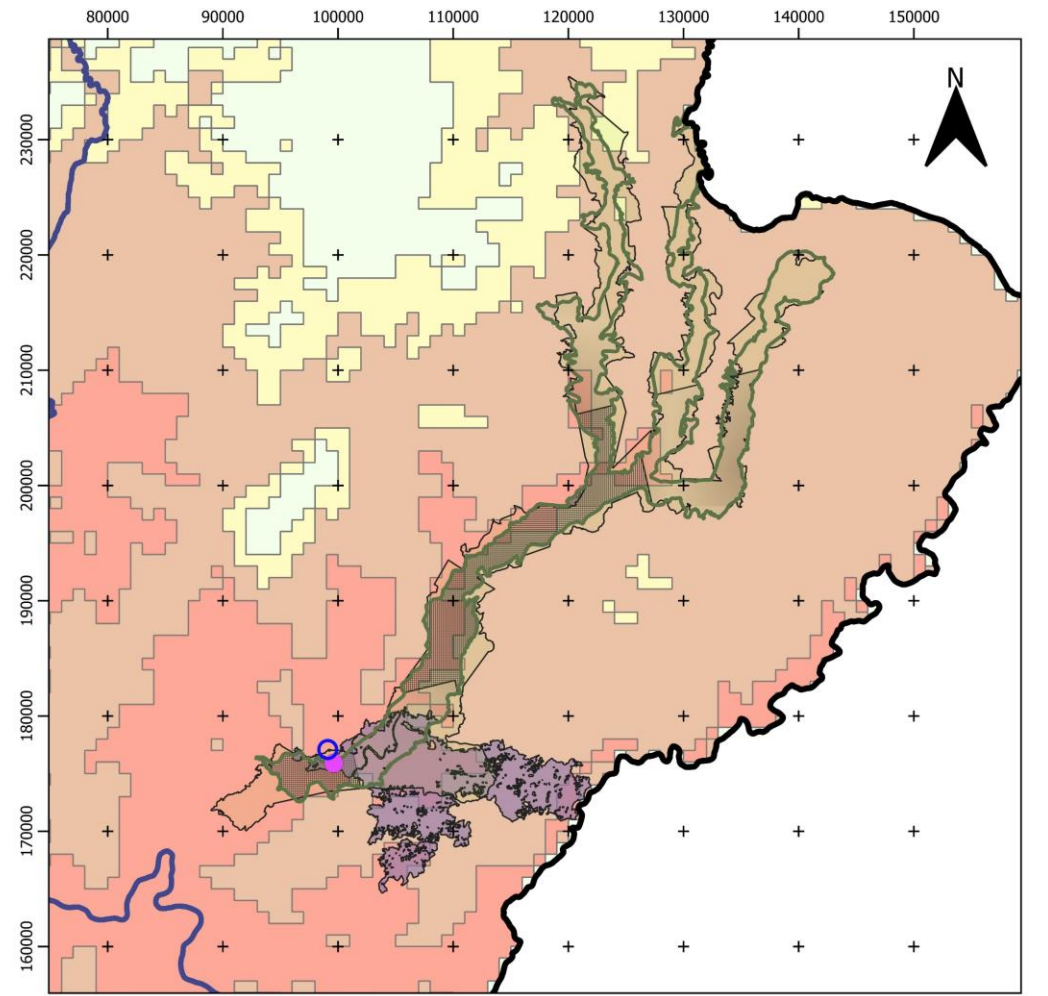
How the project contributes to PANCD:

The proposed activities meet the goals established on the National Action Plan to Combat Desertification (PANCD), concerning the limitations and constraints overtaking under climate change scenario: **drought, water scarcity and susceptibility to desertification.**

Study area

Is part of the Natura 2000 Network, namely the **Site of Community Importance Rios Sabor e Maçãs** (partially) and the **Special Protection Area of the same name**, attesting to the importance of its natural patrimony;

Is classified according to the Aridity Index (from 1980 to 2010) as **semiarid** and **suffered due to a big wildfire in 2013** attesting for its increased erosion risk.



Map 1: Intervention area framework for the SOILING project: aridity index, great forest wildfires and Natura 2000 network.

Legend

- Portuguese-Spanish border
- Bragança's district limit
- Picões
- Intervention Area
- Site of Community Importance (SCI) Rios Sabor e Maçãs
- Special Protection Area (SPA) Rios Sabor e Maçãs
- Area affected by the great wildfire of Picões
- Habitat 9560 on the Rios Sabor e Maçãs SCI
- Habitat 5210 on the Rios Sabor e Maçãs SCI

Aridity Index (1980-2010)

- Humid
- Humid Subhumid
- Dry Subhumid
- Semi-arid

Coordinate System:

ETRS89 / Portugal TM06.

Data Sources:

Institute for Nature conservation and Forestry (ICNF);
Open Data of the Public Administration

Expected project results

I1. Detailed terrain survey and interventions' spatial distribution patterns Duration: 6 months

Description: A survey of the intervention area will be carried out with drone flight to obtain a high resolution (3 cm) Digital Terrain Model (DTM) and Surface Model (DSM), from which, in a GIS environment, which will feed erosion models (RUSLE, slopes), including SWAT. These elements will support the application of the model to optimize the spatial distribution of interventions (MODEI).

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Cartographic products: MDT; Base cartography, Map of the optimized distribution of interventions (247 c).

Expected project results

I2. Instrumentation of the intervention area

Duration: 6 months

Description: Erosion fences (TE) will be installed to quantify soil loss on the slopes and in the marginal strip of the temporary streams, capturing sediment produced in a drainage area of 100 m²/TE, in treated (NbS) and control sites. The effectiveness of NbS in controlling erosion will be evaluated at different positions on the hillslopes and catchments. Soil moisture sensors will also be installed, that will allow the assessment of soil water depletion in dry periods, and the spatial distribution of runoff generation during rainfall.

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: N^o of Erosion fences (TE) installed.

Expected project results

13. Formulation, application and monitoring of the NbS: OP-based compost Duration: 9 months

Description:

A compost based on Olive Pomace (OP) will be produced in an industrial scale composting process. It will be applied in wide level strips, with spacing and spatial distribution defined by the model to optimize the spatial distribution of interventions, monitored with temperature and humidity sensors, and sampled for physical-chemical analysis.

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Germination index (according to EN 16086-2_2011)

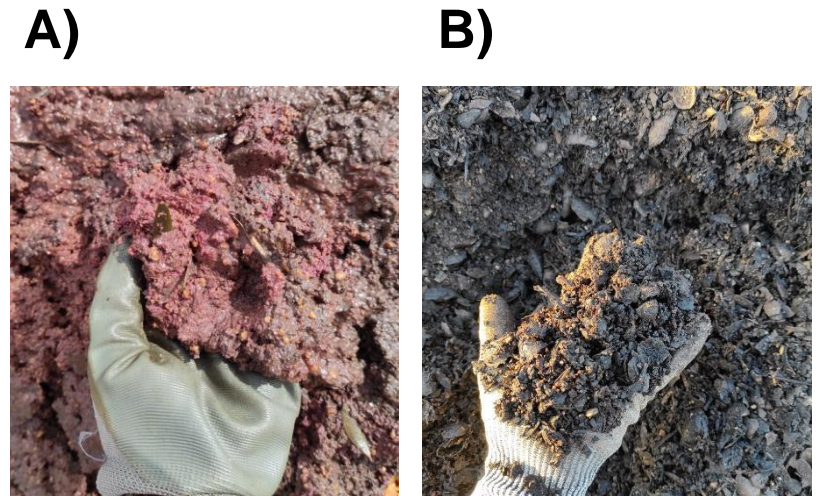


Fig. 2: Olive pomace before (A) and after (B) composting.

Expected project results

14. Formulation, application and monitoring of the NbS: OP-based biocharP

Duration: 9 months

Description: As NbS, a Biochar of OP will also be developed, which will later be impregnated with P and Mg, using secondary sources from wastewater, as well as some noble sources. A mixture of compost + BiocharP will also be tested in order to analyze the microbial load of the compost that may lodge in the BiocharP. The experimental design to evaluate the performance of this NbS will consist of 5 treatments. The applications will be made in levelled strips on the slopes or on the streams' margins, with a spatial distribution model (MODEI).

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Increasing soil P con



Expected project results

15. Biocrusts installation

Duration: 9months

Description: An experimental scheme will be installed in the pilot area of Picões over 12 months to test the effects of inoculation with biocrusts, collected in two areas about 10km from the intervention area and dried to facilitate homogeneous application, and of the addition of PAM. The treatments will consist of a factorial combination of three levels of biocrust inoculation, combined with two levels of PAM, with three replicates per treatment. Sampling of biocrusts and vegetation cover will be carried out every three months after the implementation of the treatment. After 6 and 12 months, the chlorophyll a content, aggregate stability and soil hydraulic conductivity will be determined.

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Increase in chlorophyll a

Expected project results

16. Field process monitoring

Duration: 9months

Description: The effectiveness of the NbS will be tested in the field after the first rains through collection of sediments trapped in TE. Considering the expected dynamics of the effect of treatments and their spatial distribution, collection of soil samples will be quarterly during the project and will be repeated 18 months after its completion. Sediment collection will be carried out every 2-3 months (depending on the rains) and it includes organic matter and nutrientes analyses, following FAO protocols. Physical, chemical and biological analysis of the reservoir water will be carried out. Soil moisture records will be compiled and processed, feeding water balance estimates and their spatial variability.

Target Audience: Project team, CMAdF, ICNF, land owners...

Indicator: Soil loss rate that will potentially be transported to the dam.

Expected project results

17. Soil-driven ecosystems services' evaluation: monitoring erosion, C sequestration and nutrients

Duration: 9 months

Description: The effect of soil conditioners (NbS and biocrusts), on ecosystem services, erosion control and C fixation will be evaluated. Firstly, the soil loss rate will be calculated, and the soil C loss rate and its correspondence in CO₂ emissions. These physical rates will allow to calculate the in situ costs of erosion that occur in the intervention area. In addition, the soil loss rate will make it possible to calculate the sediments that reach the reservoir, reduce the time life of the AHBS and decrease water quality (the so-called ex situ costs of erosion).

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Increasing soil C stock

Expected project results

18. Spatial monitoring soil degradation processes and water quality through remote sensing

Duration: 9 months

Description:

Data from Sentinel satellites from ESA-EU's Copernicus programme will be used, since they are freely accessible and allow images of the study area to be obtained every 3-5 days, with a spatial resolution of 10m, and portals being possible to operate from a cloud without the need to download the images. The analysis of satellite images in the visible and near infrared (VNIR) region will allow obtaining indices (based on spectral data) to discriminate differences in turbidity of a water body resulting from sediment load. By calibrating this spectral index with the field data of sediments collected, very accurate calculations can be made of the annual sediment load that drains into the reservoir and thus evaluate the effect of soil protection measures on erosion control in hillslopes and on water quality in the reservoir.

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Maps obtained from satellite images (slope and reservoir).

Expected project results

19. Economic assessment of the environmental measures applied

Duration: 3 months

Description: To assess the role of soil in C fixation, the amount of soil C retained by each soil protection measure will first be calculated. The data are then converted into Greenhouse Gas (GHG) emissions using market prices, since the price of emission allowances in Clean Development Markets (CDM) is equivalent to the cost of reducing emissions. The erosion control service will be evaluated *in situ* and *ex situ*. The *in situ* costs will be calculated as the contribution of the tested measures to the improvement of vegetation productivity, and the *ex situ* costs as the reduction of the useful life of the Hydroelectric Power Plant of the Baixo Sabor (AHBS) due to the entry and deposition of sediments in the reservoir and consequent loss of annual hydroelectric energy production.

Target Audience: Project team, CMAAdF, ICNF, land owners...

Indicator: Economic assessment of ecosystem services.

Expected project results

I10. Project's promotion and dissemination

Duration: 18 months

Description: The implementation of initiatives related to the promotion, advertising and dissemination of results achieved during the project, including the development of a Communication Plan (Appended), the management of technical-scientific information produced, the dissemination of results and progress in project activities, and the organization of events, will be assessment. This task also includes communication with the funding entity and the Program Operator, in accordance with the EEA Grants Communication Model.

Target Audience: Project team, CMAdF, ICNF, land owners...

Indicator: Number of dissemination sessions with stakeholders (from APA, ICNF, forest owners; ...).

