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Soil and water bioengineering – Sustainable erosion solutions for the Mediterranean

Accelerated soil erosion and loss is a serious environmental problem, particularly for the Mediterranean region, due to its long history of human pressures, seasonally contrasting climate and rugged topography. Anthropogenic activities such as agriculture, deforestation, urbanization and tourism, have caused these accelerated soil erosion and loss rates. In addition, climate change will increase drought frequencies, periods and intensities, leading to less vegetation cover, more runoff, flooding and erosion. Decreased land and agricultural productivity, degraded terrestrial and aquatic ecosystems health, reduction of water quality, increased flooding risks and desertification are some of the major problems caused by soil erosion and loss. The above highlight, the need to mitigate with innovative and environmentally friendly methods, this serious threat.

Fig. 1. Examples of successful soil and water bioengineering (SWB) works in the Mediterranean. A) the restoration of the Sollano Stream, (Zallain, Spain) by Sangalli Coronel y Asociados S.L – URAGENTZIA (top photos). B) Stabilization of a stream bank in Rio Baztan (Navarra, Spain) by Sangalli Coronel y Asociados S.L – GANASA (bottom photos).

The European Union is promoting Nature-Based Solutions (NBS) because they can mitigate global environmental challenges while creating jobs and promoting economic growth and innovation. This new concept promotes nature as a more sustainable and efficient solution to environmental problems. Soil and water bioengineering (SWB) are useful approaches for the design of NBS. According to the European Federation of Bioengineering, SWB is a Biology discipline with an Engineering orientation, in which native plants and/or plant parts are used as living building material to solve erosion and conservation problems, contributing to the restoration of ecosystems degraded by natural or anthropogenic causes, the dynamics of ecological and geomorphological processes and for the recovery of biodiversity. They are widely used in soil and fluvial works to improve resilience against soil loss by stabilizing stream banks, coasts and slopes. The novelty of the ECOMED project (see website http://ecomedbio.eu/) was the development of tailored SWB methodologies, material and tools for the Mediterranean region based on the stakeholders' views.

Given the semi-empirical nature of SWB works, reviewing and analyzing case studies from the Mediterranean region was a necessity. This allowed to take advantage of the accumulated experiences and existing information in the region. Specifically, three different SWB case study scenarios were reviewed: coastal, fluvial and slope. A total of 21 SWB case studies from the region were analyzed (examples shown in Figure 1). For each case study, both a summary and a detailed report was generated. All the produced information is available to SWB practitioners and the Academia.

Three protocols and template for the effective and efficient analyses of SWB works were developed: Protocol 1 – Bioengineering Work Selection Criteria, Protocol 2 – Bioengineering Work Analysis Definition, Protocol 3 – Field Work Protocol and Template 1 – Case Study Report Template. The utilization of these protocols helps professionals select the appropriate SWB works, describe the structure and stages that need to be followed to implement the works and undertake the field work variables that need to be measured. The template helps showcase the main information and conclusions of the SWB works, thus can be utilized by other professionals.

Finally, a science-based but with a clear practical bias training program was developed. This training program has the following modules: 1) Introduction to Soil and Water Bioengineering, 2) Soil and Water Bioengineering and Geological Engineering, 3) Hydrology, Hydraulics and Water Bioengineering Techniques, 4) GIS and Modern Land Surveying Methods for Soil and Water Bioengineering, 5) Environmental Planning and Impact Assessment, and 6) E-Learning, Data Management and Technical Drawing.

Overall, the case studies, protocols, template and training program will provide a strong foundation and be the basis for the long-term specialization of the Mediterranean SWB sector. The adoption and implementation of SWB techniques will improve soil conservation in a region that already faces serious soil loss and water erosion that is expected to be exacerbated due to climate change.

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