EUROPEAN FEDERATION OF SOIL BIOENGINEERING PROMOTING NATURAL BASED SOLUTIONS WORLWIDE

The *European Federation of Soil Bioengineering EFIB* is the umbrella organization of European soil bioengineering associations

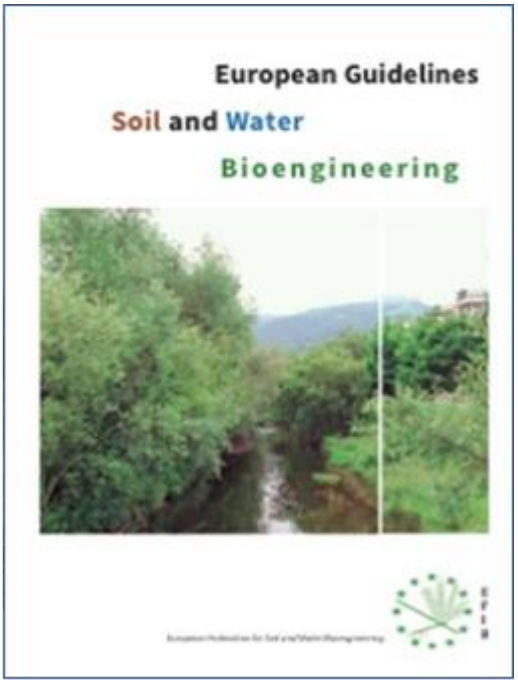
EFIB was founded in 1995 to coordinate the dissemination and advancing knowledge and experience of the association members and companies. The Federation aims at the development and advancement of soil bioengineering techniques as a technical-biological discipline, dealing with the use of plants for engineering purposes.

Currently, EFIB comprises the following associations:

- The German Company for Soil Bioengineering (Gesellschaft für Ingenieurbiologie e.V.)
- The Swiss Association for Soil Bioengineering (Verein für Ingenieurbiologie Schweiz)
- The Austrian Federation for Water and Waste Management ÖWAV (Österrreichischer Wasser- und Abfallwirtschaftsverband), Working Group Soil Bioengineering
- The Italian Association for Soil Bioengineering AIPIN (Associazione Italiana per l´Ingegneria Naturalistica)
- The Spanish Association for Soil Bioengineering AEIP (Asociación Española de Ingeniería del Paisaje)
- The Portuguese Association for Soil Bioengineering APENA (Associação Portuguesa de Engenharia Natural)
- The French Association for Soil Bioengineering AgeBio (Association française de génie biologique)
- The Russian Forestry Association Section MAIKOP.

- A focus lies on the research on plants to be used as construction material for stabilization work at river banks, lakes and coasts, for slopes and for gullies; it is intended to reduce and prevent erosion and sliding processes. EFIB further aims at the revitalization of water bodies, the improvement in biodiversity, the integration in the landscape and the enhancement of life quality. The term “bio” is related both *“to the nature of the building materials used (i.e. mostly native plants with appropriate biotechnical characteristics), and to the purpose of rebuilding ecosystems and increasing biodiversity”*.

.In this framework, in December 2022, The *European Federation of Soil Bioengineering EFIB* concluded the work and published the document *European Guidelines Soil and water Bioengineering. The guidelines* put together by all the European associations for Soil and Engineering, aims at disseminating the basic principles, technical and practical approaches as well as the positive effects of Soil and Water Bioengineering. They aim at building a contribute to the upgrade and revision of different European Directives, in particular the EU Water Framework Directive, the Directive on the assessment and management of flood risks and the EU Soil Thematic Strategy. They are also aimed at being an instrument for the dissemination and standardization of Soil and Water Bioengineering. Besides its application in the domains of Soil and Water Engineering, Bioengineering is a critical instrument for the prevention and protection of catastrophes und is already recognized worldwide as a soft or even unconventional alternative to the traditional Civil Engineering approaches, to the prevention and solution storms and floods.



In particular, the introductory chapter presents the *Basic principles of Soil and Water Bioengineering* offering a synthesis of the methodological characteristics that define this discipline as an innovative way of intervening in degraded cosystems and in general in the territories to reduce their vulnerability.

"Soil and Water Bioengineering (SWB) is a specific discipline that combines technology and biology in which native plants and plant communities are used as living building material to solve erosion and conservation problems, contributing to the regeneration of degraded ecosystems due to natural or anthropic causes, to regenerate the dynamics of ecological and geomorphological processes and to the recovery of Biodiversity Typically, plants and parts of plants are used as living building materials, in such a way that, through their development in combination with soil and rock, they ensure a significant contribution to the long- term protection against all forms of erosion. In the initial phase, they often have to be combined with non-living building materials, which may, in some cases, ensure more or less temporarily, most of the supporting functions. The use of organic materials is preferred, because parallel to the development of the vegetation and its increasing stabilization ability, these materials will rot and be reincorporated in the natural biogeochemical cycles. Also preferred are indigenous (autochthonous) and site-specific plants, as they promote a biodiversity suited to the landscape. The planning and construction objectives are the protection and stabilization of land uses and infrastructures as well as the development of landscape elements

. The main areas of application of Soil and Water Bioengineering are the stabilization of embankments, slopes, riverbanks, forelands, dykes, dams, landfill sites, post-mining landscapes as well as areas surrounding infrastructures.

- In riverbanks: Soil and Water Bioengineering techniques contribute to the protection of erosion, channel realignment of watercourses, revitalisation of non-natural watercourses and channels as well as increasing flood-retention in floodplains and the improvement of flood control always in accordance with the promotion of their ecological efficiency, protection of land uses and stabilisation of dykes, dams and forelands.

- In slopes and embankments: soil bioengineering techniques contribute to the prevention of the different types of erosion, to the revegetation and stabilisation of areas affected by landslides as well to the immediate and long-term protection of slopes against failures and landslides trough the anchoring and buttressing effects of plant roots; they also contribute through plant transpiration to soil drainage and the consequent increase of particle cohesion.
- In the improvement of the local and regional water regime: through suitable Soil and Water Bioengineering measures, of forestation and restoration of the vegetation cover on slopes including above the timberline
- At sea and lakeshores: in the reinforcement of endangered shores -due to erosion- and the stabilisation of dykes, dunes and forelands.
- In wetland areas: in the creation of suitable habitats.
- In post-mining landscapes and brown field sites: in the protection and development of new vegetation communities and the revegetation of new landforms and structures.

Bioengineering techniques can use plants wherever there is a potential habitat for vegetation. A protective and stabilising vegetation cover to prevent erosion can be used as an alternative or in addition to conventional engineering methods as long as the plants ensure adequate biotechnical properties. The development of bioengineering solutions combines the technical expertise of the engineering disciplines with knowledge from the fields of biology and landscape ecology in order to develop a sustainable vegetation cover using site-specific plants able to perform the necessary technical and structural functions. Along with their ability to prevent erosion and contribute to the regulation of the water regime, Soil and Water Bioengineering measures also have a positive effect on microclimate, biotope structure and landscape.

Advantages of Soil and Water Bioengineering measures compared to conventional engineering methods include:

- Prolonged and sustained functional development due to the ability of plant growth, regeneration, and the formation of plant communities.
- Establishment of a more developed plant community in the frame of the natural vegetation succession.
- Increase in stability as the plants develop.
- Favourable response to disturbance through the natural ability of plants to adapt.
- Adaptation of plants to the forces to which they are subjected through their elasticity, resistance to pull- out and new succession lines.
- Structuring function of plants.
- Increase in biodiversity and habitat functionality (ecology).
- Enhancement of landscape (landscape aesthetics).
- Support of socio-economic factors (tourism, local recreation)

Measures that are of low-impact, use little energy and promote the self-development of nature (noregret measures)

The preferential use of indigenous plant material preferably from natural origins, instead of cultivated and not site-specific plant species, has a number of additional positive effects:

- successful and long-term stabilisation due to optimum integration in the local ecosystem, better adaptation to extreme local conditions and local and regional climate and geology,
- greater potential for the development of site-specific plant communities,
- better and more sustainable integration into the ecosystem and landscape processes,
- better cost-benefit ratio and greater cost-efficiency.

The result of Soil and Water Bioengineering interventions are living systems, which develop and maintain their balance by means of natural succession, i.e. by undergoing a process of dynamic self-regulation without artificial energy input. The correct choice of living as well as non-living building materials and types of construction ensure an exceptionally high level of sustainability whilst requiring minimum maintenance. These living systems ensure the following technical, ecological, aesthetic and economic functions.

With these characteristics, Soil, water and Bioengineering actions have found a strategic place in the interventions aimed at reducing the impact of climate change in territories, to reduce their vulnerability through what is defined as nature-based solutions.

EFIB specifically is involved in the following activities: The coordination of the member associations and companies activities; The cooperation with other specialized organizations, administrations, institutions in and outside Europe; The representation of interests and the discipline within the European Union; Ensuring provision of information on the activities of the member associations and companies and other scientific organizations, institutions, academies, etc.; The joint preparation and development of guidelines and working documents; The advancement of research, successful evaluation of education, and training of professionals working in the discipline;Support in the establishment of soil bioengineering associations and companies in other European Member States

For years the members of the Federation have also been involved in the promotion of bioengineering strategies in non-European countries where they collaborate with governments and public and academic institutions by carrying out international cooperation activities. In this way, the results achieved by the Federation in Europe for the dissemination of soil and water bioengineering methodologies can be used in the framework of broader initiatives currently underway to mitigate the negative effects of climate change and apply nature-based solutions in the recovery of damaged territories.

To know more

European Federation of Soil Bioengineering EFIB website

Austrian Federation for Water and Waste Management ÖWAV
Italian Association for Soil Bioengineering AIPIN
Spanish Association for Soil Bioengineering AEIP
Portuguese Association for Soil Bioengineering APEA
German Company for Soil Bioengineering (Gesellschaft für Ingenieurbiologie e.V.)
Swiss Association for Soil Bioengineering (Verein für Ingenieurbiologie Schweiz)

French Association for Soil Bioengineering AgeBio (Association française de génie biologique

EFIB Publications

SWB Examples EFIB website

European Guidelines Soil and water Bioengineering.

Bioengineering in Wikipedia

Soil bioengineering measures for hill and slope stabilization works with plants. FAO.org

Soil and water bioengineering: Practice and research needs for reconciling natural hazard control and ecological restoratin Article in sciencedirect.com

Soil and Water Bioengineering (SWB) is and has always been a nature-based solution (NBS): a reasoned comparison of terms and definitions Article in sciencedirect.com

Soil and Water Bioengineering as Natural-Based Solutions- Articles in springer.com

Nature based solutions in naturalea.eu

water and soil bioengineering in naturalea.eu

Article in core.ac.uk

Soil bioengineering for risk mitigation and environmental restoration in a humid tropical area. Article in flore.unifi.it

Soil and water bioengineering: Practice and research needs for reconciling natural hazard control and ecological restoration. Articles in pubmed.ncbi.nlm.nih.gov