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Overview of the degradation processes and causes of 223 soil bioengineering structures for riverbank protection

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Soil bioengineering structures for riverbank protection are nature-based solutions designed to protect human stakes from erosion with greater economic and ecological benefits than with civil engineering technics. They take advantage from well-developed vegetation to structure the riverbanks and imitate natural schemes. Their use is mainly based on expert knowledge and is still limited by the lack of dimensioning criteria.

This study focuses on damaged structures. The understanding of the deterioration processes and causes of failures from an empirical approach makes it possible to establish further recommendations in order to prevent the collapse of the structure and improve their conception and implementation. Based on the study of 223 degraded riverbanks bioengineering structures, 454 observations of degradations were collected.

Two main failure types could be observed: the mortality or the absence of growth of the vegetation and the mechanical failure of the structure. The prevalent causes of vegetation mortality were submersion, dryness, shade, lack of contact with the substrate and concurrence between species. The prevalent processes leading to mechanical failure were in a decreasing frequency: scouring at the toe, erosion behind and erosion at the extremities of the structures, scouring around hard points in or surrounding the structures and partial failure of the internal structure. Toe scouring and erosion behind the structure removed substrate and therefore affected seriously vegetation growth.

Multiple erosions can lead to the total collapse of the structure. Therefore, anticipating them from conception and maintaining the structure when erosion signs occur can help preventing the failure. Moreover controlling the erosions surrounding the structures helps the vegetation recovery by maintaining the contact with the substrate. Finally, the causes of deteriorations point out the need of special care for bioengineering structures the first years after implementation as watering, replanting, pruning and maintenance.