

“Proteger”: a sustainable soil bioengineering project for riverbank protection in the Caribbean

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Tropical areas are particularly subject to erosion. In the Caribbean, precipitation regimes, associated to frequent hurricanes, are characterized by high rainfall events. On steep slopes and along riverbanks, even minor disturbances can lead to erosion and landslides. To respond to societal needs on erosion risk prevention and to guarantee the safety of human investments, local authorities must carry out works to protect the banks of watercourses and the slopes of gullies. In most cases, these constructions are made of civil engineering mostly pure or concrete riprap. These civil engineering techniques are widely used and mechanically efficient, but they have a strong negative impact on riparian ecosystems, affecting their ecological structures and functions through degradation of riparian and aquatic biodiversity, buffer zone or ecological corridors. In relation to civil engineering, soil bioengineering represents a softer and more respectful option, from an environmental and landscape perspective. In the Caribbean biodiversity hotspot, the natural flora of riverine network system has hardly been studied and native species are still not used extensively in the work of protecting watercourse. The rare revegetation works were mostly done with non-native species such as *Chrysopogon zizanioides*. The lack of knowledge of riparian flora and the need for their restauration in Guadeloupe led to the emergence of the “Proteger” project in 2015 to develop and promote soil bioengineering techniques on riverbank of this territory and around.

As soil bioengineering techniques aim to copy natural model, the first phase of this project (2016-2018) aimed to describe the riparian plant assemblages, and then to identify, *in situ*, the local species most suited to maintain riverbanks. Trees, shrubs, ferns and herbs owning to different riparian ecosystems were therefore selected on their biotechnical traits relevant for soil bioengineering. The second phase of the project (2019-2022) consists in controlling the multiplication of these species, in order to feed future bioengineering works. Vegetative propagation is widely used for bioengineering works as it represents a low cost, fast and effective way to obtain plant material, and allow the construction of specific bioengineering techniques such as fascines or brush mattresses. Then we conducted a first *ex situ* experiment aiming to evaluate the vegetative propagation potential of cuttings from thirty-two herbs, shrubs and tree native species. Experimental conditions were representative from those compatibles with soil bioengineering works settlement (low cost, low technology).

Our results indicate that some Caribbean native riparian species can be easily propagated. Among the selected species, propagation of three trees (*Citharexylon spinosum*, *Chimarrhis cymosa*, *Homalium racemosum*) four shrubs (*Clidemia hirta*, *Ludwigia hyssopifolia*, *Piper dilatatum*, *Piper dussii*) and three herbs (*Dieffenbachia seguine*, *Hymenachne amplexicaulis*, *Thelypteris reticulata*) species can be

controlled in low tech conditions, allowing the development of soil bioengineering techniques in Guadeloupe and in the Caribbean.

The next step will be to control the germination of species that can't resprout from cuttings. The final aim of the Proteger project is to mainstream riverbank soil bioengineering techniques in the Caribbean. For that purpose, technical knowledge about species and techniques will be transferred to local firms and authorities, in order to contribute to a more sustainable management of these highly biodiverse ecosystems.