



## **Bioengineering applied to erosion and stability control in the North Apennines (Emilia-Romagna Region, Italy): a check about critical aspects of the works.**

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Because of its geological structure, in the Emilia-Romagna Region over 32,000 landslides have been identified. Several works have been made in order to control mass movement's dynamics and to secure of Reno and Lamone Mountain Basin Rivers, the road network and near by villages and towns. Most of the control works dealt with bioengineering practices: palisades piles, geotextiles, seedings, surface flow control works, dikes within main drainage ditches.

In order to check about critical aspects related to the use of these techniques in the Apennines, a survey in this basins was designed with specific interest in the several kinds of works realised, in which plant species were mostly used and in the factors that affected the success or failure of the works.

Territory encompasses steep slopes covered with woods to low reliefs covered with grasslands. It is characterized by prevailing clays, inducing instability, and arenaceous lithology with impermeable soils; drainage density is quite high and hillsides suffer extensive and severe erosion and slope stability problems. Chestnut woods mainly represent land use at higher altitudes, while coppice, pastures and crops are present on milder hillsides. The remaining part of the basin is covered by vineyards, orchards, ponds and urban areas, which are basically located in the valley floor.

Precipitation events mainly consist of rainfall ranging between 950-1015 mm per year; few snowfalls occur during winter and a long dry season lasts from June until September.

We have analyzed 187 works designed mainly for the consolidation of slope instabilities through a widespread enhancement of the vegetation cover. The surveyed works are classified as a function of their building features: it can be seen that cribwalls and palisades are by far the most common types, being the 24% and the 34% respectively of the works.

As far as the most adopted plant species, they were silver willow (*Salix alba*), Spanish Broom (*Spartium Junceum*) and purple willow (*Salix purpurea*). Only the 25% of the interventions was accomplished by the use of secondary plant species, as tamarisk (*Tamarix spp.*), blackthorn (*Prunus spinosa*), whitethorn (*Crataegus spp.*), sea-buckthorn (*Hippophae rhamnoides*), wild pear (*Pyrus pyraster*), cottonwood (*Populus nigra*), eglantine (*Rosa spp.*), goat-willow (*Salix caprea*) and cornel (*Cornus sanguinea*).

Better results were achieved with Spanish Broom, a very rural plant that can effectively colonise even poor soils like badlands; as a matter of fact, more than the 75% of the interventions had positive outcomes

The efficacy of the consolidation work by the presence of living structures point out an increase of the stability of those interventions older than 4 years, with taking root species present from 54% to 78%.

So far, the construction and the reliability of the works have been monitored, in order to capture critical aspects for the success of works and to build a geo-referenced data base of the existing works and their status.