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Suspended sediment control and water quality conservation through riparian vegetation:

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Soil erosion and Suspended Sediment River are strongly related in the Apennines catchments which are generally characterised by a clayey lithology and impermeable soils and extensive and severe erosion and slope stability problems. In fact the suspended sediment yield represents one of the most reliable tools to assess real basin soil loss (Pavanelli and Pagliarani, 2002; Pavanelli and Rigotti, 2007) from the surface rain erosive features in a mountain watershed, as rills and interrills erosion, gullies, bad-lands (calanchi basins).
Suspended sediment yield is known to imply several detrimental consequences: soil losses from agricultural land, worsening of the quality of the water, clogging of water supply filters and reservoir siltation. In addition, suspended sediment yield is also one of the main vector for pollutants and nutrients: various studies have already proved how nitrogen content has been constantly rising in aquifers and surface waters [Böhlke and Denver, 1995]. Finer particles and their aggregates have been proved to be the preferential vehicle for particulate nitrogen [Droppo et al., 1997; Ongley et al., 1992].
In one research [Pavanelli and al. 2006] four Apennines torrents (Gaiana, Sillaro, Savena and Lavino) with mountain basins ranging from 8.7 to 139 Km2 were monitored via automatic sampling devices, the samples of water collected were analysed to characterise suspended solids in terms of their grain size distribution and total nitrogen with respect to the source of eroded area in the catchment. Preliminary results [Pavanelli and al. 2007] seem to show the existence of a direct relationship between nitrogen concentration and finer particle concentration (<20 μm), with the maximum nitrogen loss values being related to factors like the presence of clayey formations, their position within the catchment and the availability of suspended particles. The results seem to indicate hillsides as main sources of suspended sediment to the torrents monitored.

The problem of controlling the river suspended sediment concentration can be tackled by increasing the riparian vegetation able to hold back the ground eroded by the slopes, but it is necessary to know where the critical zones are.

The aim of the work is to propose a method allow us to detect the risk of soil erosion areas near the river and the functionality of existing riparian vegetation along river as buffers / filters towards the eroded soil from the hill slopes. The proposed methodology is supposed has been designed for water pollution control from suspended solids, pollutants and nutrients coming from hills and an improvement of the quality of the river environment.

The methodology was applied on the riparian vegetation of the Gaiana torrent where it was related to soil cover and erosion areas of the hillslope, thus correlating the impact of human activities. The Gaiana catchment area is 8.6 km2 and the mean altitude is 237 a.m.s.l., the average rainfall is of 784 mm.. It is a typical Apennines streams, about 35 km south of Bologna, Italy. The main trunk stream is 6 km long and the whole drainage network is organized in a dendritic pattern, typical of clayey lithology of the basins. The main erosion processes active in the area are caused by precipitation and surface runoff: sheet wash, concentrated water erosion and badlands watersheds (calanchi), which represent about 15% of the basin area.
The vegetation of the Gaiana basin is constituted by crops (39%), woods (37%), rock outcrops(i.e. badlands)(15%), bushes (5%) and pastures(3%).

The stages of the study are to spot critical areas made up of streambank and the eroded areas on the slopes near the river, with the support of aerial photos and satellite images, survey and a geographic information system. The Gaiana riparian vegetation map has been drawn and, on a strip buffer 200 metres wide along river, the Vegetation cover and the Geomorphology maps (scale 1:5000) has been drawn, after photogrammetric interpretation of aerial photography and satellite images . The two maps have been overlapped to compare spatial distribution of the soil use and the erosion features of the Geomorphology map. To every situation a degree of risk is assigned and connected to riparian vegetation map of the stream. The worst conditions are in the presence of landslides, calanchive basins, road lines very close and parallel to the stream and where the agricultural mechanisation of land and the erosion features are present.

The methods allow us to detect the situations of insufficiency (both in quality and quantity) of the riparian vegetation in comparison to the degree of risk of soil erosion in the strip buffer and the riverbank stability. Finally, they can help us to suggest ways to improve or replant the existing vegetation on the stream bank identify , according to specific and multifunctional sylvicoltural models.

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