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Analysis of mine sites restoration strategies for soil and water resources protection

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Mine reclamation represents an important environmental challenge due to the necessity of identifying the appropriate restoration measures to handle landscape change and minimize the associated environmental impacts. Water management plays a key role for determining strategies to reduce these impacts, e.g. necessity of restoring natural drainage patterns, implementing flood control measures and restoring hydrological natural behaviour. Fundamental aspects are certainly represented by the runoff variation and the proper sediment management.

The objective of this study is to give quantitative evidence on the effectiveness of decommissioning strategies on water and sediment management. The selected case study is a former lignite mining site located in San Cipriano catchment (Tuscany, central Italy) that include a reservoir severely hit by silting problems. The Soil Water Assessment Tool (SWAT) was used to analyse current situation and to implement different LULC changes analysis. Since hydrometric gauge stations were not available in the catchment, the model calibration focused on sediment transport using observed silting volume in the reservoir, which has been estimated thanks to multiple bathymetric campaigns carried out over the years. Two environmental restoration scenarios have been analysed: the first is focused on the land use change with the afforestation of the former mining site with native plants; the second is a wider landscape restoration project that also includes river bodies rehabilitation.

Results highlight a strong reduction of sediment yield and a decrease in water yield associated to the restoration intervention. This is mainly due to the effects of reforestation that influence the hydrological cycle inducing an increase of water storage in the soil and determine a strong reduction of sediment input to the reservoir. The model results represent a valuable decision support tool that help understanding the hydrological impacts of LULC changes, supporting the identification of the most appropriate mining decommissioning strategies.

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