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Effectiveness of gully bed recolonisation on reducing hydrological connectivity in degraded mountain catchments

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Active gully systems developed on highly weathered or loose parent material are important sources and transport routes of runoff water and sediment in degraded mountain catchments. However, a decrease of land pressure may lead to a return of a partial vegetation cover, whereby gully beds are preferred recolonisation spots. Any change in the state of gully systems may have an effect on the hydrological connectivity and response of degraded catchments by reducing the transport of runoff water and sediment from the hillslopes towards intermittent or permanent river systems.

In this paper, we present results on sediment deposition and runoff water infiltration along the vegetated gully beds. Field measurements on 138 gully segments located in 13 ephemeral steep gullies with different ground vegetation cover indicate that gully bed vegetation is the most important factor in promoting short-term (1 to 15 years) sediment deposition and gully stabilization: about 50 % of the observed variance in sediment deposition volumes can be explained by the mean ground vegetation cover of the gully bed. Estimates of potential sediment storage to potential sediment generation rate ratios for 17 small-sized catchments in the region show that sediment storage in vegetated gully systems can alter the overall short-term (1 to 15 years) sediment budget of restored mountainous catchments significantly. Concentrated flow experiments carried out in 9 steep gully channels show that the formation of vegetated buffer zones

in the gully channel retards the runoff flow and enhances infiltration of surface runoff. Gullies with more than 50% surface vegetation cover are characterized by slow advancement of the water advance front, and exhibit the highest cumulative infiltration coefficients (81% for ‘dry runs’, and 34% for ‘wet runs’). The efficiency of gully bed vegetation in reducing runoff water transfer is the highest for dry gully beds, i.e. at the beginning of a rainfall event.

These findings indicate that relatively small changes in landscape connectivity have the potential to create strong (positive) feedback loops between erosion and vegetation dynamics.