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Impacts of check dams: a monitoring experience along a mountain watercourse

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Torrential dynamic is a complex combination of natural processes along a mountain watercourse, including sediment deposition and erosion that cause cross-section occlusions and streambank failure, respectively. Thus, monitoring and managing sediments are fundamental activities for the maintenance in mountain watersheds. To regulate the sediment transport, a common countermeasure is the check dam, designed to control the sediment movement along the watercourse (Piton et al., 2017). Building check dams is complex and expensive, especially in mountain watercourse. These structures largely modify the surrounding environment and landscape; however, if well designed, check dams are very effective solutions to mitigate the potential losses due to flood, debris flood, and debris flow.

This study presents the monitoring of a stretch of a mountain watercourse over several years in an Alpine environment. The observed dominant process was the sediment deposition that has been countered by the construction of a slot check dam. The torrential dynamic has been strongly influenced by this in-channel structure, exacerbating the change of cross-sectional and longitudinal profiles (width and depth of the cross-sections, longitudinal profile, and bed granulometry) not only in proximity of the structure, but also along the observed overall stretch (downstream and upstream). The monitoring consists in measuring the hydrological response during rainfall events and assessing the geomorphic change using digital elevation models differencing (2010, 2014, 2021, 2023). The last topographic surveys were conducted immediately after the construction of the slot check dam and immediately after the first severe debris flood occurred several months later.

The results of monitoring show a clear geomorphic evolution along the observed stretch, contrary to the previously detected tendency of sediment dynamics and, moreover, a different hydrological response at downstream of the structure. As expected, sediments were trapped upstream of the structure, whereas a severe erosion removed the armoring layer bringing to light several bed sills at downstream.

This study underlines how artificial works have a spatially distributed effects on geomorphological

change, on hydraulic behaviour, and in some cases on the flood hazards (also far from the structure). Thus, the prediction of geomorphological change, even if qualitative, is extremely important to improve the effectiveness of the check dam in managing sediment dynamics. In addition, sharing this information is essential to support designers (showing practical examples) in planning works not only focusing on the structural and hydraulic perspectives, but also from a geomorphological point of view, which is often neglected.

Piton, G., Carladous, S., Recking, A., Tacnet, J.M., Liébault, F., Kuss, D., Quefféléan, Y., Marco, O., 2017. Why do we build check dams in Alpine streams? An historical perspective from the French experience: A Review of the Subtle Knowledge of 19th Century Torrent-Control-Engineers. Earth Surf. Process. Landforms 42, 91–108. https://doi.org/10.1002/esp.3967