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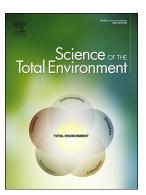
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#### **Editorial**

The use of check dams for soil restoration at watershed level: a century of history and perspectives.

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Check dams are transverse structures built across stream-beds and gullies for controlling water flow and sediment transfer. Typically, check dams are made of stones, gabions, earth, masonry, concrete or wood logs. Throughout the world, national, regional and local authorities have spent, and still spend, large amounts of funds for erosion-control schemes at the basin scale. These projects focus on runoff detention and the control of sediment supply to rivers by constructing

check dams along with other soil conservation and vegetation restoration tools in watershed uplands. The stabilization role of these structures is well known, i.e. they durably constrain the stream-bed through the creation of vertical and planar fixed points. These structures and their side effects serve the purpose of better controlling solid transport. Several papers in this Special Issue, demonstrate expected key side effects of check dam construction for example, improving vegetation cover (Ricci et al. 2019) or bringing targeted changes in sediment connectivity (Marchi et al. 2019). Abbasi et al. (2019) provide many different well established examples from around the world regarding the use of check dams in watershed management projects that aim to control soil erosion and runoff. However, although the number of constructed check dams continues to increase in response to soil erosion prevention purposes, flood control needs and sediment transport regulation, their expected impact - to reduce the upstream slope of the regulated reaches or to stabilize torrent beds - is sometimes not achieved due to local circumstances such as the poor construction quality, inadequate check dam location and lack of rational design procedures. Observations of channel cross sections and bed materials made in several studies indicate that check dams may increase erosion downstream of the structures. In addition, other studies have pointed out that dams represent one of the most dominant forms of human impact upon fluvial systems (Wohl 2006), as they disrupt the downstream transfer of water and sediments. However, a number of works have focused on preventing such problems and failures in projects and structures. For example, Rossi and Armanini (2019) provide a new approach for impact force estimation on open check dams to help prevent structural failures. Gregoretti et al (2019) presented a new model-based approach for design and performance evaluation of works controlling stony debris flow with an application to a case study at Rovina di Cancia (Venetian Dolomites, Northeast Italy).

Check dam installation is often carried out with general expectations of controlling water flow and sediment supply, but the actual responses frequently remain untested. Research papers presented in this special issue aim to achieve a comprehensive synthesis of check dam effects at the watershed level in soil restoration schemes including conceptual thinking, field observations, and feedback from applied tests and trials. This Special Issue brings together scientific and technical experiences from all around the world and provides an evidence of the legacy effects of check dams. Shared insights highlight the role of complex interactions between ecological elements,

geomorphic processes and engineering activities to improve the use of check dams for conserving soil and water resources. More in detail, this Special Issue gathers twenty contributions to a better knowledge of check dam functioning and effects on erosion and hydraulic processes. These papers demonstrate that studies using remote sensing data or aerial photographs (Alfonso-Torreño et al., 2019; Ricci et al. 2019), field survey (Robichaud et al., 2019; Li et al, 2019; Nichols et al., 2019; Mongil et al., 2019; Shi et al., 2019; Navarro-Hevia et al., 2019), numerical modelling (Gregoretti et al., 2019) and laboratory experiments (Rossi et al., 2019) are important for understanding the numerous interactions between water and sediment, as well as the geomorphology and ecology of hillslopes and channels. This information will help researchers to better understand the key geomorphic impacts that transversal structures may have at the watershed level and will provide managers with some new methods and criteria to prioritize maintenance operations and plan new construction. Future research should aim to demonstrate the effectiveness and feedbacks based on long term monitoring of existing systems or from extreme events experienced by structures. New monitoring and modelling techniques need to be investigated to improve check dams design and adaptations. Finally, innovative design criteria that advances both traditional and open check dams should be encouraged to optimize future installations within various geomorphological, climatic and ecological settings.

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