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The connectivity between soil erosion and sediment entrapment in reservoirs

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Abstract

Rivers are characterized by their water flow regime and sediment transport. Sediments are crucial for channel morphology, water quality, providing habitat for aquatic organisms and, finally, for sustaining deltas. Rivers are, however, fragmented by dams and will face an additional building boom due to actions to mitigate climate change (with hydropower) and water scarcity. Reservoir siltation is a serious challenge for reservoir management but also entails downstream morphological impacts. However, sediment entrapment is an often neglected element in reservoir planning and environmental assessment. The aim of this study thus is to give an overview on the links between soil erosion and sediment entrapment in reservoirs, its degree on a global scale (reservoirs lose annually 1% of their capacity), the driving factors that influence associated processes and the different approaches for reservoir management to reduce siltation and its impacts downstream.

Highlights

- Soil erosion and sediment entrapment in reservoirs are integrated and analysed in relation to driving parameters.
- The degree of sediment entrapment as annual reservoir capacity loss is illustrated based on worldwide sedimentation data.
- Sediment transport is a crucial element often neglected in reservoir planning.

Keywords: sediment transport; land-use change; reservoir capacity; dams

1. Introduction

Water availability in time is, and has been, technically fostered by storing water in reservoirs already millennia ago [1]. These reservoirs are mainly created by building a dam that stores the water that is draining from the upstream catchment. According to numbers of the current World Register of Dams, today more than 58,000 large dams (> 15 m high or impounding more than 3 million m^3) store in total more than 16,000 km^3 of water globally [2]. But not only has water supply fostered dam construction. Global economic growth, an increasing electricity demand, and the need of reducing greenhouse gas emissions to curtail climate change promote an increasing search for renewable, "climate neutral" electricity sources. Currently, 22% of the global electricity production is provided by renewable sources, and 73% of these is covered by hydropower (data for 2014;[3]). In the future decades, we will most likely face an unprecedented boom in dam construction, with about 3,700 major hydropower dams already in construction or in planning, especially in countries with emerging economies [4].