

A Novel Approach to Managing Riverine Sediment Deposition

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Abstract

Low-head dams can be built in ephemeral streambeds to trap sediments which can store water or serve as sand reserves for other uses. For sand dams to provide sustainable and dependable water supplies, or to provide valuable sand for other purposes, these reservoirs should primarily fill with coarse sand rather than fine sediments. The problem of sand dams being negatively impacted by an excess of fine sediments is a widespread issue. In Kenya, 40-60 percent of sand dams are reported to be affected by this problem, which can limit their ability to recharge and provide recoverable water. We describe a novel approach to preventing collection of fine sediments by geomorphic management of reservoir sedimentation. Specifically, we suggest building dams with “Eiffel Tower” shaped outlets (broad at the base and narrowing with height) to remain open until the reservoir is sediment filled. The opening is designed to provide constant Rouse number of 2.5 for 0.125 mm grains so that regardless of flow, only sand of size greater than 0.125 mm will accumulate. Considering the limitations of 1-dimensional simulations in capturing edge effects, a stage discharge relationship acquired through HEC-RAS simulation is utilized to correct the opening. Numerical modeling confirmed that these outlets maintain constant bed shear stress, and thus promote the deposition of uniform coarse sediments within the reservoir regardless of riverine flow rate. The findings of the HEC-RAS simulation demonstrate that bottom-notch openings, especially those of the “Eiffel Tower” shape, exhibit superior performance with an MSE value of less than 1% when determining the deviation between the desired Rouse number (2.5) and the calculated Rouse number.

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