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# A decision-making framework for the design of check dam systems in erosion-prone areas

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Check dams represent a common engineering solution to control sediment flow and landscape dynamics in erosion-prone areas. Yet, there seems to be a lack of numerical tools that can help decision-makers design such important infrastructures. The existing spatially-distributed models, such as SWAT or WaTEM/SEDEM, can assess the effect of check dams on a catchment's sediment yield but cannot simulate the dams' sediment retention capacity, variation of storage capacity, and life expectancy—key processes determining the performance of a check dam system. To overcome this limitation, we developed a decision-making framework that supports planners in determining the optimal location and storage capacity of check dams. The core of the decision-making framework is the Storage Dynamics Model (StoDyM), which estimates the annual variation of the dams' storage capacity (due to sediment trapping), their life expectancy, as well as the catchment's Sediment Delivery Ratio. StoDyM is then coupled with a Multi-Objective Evolutionary Algorithm (MOEA), which determines the dams' location and initial storage capacity that maximizes four objectives accounting for life expectancy, dynamics of storage capacity, and capability to retain sediment. The framework is tested in various catchments characterized by diverse climate conditions, land use, and erosion processes, namely Shejigaou (4.26 $km^2$with five check dams) and Majiagou (13.97 $km^2$ with ten check dams)—both located in the Loess Plateau, China—and Dolenja vas (163 $km^2$with eleven check dams), Slovenia. The results show that the performance of the existing check dam systems can be improved significantly by controlling the dams' location and storage capacity.