

Sediment yield estimation in a small watershed on the Northern Loess Plateau, China

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Soil erosion is one of the most significant forms of land degradation in the world and is the key environmental problem threatening the ecosystem on the Chinese Loess Plateau. Currently, check dam has become the most effective approach for soil and water conservation in this region. Sedimentation in the check dam can be very helpful for understanding sediment yield dynamics in the catchment scale.

In this study, we identified sediment yield through field sampling, ^{137}Cs dating and flood events analysis in a check dam controlled catchment: Xiaoshilata Gully. It has a drainage area of 0.64 km^2 , and located in the Huangfuchuan watershed, northern Loess Plateau. The modified WATEM/SEDEM model was applied to assess the spatial pattern of sediment yield. The estimated dam sedimentation rates were used for model calibration.

The dam infill sediments showed evidence of at least 31 flood couplets corresponding to rain storms, and a total of $16.5 \times 10^4 \text{ t}$ sediment was trapped behind the check dam during the period of 1958-1972. The annual sediment yield ranges from 0 t in 1965 to 59,990 t in 1959. An average annual sediment yield was estimated to be $175.4 \text{ t ha}^{-1} \text{ yr}^{-1}$, which is very close to the average values recorded at Huangfu station in the Huangfuchuan catchment between 1958 and 1972. The WATEM/SEDEM model produced satisfactory results with NSE values of 0.92 and relative root square error 0.86. A total soil erosion of $19.74 \times 10^4 \text{ t}$ was examined. The bare Pisha stone in the steep gullies contributed approximately 92.8% of sediment yield on average, and the remaining were mainly from bare loess slopes and fluvial plain. The sediment delivery ratio is 83.6% in the Xiaoshilata Gully, suggesting that majority of soil eroded by water was routed down from hill slope and transported to the dam of catchment. Our study indicated that the modified WATEM/SEDEM model is a useful tool for sediment yield

estimation, but needs comprehensive calibration and validation from both temporal and spatial observation data. Deposited sediments behind the check dams show great potential of an indirect observation for the quantitative analysis of sediment dynamics in ungauged basin on the Loess Plateau.

Keywords: check dam; sediment yield; sediment sources; modified WATEM/SEDEM model; the Loess Plateau