Separating the effects of revegetation and sediment-trapping dams construction on runoff decrease in a semi-arid watershed of the Loess Plateau

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Runoff decrease as was triggered or exacerbated by human activities over the past decades on the Loess Plateau has grown to be a hot spot increasingly drawing nationwide concerns; distinguishing human-induced runoff-altering factors from one another is of great significance to decision-making on maintaining regional water, ecological and economic security. Sediment-trapping dams (STDs) construction and revegetation are the two major soil conservation practices regarded to have also caused runoff reduction, whose hydrologic effects on the basin scale have not been separated quantitatively. Our study, choosing the Huangfuchuan River Basin as the study area and based on analyses of its hydrologic, climatic and underlying condition changes, proposed a physically-based attribution framework which is able to account for the hydrological effects of STDs, revegetation, land use change and climate change simultaneously, and attributed runoff decrease of the basin among factors including climate change, STDs construction, revegetation and land use cover change. The model-based attribution results indicate that STDs construction caused a 45\% (48\%) runoff reduction from 1976-1988 to 1989-2000 (2001-2014) and revegetation was responsible for a 30\% runoff decrease from 1976-1988 to 2001-2014, with daily simulation implying that the hydrologic effect of revegetation to affect flow magnitudes more consistently than that of STDs. Our study demonstrates that STDs construction is the prime contributor to runoff decrease in the study area and suggests that STDs should be taken into account in similar studies on the Loess Plateau in the future.