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Effects of soil and water conservation engineerings on runoff and erosion in a hilly watershed of the Loess Plateau, China

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Abstract: Soil and water conservation engineerings as land preparation techniques are effective measures to prevent water loss and soil erosion. In this study, the typical soil and water conservation engineerings (level bench, level ditch, fish-scale pits, and adverse grade tableland) in hilly watershed of the Loess Plateau were used to study the runoff reduction and sediment prevention under engineering measurement and different vegetation type (Caragana korshinskii, Platycladus orientalis, Pinus tabulaeformis and Prunus armeniaca) conditions, and natural slope with the same vegetation served as a control. Soil samples at each site were collected from depths of 0—20, 20—40, 40—60, and 60—80 cm. Soil particle size distribution was analyzed. Soil water retention curves were monitored and simulated by Brooks-Corey, Gardner, and van Genuchten models. Network analysis was used to identify the factors (rainfall features, vegetation types, and engineering measurement) influential in surface runoff and erosion, while RDA was used to focus on the relations between surface runoff, soil erosion, and all of the influencing factors. The results showed that the effects of soil and water conservation engineering on soil particle size distribution varied with soil depth. The Brooks-Corey, Gardner, and van Genuchten model can well fit the soil water retention curve of different soil and water engineering approaches. Compared with control slope, the runoff coefficient could be reduced 37.7%, 31.9%, 44.3%, 60.5%, 18.2%, and 63%, respectively. Erosion modulus could be reduced 77.8%, 62.9%, 82.6%, 84.7%, 53.9% , and 76.3%, respectively. Results of network analysis indicated that rainfall was the most important influence factor on runoff and soil erosion, followed by vegetation type and engineering measurements. The effects of soil and water engineering on the soil available water in the surface soil layer were more pronounced after long-term implementation of soil and water engineering. Our findings could be benefits to provide references for the slopeland amelioration, erosion control and water conservation during the processes of vegetation restoration in semi-arid watershed.

Key words: soil and water conservation engineering; vegetation type, runoff and erosion, network analysis; Loess Plateau