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Effect of Vegetation on Debris flow Mitigation

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Traditionally, debris flows in mountainous regions are controlled by civil engineering structures, while, some of the structures are proved to have short life span and the misuse of these structures may cause even much more serious disaster (e.g. the debris flow happened in Zhouqu on August 8, 2010). Riparian vegetation could have profound impacts on the fluvial dynamic and the geomorphology of channels. However, only a small part of the effects has been clearly revealed, especially in active environments like southern Gansu which has long been attacked by geo-hazards such as mudflows and landslides. The goal of this research is to investigate how the bioengineering effects from vegetation develop with time in such kind of environment. From 2012-2015, we collected detailed data on vegetation type, density, root system morphology and measured profiles of the valley through field experiments. Based on field investigation and indoor tests, *Robinia pseudoacacia* were picked out from three common afforestation species in this area to be studied in detail. Then the root additional cohesion from three artificial monospecific stands of *Robinia pseudoacacia* in different ages growing within the debris valley were investigated. These data were incorporated into modified BSTEM (Bank Stability and Toe Erosion Model). In a larger scale, the field data were incorporated into a cellular braided-stream model to simulated the sediment movement and vegetation's effects on the channel dynamics. The result showed that with the increasing ages, the FOS of the bank could increase obviously (the increased values are from 0.02 to 1.1). At the same time, the area that occupied by water in the valley caused by simulated flood events will be diminished at a range of 18%-24% in average. The results show that the vegetation strength could bring in a less activity valley system and the development of debris. Compared to traditional engineering methods, the controlling vegetation are cheap, sustainable and eco-friendly. But some time (e.g. 2 to 4 years) may be needed for vegetation to become strong enough. This study could benefit the practices of debris flow mitigation and ecosystem restoration in the regions like Zhouqu and Wudu which possess deep valleys and vast relative relief.