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A study on topography versus sediment yield under simulated rainfall

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Abstract. This study investigates the effects of topography on the amount of sediment yield under simulated rainfall. The slope gradient and length would affect the runoff depth (V) and peak flow volume (Q_p) and thus the amount of surface runoffs. In this study, the simulated 150mm/hour rainfall intensity was applied on triangular prism-shaped, cone-shaped and pyramid-shaped models for determination of the amount of respective sediment yields (tons/storm event). It was observed that the sediment yields of the triangular prism-, cone- and pyramid-shaped amounted to 0.144, 0.143 and 0.125 tons/storm event, respectively. The triangular prism-shaped topography has the highest sediment yield amount as it experiences highest runoff depth and highest surface runoff velocity at downslope. Based on the experimental outcomes, it was shown that MUSLE could over-estimate sediment yield as much as 3.6 times for areas characterized by hilly landscape.

1. Introduction

The term “Sediment Yield” can be defined as the amount of eroded soils collected at the outflow end of an observation plot, field, channel, or watershed [1]. In a watershed, sediment yield refers to the amount of eroded material at a designated point remote from the origin of the detached particles; includes the soil loss from slopes and channels, mass wasting and deposition of eroded material on both slopes and in channels [1,2]. The quantity of sediment yield and sediment’s size characteristics are important in analyses of the scale of pollution in a watershed and indicate the decision-making for best management practices [2].

The Modified Universal Soil Loss Equation (MUSLE) has been widely used to predict sediment yield amount for a watershed or a catchment area [3,4,5]. The MUSLE is a modified version of Universal Soil Loss Equation (USLE) used to predict the amount of sediment yield on a storm basis from the outlet of watershed based on the runoff characteristics [5,6,7,8]. Williams and Berndt [5] developed a runoff factor $11.8(V \times Q_p)^{0.56}$ by investigating 778 individual storm events in 18 catchments with areas ranging from 15 to 1500 ha, and subsequently replaced the Rainfall Erosivity Factor (R) in the Universal Soil Loss Equation (USLE) to become MUSLE [5,7]. The MUSLE was recognized by United States of America, Department of Agriculture (USDA) as the best single indicator for sediment yield prediction, the amount of sediment yield in a watershed to a specific location for a specific storm as expressed in equation 1 [7,8]. Equation 1 was later revised by CPESC,