Modelling sediment transport capacity of loessial slopes based on effective stream power

Chenye Gao[1], Jingwen Wang[2], Xile Liu[3], and Kuandi Zhang[4]

[1]Key Laboratory of Agricultural Soil and Water Engineering of Ministry of Education in Arid Areas, Northwest A&F University, Yangling,712100, China.
[2]State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Hubei 430072, China
[3]Key Laboratory of Agricultural Soil and Water Engineering of Ministry of Education in Arid Areas, Northwest A&F University, Yangling,712100, China..
[4]Northwest A&F University, College of Water Resources and Architectural Engineering, , Xinong Road, Yangling 712100, Shaanxi, PR China

October 30, 2020

Abstract

The sediment transport capacity must be considered because it provides a theoretical basis for accurate prediction of soil erosion. Existing studies tended to study sediment transport capacity using a particular soil, but the models derived from one kind of soil cannot be applicable to other soil types. To obtain a prediction model for a variety of soils and evaluate its applicability, sandy loess and loess soil (d50=0.095 mm and d50'=0.04 mm) were chosen in the indoor artificial simulated sediment transport experiments. The experimental slopes ranged from 7% to 38.4% and the unit discharges were adjusted from 0.00014 to 0.00526m2/s. Moreover, this study combined the experimental data with cohesive soil and cohesionless sand from four scholars so as to analyze the response relationship between sediment transport capacity and each flow intensity parameter through dimensionless processing. Results showed that the dimensionless sediment transport capacity varied with its power function relationship with the flow intensity parameters. Through analysis, the effective stream power could be seen as an optimum indicator (R2=0.9692). After considering the effective stream power and volume sediment concentration, this study derived a formula for calculating the sediment transport capacity. It was better than the ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) model, improved WEPP (Water Erosion Prediction Project) model, Zhang's formula and Ali's model due to its superior applicability to cohesive soil and cohesionless sand. These findings lay a basis for establishing prediction models of soil erosion.

Hosted file

`manuscript.pdf` available at https://authorea.com/users/371431/articles/489777-modelling-sediment-transport-capacity-of-loessial-slopes-based-on-effective-stream-power

Hosted file

`Images and Tables for the paper.pdf` available at https://authorea.com/users/371431/articles/489777-modelling-sediment-transport-capacity-of-loessial-slopes-based-on-effective-stream-power