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DISSERTATION

SPECIFIC DEGRADATION AS FUNCTION OF WATERSHED CHARACTERISTICS AND CLIMATIC PARAMETERS

Submitted by

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ABSTRACT OF DISSERTATION

SPECIFIC DEGRADATION AS A FUNCTION OF WATERSHED CHARACTERISTICS AND CLIMATIC PARAMETERS

Soil erosion and its transport by overland flow involves very complex processes influenced by factors such as climate, watershed drainage area, soil type, topography, vegetation and human activities. Although considerable research has already been done and significant results have been obtained, the prediction of gross erosion, sediment yield and specific degradation (SD) with a great level of accuracy still remains a challenge. In this study, an extensive database covering different climate types throughout continental United States were compiled and used to derive regression equations relating specific degradation with key parameters that were determined through theoretical analysis. New SD relationships were determined at a 95% confidence interval. The database was used to test the accuracy of existing specific degradation relationships. The new obtained relationships were validated using an independent dataset.

The main objectives of this study were:

1) Compile an extensive database on sediment yield and specific degradation;

2) Develop new specific degradation relationships and determine the 95% confidence intervals;

3) Validate the new developed equations using an independent dataset and test the accuracy of other specific degradation relationships found in the literature

Statistical analyses revealed that SD data are log normally distributed with respect to the independent variables.

Using regression analysis, it was possible to derive new SD relationships as a function of a single variable (mean annual rainfall, R, drainage area, A, and slope, S) and as a function of a combination of variables (R and A, and R, A, S, and the vegetation factor, V). The accuracy of the predictions slightly increases as more independent variables are incorporated into the SD equation. The results showed that the equation in which SD is expressed in terms of the four key parameters R, A, S, and V is the most accurate, followed by the equation with R and A. The equation in which SD is expressed in terms of S is the least accurate of all.

The existing equations with R as independent variable are less accurate than the proposed equation. Specifically, with respect to mean SD predictions, the relationships of Langbein and Schumm, Wilson, and Fournier have accuracies in which 76%, 86%, and 24% of the predictions fall within a discrepancy range of $0.5<R<2$ respectively. In contrast, for the same discrepancy range, the accuracy of the new developed equation in which SD is expressed in terms of R is 90%. As of the equations with A as independent variable, all except one overestimate SD by several orders of magnitude. The only equation that has predictions of mean SD lying within $0.5<R<2$ is the one of Fleming with 100%, though 79% of them are with $0.5<R<0.2$, which indicates an slight underestimation. In comparison, using the new proposed equation, the number of points of mean SD values falling within a discrepancy ratio of $0.5<R<2$ is 100%.

The proposed equations in this study were validated using an independent data set.

It follows that the new developed equations in this study improve significantly the predictions of SD compared with the existing relationships.

The validation of the new equations was completed with a example concerning California Gulch watershed in Colorado.

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