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Sensitivity Analysis of the USLE Soil Erodibility Factor to Its Determining Parameters

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Soil erosion is recognized as one of the most serious soil threats worldwide. Soil erosion prediction is the first step in soil conservation planning. The Universal Soil Loss Equation (USLE) is one of the most widely used models for soil erosion predictions. One of the five USLE predictors is the soil erodibility factor (K-factor), which evaluates the impact of soil characteristics on soil erosion rates. Soil erodibility nomograph defines K-factor depending on soil characteristics, such as: particle size distribution (fractions finer that 0.002 mm and from 0.1 to 0.002 mm), organic matter content, soil structure and soil profile water permeability. Identifying the soil characteristics, which mostly influence the K-factor would give an opportunity to control the soil loss through erosion by controlling the parameters, which reduce the K-factor value. The aim of the report is to present the results of analysis of the relative weight of these soil characteristics in the K-factor values.
The relative impact of the soil characteristics on K-factor was studied through a series of statistical analyses of data from the geographic database for soil erosion risk assessments in Bulgaria. Degree of correlation between K-factor values and the parameters that determine it was studied by correlation analysis. The sensitivity of the K-factor was determined by studying the variance of each parameter within the range between minimum and maximum possible values considering average value of the other factors. Normalizing transformation of data sets was applied because of the different dimensions and the orders of variation of the values of the various parameters. The results show that the content of particles finer than 0.002 mm has the most significant relative impact on the soil erodibility, followed by the content of particles with size from 0.1 mm to 0.002 mm, the class of the water permeability of the soil profile, the content of organic matter and the aggregation class. The relationships of the K-factor with the relative content of particle size from 0.1 to 0.002 mm and the class of aggregation are linear, directly proportional. When the content of particles sized from 0.1 to 0.002 mm increases with one relative unit, the K-factor increases with 0.0091 t ha h / ha MJ mm, while the same relative increase of the class of aggregation, results to an increase of the K-factor by 0.0034 t ha h / ha MJ mm. On the other side, the relationships between the K-factor values and the contents of clay and organic matter, and the class of profile water permeability, are linear, inversely proportional. When the clay content increases with one relative unit, the K-factor value decreases by 0.0099 t ha h / ha MJ mm. The same relative increases in the content of soil organic matter and the class of soil profile water permeability, result to a decrease of the values of K-factor respectively by 0.0042 and 0.0045 t ha h / ha MJ mm.