

An Establishment of Rainfall-induced Soil Erosion Index for the Slope Land in Watershed

(Version 1)

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With more and more concentrated extreme rainfall events as a result of climate change, in Taiwan, mass cover soil erosion occurred frequently and led to sediment related disasters in high intensity precipitation region during typhoons or torrential rain storms. These disasters cause a severely lost to the property, public construction and even the casualty of the resident in the affected areas. Therefore, we collected soil losses by using field investigation data from the upstream of watershed where near specific rivers to explore the soil erosion caused by heavy rainfall under different natural environment. Soil losses induced by rainfall and runoff were obtained from the long-term soil depth measurement of erosion plots, which were established in the field, used to estimate the total volume of soil erosion. Furthermore, the soil erosion index was obtained by referring to natural environment of erosion test plots and the Universal Soil Loss Equation (USLE). All data collected from field were used to compare with the one obtained from laboratory test recommended by the Technical Regulation for Soil and Water Conservation in Taiwan. With MATLAB as a modeling platform, evaluation model for soil erodibility factors was obtained by golden section search method, considering factors contributing to the soil erosion; such as degree of slope, soil texture, slope aspect, the distance far away from water system, topography elevation, and normalized difference vegetation index (NDVI).

The distribution map of soil erosion index was developed by this project and used to estimate the rainfall-induced soil losses from erosion plots have been established in the study area since 2008. All results indicated that soil erodibility increases with accumulated rainfall amount regardless of soil characteristics measured in the field. Under the same accumulated rainfall amount, the volume of soil erosion also increases with the degree of slope and soil permeability, but

decreases with the shear strength of top soil within 30 cm and the coverage of vegetation. The slope plays more important role than the soil permeability on soil erosion. However, soil losses are not proportional to the hardness of top soil or subsurface soil. The empirical formula integrated with soil erosion index map for evaluating soil erodibility obtained from optimal numerical search method can be used to estimate the soil losses induced by rainfall and runoff erosion on slope land in Taiwan.

Keywords: Erosion Test Plot, Soil Erosion, Optimal Numerical Search, Universal Soil Loss Equation.

降雨誘發集水區坡地土壤沖蝕特性分析與評估模式建置

(初稿)

摘要

近年來由於氣候異常，降雨量豐沛且強度集中，加上台灣地形陡峻、坡短流急，致使坡地表土沖蝕加劇。因此，本研究針對台灣部分流域之上游集水區進行土壤沖蝕特性的調查，配合長期持續觀測之現地沖蝕釘沖蝕深度之量測，及試區土樣現地及室內土壤試驗結果，探討不同自然區位環境下，降雨對集水區坡地土壤沖蝕之影響。本研究亦運用最佳數值搜尋原理之黃金切割法，以 MATLAB 程式平台，建構土壤沖蝕指數(soil erosion index)評估模式，模式中所考量之土壤沖蝕影響因子，包括坡度、土質種類、坡向、距水系距離、高程及常態化差異植生指數(NDVI)等。

結果顯示，現地試區內不論何種土壤特性，當觀測期間之累積雨量增加，則土壤沖蝕量亦有隨之增加的趨勢。在相同觀測期間累積雨量下，現地試區之地表覆蓋率較高、表土剪力強度或表土硬度越強，其相對應之土壤沖蝕量則有較小的趨勢；此外，當現地試區之坡度越陡，其相對應之土壤沖蝕量則有越大的趨勢，且坡度對土壤沖蝕之影響高於表土透水性之影響。結果亦顯示，本研究以最佳數值搜尋原理建構之土壤沖蝕指數模式，有其合理之評估能力，預期可作為估算研究範圍全區降雨誘發土壤沖蝕量之參考。

關鍵詞：沖蝕試驗、土壤沖蝕、最佳數值搜尋、萬用土壤沖蝕模式。