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ESTIMATION OF SOIL EROSION IN NORTHERN KIRKUK GOVERNORATE, IRAQ USING RUSLE, REMOTE SENSING AND GIS

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Abstract: A quantitative assessment of annual soil erosion by water in the northern part of Kirkuk Governorate, north of Iraq was investigated through integration of remote sensing, GIS and empirical RULSE soil erosion model. The five factors of RULSE model (rainfall erosivity R, soil erodibility K, slope length and steepness LS, crop management C, and practice factor P) were derived from different resources such as field survey, archival data, digital elevation model, and LANDSAT 8 multi-bands imagery. The annual soil erosion loss was estimated by multiplying the five factors in raster format using raster calculator of ArcGIS 10.2 software. The estimated annual soil losses rate for the study area ranges from 0 to 245 (t ha^{-1} yr^{-1}) with an average of 2 (t ha^{-1} yr^{-1}). The value ranges were classified into four categories: minimal, low, moderate, high soil erosion hazard zones using four classification schema: quantile, natural breaks, geometric, and standard deviation. Due to the similarity of results, the comparison was carried out between two schemas: natural breaks and geometric. The area covered by minimal-low soil hazard zones extends over an area of about 88% and 99% based on geometric and natural breaks schema, respectively. In turn, the moderate-high soil hazard zones cover only very small area (0.3%) based on natural breaks and relatively small area (12%) depending on geometric scheme. In general, both method results indicate that hazard of soil erosion is low in the study area. The spatial pattern of classified soil erosion rate indicates that the areas at moderate to high risk is located in the northeast and very small area in the east, while the minimal to low zones cover the other parts. The obtained results of could be useful to implement soil conservation practices in the study area.

Key words: RUSLE, GIS, NDVI, Kirkuk, Iraq, soil erosion.

1. INTRODUCTION

Soil erosion by water is a world major problem that results in decrease of soil fertility, land degradation, and also affecting the sustainability and productivity of agricultural areas. In fact, soil erosion is a geomorphological process driven by natural forces, and it could be accelerated by human activities such as deforestation, construction, agriculture, and mining. To quantify soil rate, techniques such as erosion modeling can be helpful. Soil erosion modeling consists in mathematically describing of the soil particle detachment, sediment transport and deposition on land surface (Lal, 1994). For assessing the soil erosion, many empirical models were developed in the past such as USLE, Universal Soil Loss Equation (Wischmeier & Smith, 1978); WEPP, Water Erosion Prediction Project (Nearing et al., 1989), EUROSEM, European Soil Erosion Model (Morgan et al., 1998) and many others (Pervoić et al., 2013). Among these known models, the USLE and revised RUSLE version are the most widely used models for assessing soil erosion hazard around the world, especially in the developing countries due to simplified structures and data demand. In recent years, the combined use of satellite imagery, geographic information system with RUSLE model makes soil erosion estimation on regional scale feasible with reasonable costs and better accuracy (Millward & Mersey, 1999; Wang et al., 2003; Lu et al., 2004; Jasrotia & Singh, 2006; Krishna Bahadur, 2009 in Prasannakumar et al., 2011). Many researchers applied USLE/RUSLE linked with remote sensing and GIS techniques for assessing soil erosion and sediments yields with successful results (Angima et al., 2003; Lee, 2004; Lu et al., 2004; Kim et al., 2005; Onyando et al., 2005; Onori et al., 2006; Pandey et al., 2007;