

Relationship between Gully Development and Characteristics of Drainage Area in Semi-Arid Region, NW Iran

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Abstract : Gully erosion is a widespread and often dramatic form of soil erosion caused by water during and immediately after heavy rainfall. It occurs when flowing surface water is channelled across unprotected land and washes away the soil along the drainage lines. The formation of gully is influenced by various factors, including climate, drainage surface area, slope gradient, vegetation cover, land use, and soil properties. It is a very important problem in semi-arid regions, where soils have lower organic matter and are weakly aggregated. Intensive agriculture and tillage along the slope can accelerate soil erosion by water in the region. There is little information on the development of gully erosion in agricultural rainfed areas. Therefore, this study was carried out to investigate the relationship between gully erosion and morphometric characteristics of the drainage area and the effects of soil properties and soil management factors (land use and tillage method) on gully development. A field study was done in a 900 km² agricultural area in Hshtroud township located in the south of East Azarbijan province, NW Iran. Toward this, two hundred twenty-two gullies created in rainfed lands were found in the area. Some properties of gullies, consisting of length, width, depth, height difference, cross section area, and volume, were determined. Drainage areas for each or some gullies were determined, and their boundaries were drawn. Additionally, the surface area of each drainage, land use, tillage direction, and soil properties that may affect gully formation were determined. The soil erodibility factor (K) defined in the Universal Soil Loss Equation (USLE) was estimated based on five soil properties (silt and very fine sand, coarse sand, organic matter, soil structure code, and soil permeability). Gully development in each drainage area was quantified using its volume and soil loss. The dependency of gully development on drainage area characteristics (surface area, land use, tillage direction, and soil properties) was determined using correlation matrix analysis. Based on the results, gully length was the most important morphometric characteristic indicating the development of gully erosion in the lands. Gully development in the area was related to slope gradient ($r = -0.26$), surface area ($r = 0.71$), the area of rainfed lands ($r = 0.23$), and the area of rainfed tilled along the slope ($r = 0.24$). Nevertheless, its correlation with the area of pasture and soil erodibility factor (K) was not significant. Among the characteristics of drainage area, surface area is the major factor controlling gully volume in the agricultural land. No significant correlation was found between gully erosion and soil erodibility factor (K) estimated by the Universal Soil Loss Equation (USLE). It seems the estimated soil erodibility can't describe the susceptibility of the study soils to the gully erosion process. In these soils, aggregate stability and soil permeability are the two soil physical properties that affect the actual soil erodibility and in consequence, these soil properties can control gully erosion in the rainfed lands.

Keywords : agricultural area, gully properties, soil structure, USLE

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