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Identification of areas vulnerable to soil erosion risk in India using GIS methods

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Abstract. This paper attempts to provide information for policymakers and soil conservation planners in the form of district-wise soil erosion risk (SER) maps prepared for the state of Telangana, India. The SER values for each district were computed by extracting the information on grid-wise soil erosion and soil loss tolerance limit values existing on the country-scale in a GIS environment. The objectives of the study were to (i) identify the areas of the state with a high erosion risk, and (ii) identify areas with an urgent need of conservation measures. The results reveal that around 69 % of the state has a negligible risk of soil erosion above the tolerance limits, and does not call for immediate soil conservation measures. The remaining area (2.17 M ha) requires conservation planning. Four districts, viz. Adilabad, Warangal, Khammam, and Karimnagar are the most risk-prone with more than one-quarter of their total geographical areas showing net positive SER values. In order to obtain a clearer picture and categorize the districts based on their extent of vulnerability, weighted erosion risk values were computed. Adilabad, Warangal, and Khammam were identified as the worst-affected districts in terms of soil erosion, and therefore are in need of immediate attention of natural resource conservation.

1 Introduction

Soil is a finite and non-renewable natural resource. It takes between 200 and 1000 years for 2.5 cm of topsoil to form under cropland conditions (Pimentel et al., 1995). Fertile soils have always been the mainstay of prosperous civilizations, and great civilizations have fallen in the past because they failed to prevent the degradation of soils on which they survived (Diamond, 2005). The inherent productivity of many lands has been dramatically reduced as a result of soil erosion, accumulation of salinity, and nutrient depletion (Scholes and Scholes, 2013).

Global estimates show an increasing trend in degraded areas, with other areas becoming vulnerable to various forms of degradation (Reich et al., 2001; FAO, 2011; UNCCD, 2013). Similarly, in India, areas under land degradation have been on the rise, particularly during the last few decades, and the latest estimates show that an area of about 120.72 M ha (million hectares) is affected by various forms of land degradation, of which 82.57 M ha is solely accounted for by water-induced soil erosion in excess of 10 Mg ha^{-1} yr^{-1} (Maji, 2007).

Among the Indian states, erstwhile Andhra Pradesh (AP) was the third most vulnerable in terms of soil erosion, with nearly 40 % (10.93 M ha) of the total geographical area (TGA) being eroded by water (Maji et al., 2010). Reddy et al. (2005) reported that the 10 districts of the newly formed Telangana, which was a part of erstwhile AP, accounted for 42 % of the water-erosion-affected area (soil loss >5 Mg ha^{-1} yr^{-1}) of the undivided state. On computing the extent of soil erosion in Telangana alone from the report by Reddy et al. (2005), it was found that more than two-thirds of the TGA of the state is affected by soil erosion.

The above situation may look alarming for the soil conservation planners of the state, but the statistics only provide