

## **A New Soil Erosion Severity Map for India Using Geospatial Modeling and Machine Learning**

Soil erosion is a critical agricultural and environmental problem as it poses threats to agricultural productivity, soil fertility, and hydrological processes on a large scale, affecting 751 million hectares globally through water erosion. Considering the substantial reliance of the Indian economy on agriculture, the significance of erosion is amplified. The escalating demand of the unplanned growing population is generating scenarios wherein forests and grasslands undergo alterations, exposing the uppermost fertile soil layer to rainfall intensity and runoff-induced erosion. Approximately half of the total geographical area of India is susceptible to erosion induced by water. This thesis encompasses the political boundary of India, despite having some initial estimates of soil loss, no national-scale estimates of soil erosion are available for India. There is a need for comprehensive soil erosion assessments on a national scale. Estimating and monitoring erosion over an extended period for a large region is both expensive and time-consuming. Various methods, such as empirical, mathematical, and GIS (Geographic Information System)-based models, are employed to calculate soil loss, each with inherent limitations. The Revised Universal Soil Loss Equation (RUSLE) model stands out globally for its precision in estimating soil loss over larger areas. In this thesis, soil loss was assessed using the RUSLE-based algorithm, encompassing all five of its factors. Notably, there is a lack of national-scale estimates for all five RUSLE factors contributing to soil loss—rainfall erosivity, soil erodibility, slope length and steepness, cover management, and agricultural support practices—across India. The importance of contributing factors like rainfall intensity, soil properties, LULC, and agricultural practices on the soil erosion process in Indian conditions was also discussed using the Random Forest algorithm in machine learning (ML). All these factors were modeled and mapped over the study region, specifically, the factors associated with rainfall intensity and soil properties, with feature importance analysis of these factors using ML. Finally, a new erosion-severity classification system has been implemented to develop a national soil erosion susceptibility map to classify and visualize areas suffering from erosion in India. This thesis claims to be the first comprehensive national-scale assessment of rainfall erosivity, soil erodibility, soil erosion, and sediment yield mapping across India. This study enhances our understanding of rainfall-induced erosion, driven by both rainfall and runoff, providing a crucial resource for experts engaged in soil conservation and erosion management planning.