Title:	Spatio-Temporal Dynamics of Gully Erosion in Chambal Using Machine Learning and Satellite Observations
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Abstract:	The study of ravine and gully erosion holds significant importance in the realms of geomorphology and soil erosion research. Gully erosion stands out as one of the most severe manifestations of land degradation driven by water-induced erosion processes. Its impacts extend far beyond mere landscape alterations, affecting ecosystem function, soil productivity, water quality, and even the livelihoods of communities residing nearby. In India, where agriculture plays a pivotal role in the economy and the population is dense, gullied 'badlands' pose a substantial threat to food security and economic development. Recognizing the urgency of the situation, various governmental and non-governmental entities have initiated policy adaptations and implemented ravine reclamation schemes to manage and mitigate the problem of gully erosion. These efforts emphasize crucial aspects such as gully erosion assessment, erosion susceptibility analysis, and the accurate estimation of their impacts. To address these challenges, remote sensing coupled with geospatial data and machine learning technology has emerged as a powerful tool for assessing ravine health and monitoring gully erosion dynamics. In this study lower Chambal valley of the Indian subcontinent has been taken into consideration for gully erosion susceptibility by using geospatial data and machine learning models. Chapter 1 presents the background of ravine and gully erosion, mechanism of gully erosion, and their types. Understanding the factors influencing gully erosion, quantifying them for Chambal region and comparing different models of quantifications are the objective of the present study. Chapter 2 is focused on the study area details i.e., the Rajakhera and Dholpur region of Rajasthan, India. This section explains the study areass geology, climate, flora and fauna, environmental condition, and approaches to address environmental degradation. Chapter 3 delves into an in-depth exploration of the Revised Universal Soil Loss Equation (RUSLE) Model, a widely recognized framework utilized for estimating erosion rates in various environmental settings. This chapter presents the constituent factors of the RUSLE Model, explaining how each element contributes to the overall estimation of erosion rates, and quantification of erosion rates by RUSLE model. Chapter 4 deals into an alternative method known as the Difference of DEM (Digital Elevation Model) approach, which offers a direct perspective on understanding gully erosion processes and quantifying soil deposition. Unlike the RUSLE Model discussed in Chapter 3, the Difference of DEM method focuses specifically on analyzing changes in terrain elevation over time to assess gully erosion dynamics. Chapter 5 is based on machine learning method that quantified the total gully erosion volume for the study area. The research framework presented in this chapter can be useful in the erosion rate estimation of whole Chambal valley Badland and can be utilized effectively in ravine reclamation projects. Chapter 6 presents the comparison results of three different models discussed in Chapter 3 to Chapter 5, and the conclusion and other key findings of the study. Limitations and future perspectives are also presented. Keywords: Gully erosion, Digital Elevation Model (DEM), RUSLE, Average annual soil loss, Machine learning.
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