Soil Erosion Estimation using Land-Use Change and Landslide Frequency Ratio Method: A Case of Kalu River Catchment of Sri Lanka

Madushani N.M.O.[1 *], and Ranasinghe A.K.R.N.[2]

[1]*Department of Remote Sensing and GIS, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, Sri Lanka*
[2]*Department of Surveying and Geodesy, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, Sri Lanka*
[*]*dolishiya96@gmail.com*

Soil erosion is a critical issue contributing to global land degradation, impacting agricultural productivity, ecosystems, and hydroelectric power generation. This research focuses on the Kalu River catchment in Sri Lanka, addressing soil erosion exacerbated by land-use changes and human activities. The study aims to quantitatively and spatially assess soil erosion severity, identify vulnerable areas, and inform effective land use management and soil conservation practices. Employing an approach combining severity assessment, land-use change analysis, and the landslide frequency ratio method, this research sets out to provide valuable insights for landscape vulnerability assessment. The research objectives include quantifying and mapping yearly soil loss, investigating the impact of human intervention on soil erosion, identifying spatial patterns of soil erosion risk, and categorizing sub-catchments based on erosion severity. Utilizing the Revised Universal Soil Loss Equation (RUSLE), this study spatially mapped soil loss and conducted multiple linear regression analysis to reveal variable influences on soil erosion. The K factor exhibited the highest coefficient, followed by LS, C, P, and R factors. The comparison of the RUSLE and Artificial Neural Network (ANN) models showed the RUSLE model's superior performance in assessing soil erosion susceptibility. Statistical analysis of the RUSLE model revealed mean soil erosion rates of 0.1215tha-1yr-1 in 2000 and 0.1387tha-1yr-1 in 2020. In contrast, the ANN model accurately predicted soil erosion with a mean value of 0.9872tha-1yr-1. The research underscores spatial variations in soil erosion among sub-catchments, emphasizing high-risk areas requiring targeted soil conservation measures. Recommendations include implementing machine learning techniques like the ANN model for enhanced predictions and raising awareness through campaigns and training programs to foster community engagement in soil conservation efforts. The identification of high-priority areas in the Kalu River basin emphasizes the importance of continuous monitoring, appropriate land cover management, and vegetation practices for sustainable land use.

Keywords: *Artificial neural network (ANN), Land-use change, Revised universal soil loss equation (RUSLE), Soil erosion, Vulnerability assessment*