PREFACE

Earthquakes pose a major threat to the Sikkim region in the northeastern Himalayas, which is known for its seismic activity. Identifying earthquake-prone areas is critical to reducing risk and protecting lives and infrastructure. This work explores an innovative approach that combines multi-criteria decision analysis (MCDA), machine learning (ML) and geospatial techniques to improve the accuracy and reliability of seismic risk assessment. Traditional methods such as the Analytical Hierarchy Process (AHP) rely heavily on expert opinion to assign weights, which can introduce bias and reduce the robustness of ratings. In contrast, machine learning models provide a data-driven weight assignment mechanism that improves objectivity and accuracy. This study uses machine learning algorithms such as Random Forest and SmileCart, integrated with geospatial data analysis through platforms such as Google Earth Engine (GEE), to evaluate multiple parameters that affect earthquake vulnerability, including fault characteristics, maximum ground acceleration, earthquake magnitude, proximity Degree, slope and other elevations. By applying these advanced techniques, this study aims to develop a comprehensive and accurate model to identify earthquake-prone areas in Sikkim. The findings are expected to make a significant contribution to disaster management strategies and improve preparedness and recovery from seismic events in the region. This study was evaluated using ML algorithms such as Random Forest and SmileCart and integrated with geographic data analysis through platforms such as Google Earth Engine (GEE). Several parameters influence earthquake susceptibility, including fault characteristics, maximum ground acceleration, earthquake magnitude, proximity, slope, and height.