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Ministry of Energy, Water Resources and Irrigation
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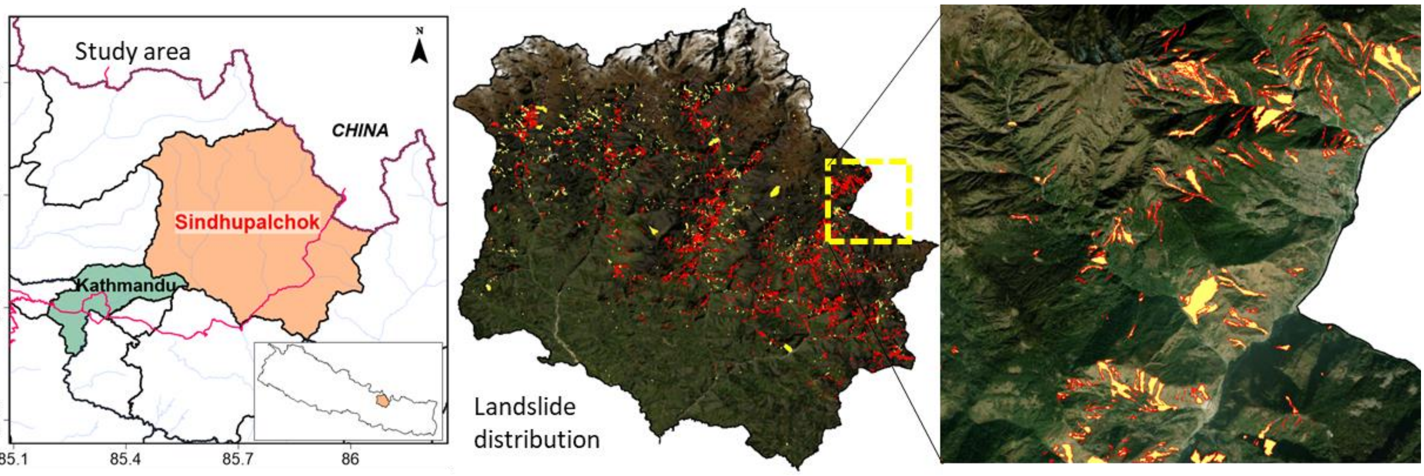
Quantification of slope unit wise vulnerability in terms of building aggregation

Background

Shallow landslides and subsequent debris flow cause thousands of deaths and serious economic damage worldwide. The mountainous terrain and highly weathered and fractured rocks contribute excessive mass wasting in Nepal Himalaya. Damages by landslides and debris flow to residential buildings are very common causing loss of lives. Therefore, it is important to analyze the potential damage to residential buildings that may be caused by landslides and their propagation. This study presents assessment of landslide vulnerability based on slope units under a scenario of data scarce in Sindhupalchok District, Nepal.

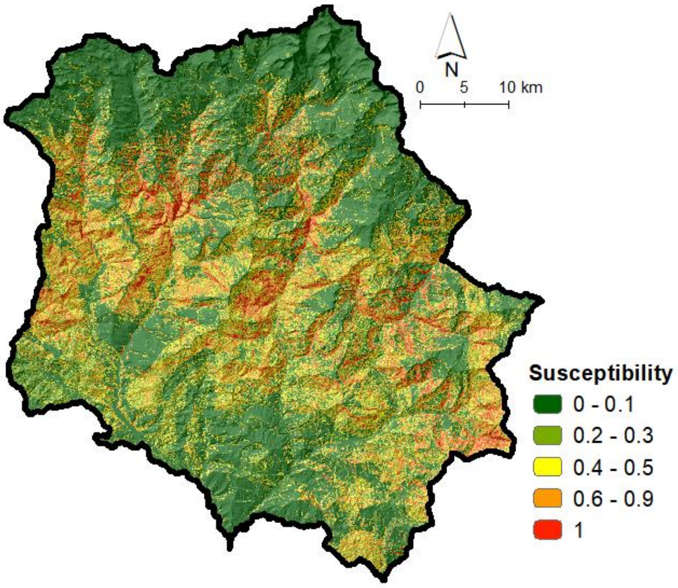


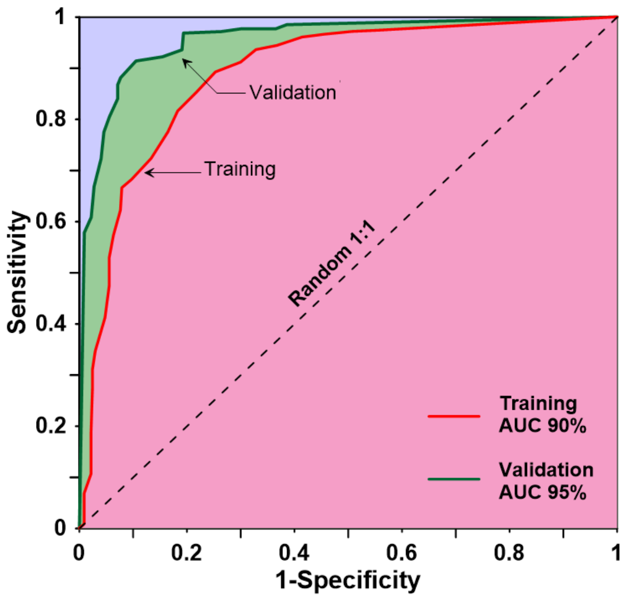
Methodology

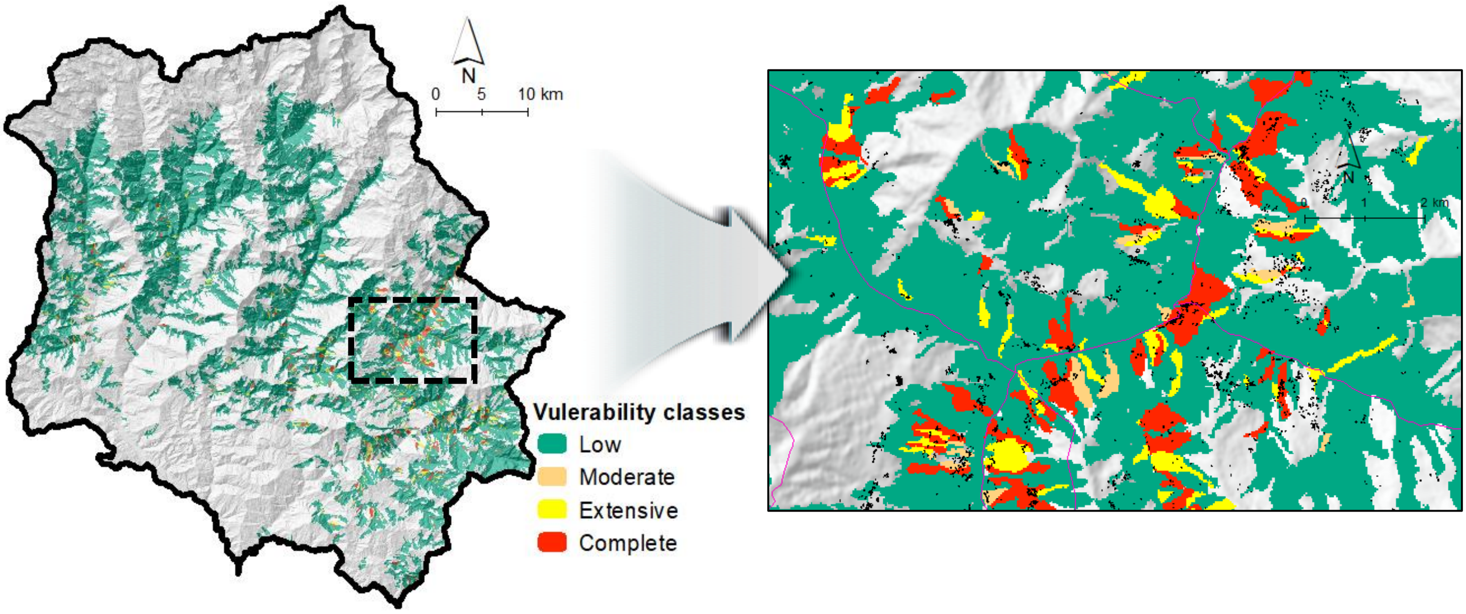
A physical vulnerability assessment was implemented by overlaying the landslide runout zone onto the area of the potentially affected buildings (Pradhan et al.; 2019). This study was performed in three steps: (1) landslide susceptibility mapping to identify probable landslide source areas using Random Forest algorithm; (2) runout assessment, using Flow-R, was performed to identify the potentially affected areas; and (3) physical vulnerability assessment was performed using a probabilistic method. For the physical vulnerability mapping, only building outlines were considered as an element at risk. Other building parameters, such as height of building and resistance to landslides, were not taken into account due to a lack of data. The unit area for the vulnerability assessment was defined by using slope-unit concept.

Results

2194 numbers of landslides in total were identified using remote sensing technique, among which 70% landslides were used as training dataset and remaining 30% landslides were separated for validation of the landslide susceptibility result. The accuracy assessment was done by using area under the curve (AOC) of receiver operating characteristics curve (ROC) which showed that the prediction rate is 90% and accuracy rate is 95%. The susceptible area encompassing landslide occurrence probability above 90% was considered as landslide source area for runout assessment. The essential parameters i,.e. velocity and travel angle were calculated using back-propagation approach for 35 prominent landslides which showed average velocity at 10.3 m/s and average travel angle at 13.02° . 97046 numbers of buildings in total were identified on a Google Earth image acquired in 2020; manual digitization was performed to vectorize the building outlines, which were stored in a GIS database. Finally, 2236 buildings were identified in the potentially affected area.







Conclusion

Physical vulnerability assessment is based on either a very detailed field inventory of building characteristics or expert judgments. In contrast to previous studies, this study presented a simple methodology under a scenario of scarce data.

Reference

Pradhan, A.M.S., Lee, J.M. & Kim, Y.T., 2019. Semi-quantitative method to identify the vulnerable areas in terms of building aggregation for probable landslide runout at the regional scale: a case study from Soacha Province, Colombia. Bull Eng Geol Environ 78, 5745–5762. https://doi.org/10.1007/s10064-019-01533-y

FOR FURTHER INFORMATION:

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