INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Rainfall-induced landslides constitute a major geo-hydrological hazard and form a significant component of the natural disasters that affect most of the hill slopes of Guwahati region, Assam, India. Although such rainfall-triggered landslides are mostly of shallow slips involving relatively lesser volumes of soil, they exhibit a recurrent temporal and spatial frequency of occurrence. The catastrophic nature of such landslides in the urbanized areas cause significant damage to infrastructure and loss of life. Hence, it is immensely necessary to conduct a well-focused research to address this phenomenon for the assessment of the landslide-induced hazard. Hill slopes within the city of Guwahati primarily comprise unsaturated residual soils. In order to address this critical issue, the potential susceptibility to rainfall-induced landslide is assessed for the region through an effective modelling of water content and matric suction variation, upon subjected to different rainfall infiltration scenarios. This study highlights the applicability of physically based models, namely TRIGRS (Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability Model), for assessing the landslide susceptibility and hazard assessment for the Guwahati region. This model is capable of computing the transient changes and progressive degradation of the hillslope stability due to rainfall infiltration, while considering the in-situ conditions and mechanical properties of the involved soils. TRIGRS offers a geotechnical perspective to the rainfall induced landslide hazard of the study area. As an input to TRIGRS, in-situ and laboratory investigations are conducted to ascertain the hydrological and geotechnical characteristics of the hillslope soils. Actual rainfall events of varying patterns and duration, which are known to trigger landslides within the study area, are used as input into TRIGRS model to simulate the slope stability condition of the hill-slopes. Digital Elevation Model (DEM) is used to represent the topography of the area and is subsequently used to derive all other topographic parameters that are required as input to TRIGRS model. The influence of various DEMs on the prediction of the rainfall-induced landslides is also assessed. The rainfall intensity-duration-frequency (I-D-F) curves are evaluated and subsequently used to compute the rainfall intensities corresponding to a specific return period and duration of rainfall. These events are further considered as input into TRIGRS simulation to generate the Factor of Safety (FoS) maps of the region. The outcomes from various such maps are then combined to develop the landslide hazard map of the study area. Further, to assess the efficacy of the simulations, the Receiver Operating Characteristic (ROC) and LR_{class} of the FoS maps is evaluated by overlaying the landslide locations in the form of GPS (Latitude-Longitude) points. To address the uncertainties related to input values of the soil shear strength parameters considered for the analysis, a probabilistic methodology is developed in which the TRIGRS simulation is aided by Monte-Carlo simulation while considering the soil parameters as random variables. The outcome of the analysis is provided in the form of a Probability of Failure (PoF) map.