GIS BASED SLOPE STABILITY MODELS FOR RAIN TRIGGERED LANDSLIDE HAZARD MAPPING: CASE STUDY - RATHNAPURA, SRI LANKA

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ABSTRACT

Landslide is one of the most destructive and very common natural hazards in mountainous terrain in Rathnapura, Sri Lanka. This study attempted to simulate the rain-triggered slope instability phenomena in this area by deterministic RS/GIS based, hydrology coupled infinite slope stability models namely the SINMAP model and model developed in PCRaster environment.

Results of SINMAP initial run were compared with landslide inventory map, comparison results indicate that 90% of landslide initiation locations fall in the unstable zone. Then, the default six stability classes were reclassified into four classes for easy comparison with NBRO hazard zonation map. SINMAP model predicts 90% of the known landslide initiation points within the very high hazard and high hazard regions whilst, NBRO's method indicate 80% of them within the same instability regions. Above results indicate that, the SINMAP model can be utilized as a tool for identification of landslide hazard zones in this area.

Having established the SINMAP model for the area, several recharge scenarios were modeled to arrive at threshold rainfall leading to full saturation and placing the area under worst conditions with regard to slope instability. Therefore, several rainfall scenarios were simulated and, it is identified as 75 mm per day rainfall and it is in close correspondence with the rainfall threshold reported by Bhandari and Thayalan (1994), 200 mm per 3 days, as that trigger landslides in the hilly and mountainous terrains of Sri Lanka.

PCRaster model was executed with averaging the lower and upper bound parameter values used in the SINMAP model and hourly rainfall time input corresponding to the historical maximum. Output time series maps are clear to indicate that the factor of safety against slope instability too shows an unsteady variation that corresponds to variation of rainfall. The unsteady nature of rainfall resulting in transient pore pressure dissipation phenomena as demonstrated through the above series of factor of safety maps illuminate the fact that why a lesser number of failures have been evidenced as opposed to those modeled by steady state models.