Prediction of soil depth using topographical variables for debris flow initiation modeling in the upper Tikovil River basin, Kerala, India

Sanjaya Devkota, **Sekhar Lukose Kuriakose**, V.G. Jetten

UNU-ITC School for Disaster Geo-information Management/Department of Earth Systems Analysis, International Institute for Geoinformation Science and Earth Observation (ITC), Enschede, The Netherlands (lukose11753@itc.nl)

Most soil surveys ignore soil depth thus limiting the use of a conventional soil survey data base for spatial deterministic modeling of landslides. The paper presents an attempt to prepare a topographically congruent soil depth data in the upper Tikovil River basin, Kerala, India. The plateau margins of highland Kerala (The Western Ghats) have all prerequisites of an active erosion zone where the natural terrain setup is conducive to slope failure/mass movements. Numerous debris flows mark the terrain and they are increasingly a concern in the state. Research works are ongoing to assess the spatio-temporal probabilities of occurrence of debris flows in the region. Preceding research works indicate that accurate soil depth data is a prime prerequisite for such an assessment.

Soil depth measurements were carried out at 239 points in a basin having an area of 9.5 km^2. For the present research soil depth to bed rock (SDTB) was defined as the depth from the surface to the non penetrable saprolite layer/bed rock. Measurements were made at road cuts, excavated pits and using an iron spear pounded into the soil where soil profile was not exposed. Locations of sampling were selected randomly and were widely distributed. Topographical parameters such as altitude, slope, curvature and compound terrain index, for the basin was derived from a 10 m X 10 m digital elevation model (DEM). The Compound Topographic Index (CTI) also named Topographic Wetness Index is a function of both the slope and the upstream contribut-

ing area per unit width orthogonal to the flow direction. The sampling data base was divided into training data set (75%) and validation data set (25%). Results of three different methods, namely, simple krigging (SK), regression krigging (RK) and multiple linear regression (MLR) were evaluated for accuracy with the validation data set using the Nash-Sutcliffe Coefficient of Efficiency (CE) and the Correlation Coefficient (r^2). The results of the analysis are listed below in the order: **Sl. No, Attribute used, Method, CE, r^2**

1, None, SK, 0.52, 0.53

2, Slope, RK, 0.59, 0.62

3, Curvature, RK, 0.6, 0.62

4, Altitude, RK, 0.58, 0.6

5, CTI, RK, 0.66, 0.7

6, All, MLR, 0.72, 0.75

Based on the analysis of the results, a multiple linear regression having the form

$$SDTB = 2.132\text{-}0.018*Slope+0.008*Curvature\text{-}0.002*Altitude+0.036*CTI$$

is proposed by the researchers as the best method for a basin scale soil depth prediction in the region. The resultant soil depth surface was used for modeling debris flow initiation in the region using STARWARS+PROBSTAB, a coupled slope hydrology-slope stability model and the results are promising.