

ABSTRACT

Western Ghats, the bold westerly escarpment of India, that traverses through the entire length of the Kerala State, from north to south, witnesses landslides very frequently during the monsoon season and causes widespread damage to life and property. The present work was carried out in parts of Western Ghats covering a geographical extent of 420 sq.km., which is spread over the geomorphologically diverse mileau of Ernakulam and Idukki districts of central Kerala. The area is characterized by outcrops of hornblende gneiss and pink granite gneiss. Structures like faults, lineaments and folds of differing dimensions are seen throughout this area. The Kerala fault and the Periyar fault are the important faults present in the study area and are the epicenters of previous earthquakes of Richter Magnitude greater than 4.5. The Deviar Fold System is the major fold system in this area and is a museum of palaeo-landslide scars. The main objective of the present study is mapping and analysis of various terrain parameters for landslide risk evaluation, estimation, assessment and management using geoinformatics.

Terrain parameters of the study area were interpreted from IRS 1D LISS III+PAN merged satellite data and field based investigation. Studies show that the present day landforms of the study area were carved out by a combination of fluvial, denudational and tectonic activities. Previous landslide studies show that tectonic landforms like escarpments and structural hill system influences landslides. In the study area, landslides are mainly associated with terrain having slopes between 10-30° whereas the most susceptible slopes are those between 30-60° in a typical tropical climate similar to that prevalent in the study area. This is due to high soil thickness in 10-30° slope division when compared to the barren rock of steeper slope category. The middle zone, demarcated on the basis of relative relief, is prone to landslide activities. Presence of plateau margin and highly dissected marginal hills is the reason behind the high incidence of landslides in this zone. Mixed cultivation with settlement and dense forest bear the brunt of landslide activity in the land use/land cover category and this indicates that human activity in unfavourable slopes is the real causative factor triggering landslides. Correlation of drainage density with landslides shows that moderate and low category (2-

3 and 1-2 km/km² respectively) have maximum landslide occurrence. This is due to less surface runoff, which results in high infiltration and increased pore water pressure. Rainfall is an important triggering mechanism in the study area. An annual average of >380 cm precipitation occurs in the study area that is higher than the average required (250 cm) to trigger this phenomenon. Deforestation is the most damaging amongst the human activities. About 34% of forestland has been deforested during a short small span of 25 years (1978-2002).

Geochemical studies of hornblende gneiss and granite gneiss shows that their response to weathering is similar, despite their apparent differences in mineralogy. Chemical Index of Alteration (CIA) values of soils developed in the weathering profiles over hornblende gneiss and granite gneiss shows values of 92.67 and 88.46 respectively. This high value shows the extensive chemical weathering process that the rocks have undergone. Triaxial shear test of the soils shows that all the samples have factor of safety less than one, which indicates that all the slopes occupied by these soils are in an unstable condition.

Landslide hazard zonation of the study area was done by multi-dimensional analysis of different terrain parameters in a GIS environment after assigning rank and weight under a supervised weighting method. The entire area is delineated into 3 zones: high landslide hazard zone, moderate landslide hazard zone and landslide free zone. Correlation of palaeo-landslides with high landslide hazard zones shows that more than 90% of palaeo-landslides have occurred in high landslide hazard zone. Vulnerability studies conducted along the high landslide hazard zones reveal that 10,41,056 nos. of human population, 2,656 cattle, livestock and poultry stock and Rs. 2,650 crore (~US\$ 588.8 m) worth of property are at risk. All this point towards a pressing requirement of management practices. Site-specific management practices were proposed for settlement zones and communication corridors within the high landslide hazard zone on the basis spatial intersection of these areas with terrain parameters.

Keywords: Landslides, Geoinformatics, Western Ghats, Deviar Fold System, Landslide Hazard Zonation, Vulnerability, Management Practices.