Landslide Zonation

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Abstract

Bureau of Indian Standard (BIS) has adopted a rating based guidelines for preparing landslide hazard zonation of hilly terrain. This approach has not considered landslide and slope erosion as parameters though these cause slope instability. The paper stresses upon the need of developing model that can predict spatial probability of landslide event and also calls for standardisation of methodology.

Landslide is one of the major natural hazards that are commonly experienced in hilly terrains all over the world. In India, there is a variation in the degree of landslide incidences in various hilly regions- high to very high in the Himalayas, high in the north-eastern hill ranges, high to moderate in the Western Ghats and Nilgiris and low in the hill ranges of Eastern Ghats and Vindhyans. Landslide zonation may be defined as type division of the area into homogeneous categories or domains and their ranking according to degree of actual/potential hazard caused by mass movements.

The first attempt of Macro Zonation was by Mazumdar in 1980, who attempted the zonation of the entire north-eastern region. Real impetus for the zonation of landslides was provided by the pioneering work of Seshagiri *et al.*, who carried out landslide zonation of the Nilgiris District, Tamilnadu and evolved a methodology. Landslide susceptibility values (LSV) were ascribed to the various parameters investigated and Landslide susceptibility Index (LSI). A five graded rating with increasing susceptibility was adopted.

The setting up Committee on the Coordinated Programme on the Study of Landslides by the Dept. of Science and Technology, Govt. of India is another important milestone in Landslide Zonation. The Committee adopted the approach paper by Anbalagan (1992) with some modifications. Anbalagan, in his approach, slightly modified the methodology of Seshagiri *et al.* He added lithology and relationship of structural discontinuity with slopes making it applicable for rock slopes also and renamed LSI as LHEF (Landslide Hazard Evaluation Factor) and LSV as TEHD (Total Estimated Hazard).

BIS (Bureau of Indian Standards) adopted a broad guideline for the preparation of landslide hazard zonation map, be it in the region like Himalayas, North Eastern Region, Central India, Nilgiris or Western Ghats. The parameters may not hold good for every region, as the problems are site specific, while in the areas except Nilgiris or Western Ghats, most of the slides are rockslides or either shallow sheet slides or debris flow involving the regolith. Most of the slides take place either during the monsoon or immediately after the monsoon. In most of the cases the critical equilibrium is rendered supercritical by intense rainfall, non-existent surface and sub surface drainage system in material of poor shear strength leading to high pore water pressure and triggering of slide.

Landslide incidences have not been considered as it is not a causative factor for slope destabilization but suggests manifestations of slope instability and hazard prone.

Erosion aspect of the hill slope is an important factor. Toe erosion by deep gully,

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small streams/*nalas* and large river destabilise slopes alarmingly. Condition of toe and influence of anthropogenic activities such as human interference in the developing hill slopes, blocking of drainage courses for plantation, housing on primary stream courses, etc. has to be taken into consideration.

Over the past several years, many areas in landslide prone terrain, mainly concentrated in the lesser Himalayas, have been investigated for the preparation of Landslide Hazard Zonation maps by the Geological Survey of India. DST has funded most of the projects at the academic institutions/ universities and research laboratories for carrying out landslide hazard zonation mapping in selected areas *viz.* parts of Chamoli Dist., U.P., Sukhidang area in Kumaon Himalayas, Lunglei District of Mizoram and parts of Western Ghats. A Mission Mode project on Landslide Mitigation, evolved by DST, focusing on Uttaranchal State, has also been initiated. (Anon., 2005).

There have been a number of other methodologies also adopted for landslide zonation. - e.g. utilising Slope mass rating (Sharma *et al.*, 1996), Geology of the area and morphometry (Chandra, 1996), Influence of Lithology (Chibber, 1999), and Nature of slope forming material, morphometric characters of slope segments (Sharda, 1999). Enumerable attempts have been made utilising remote sensing and GIS techniques.

Ideally, a slope instability hazard map should reflect information on - Spatial probability, Temporal probability, Type of landslide, Magnitude of landslide, Velocity of landslide and Run-out distance of landslide.

Temporal probability requires the analysis of potential triggering factors (earthquakes, threshold precipitation, etc.) in relation to the landslide and application of prediction models. Triggering factors, however, cannot be predicted. For this reason, landslide hazard models show spatial probability without regard to temporal probability.

Input data for prediction models often will vary from location to location, causing problems when trying to develop model for large areas. It has become necessary to evolve a consensus on the methodology that can to be adopted for landslide hazard zonation. Can the same methodology be adopted for the entire country or a set of site-specific methodologies to suit the site and involved factors? Since the temporal probability requires analysis of potential triggering factors, can it be eschewed? These and other related issues require urgent attention of the earth scientists.

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