

## LANDSLIDES - CONTRIBUTING FACTORS, INSTRUMENTATION AND EARLY WARNING SYSTEMS

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The hill country of Sri Lanka which covers most of the central and south-western parts of the island, frequently experiences landslide disasters. Significant loss of life and damage to property have been recorded in the past. Damages to houses, buildings, infrastructures and productive land, the development constraints and loss of production are some of the direct and indirect consequences of landslide disasters, which lead to socio-economic problems.

Often, it is possible to mitigate landslide disasters with proper management and control. In such an attempt to prevent or control landslides, it is most important to understand the mechanism of landslide phenomenon and to identify the causative factors.

Instability of slopes is affected by geological, hydrological topographical, climatic and weathering conditions. Human activities can instigate changes in these conditions. Among the natural causes are;

- (a) rainfall
- (b) melting snow
- (c) frost
- (d) seepage
- (e) drought
- (f) tectonic movements
- (g) earthquakes
- (h) erosion by waterways

of which some factors are not directly related to Sri Lankan conditions.

Causative factors attributed by human interference need to be given careful attention in dealing with landslides. Man's desire to develop or conquer the hilly areas and the environmental changes associated with the development activities, in many cases are the triggering factors of landslides.

Among such man-made causative factors are;

- (a) cutting and steepening of slopes
- (b) surcharge on slopes due to embankments, buildings etc.,
- (c) impact and vibrations due to eg. blasting
- (d) rapid changes in water table
- (e) filling of reservoirs
- (g) discriminated land use
- (h) changes in land use
- (i) land denudation
- (j) poor water management

In order to study the causes and mechanism of a landslide, it would be necessary to carry out investigations some of which are listed below;

- (a) topographical investigations
- (b) geological investigations
- (c) movement investigations
- (d) slip plane investigations
- (e) ground water investigations
- (f) soil investigations
- (g) meteorological investigations
- (h) historical studies

Short or long duration or continuous measurements of many parameters such as;

- (a) variations of piezometric pressures

- (b) magnitude, rate and distribution of surface and subslope displacements
- (c) Subsidence at crown, heave at toe
- (d) size and growth of cracks
- (e) tilting of slipped masses
- (f) normal and shear stresses within slide mass
- (g) rainfall, evaporation and runoff

become essential. Instrumentation is usually necessary to obtain such information. Instruments available range from highly sophisticated electronic devices to hand made simple gadgets. In a developing country like Sri Lanka the former type may be confined to research and only where necessary while simple appropriate instrumentation techniques are used in practical situations.

Another chief objective of instrumentation is to provide realistic assessment of the risks and hazards due to incipient instability of slopes and to provide timely warning. Simple yet manageable early warning systems will prove to be very effective in saving lives from landslide disasters.