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# Need And Urgency Of Landslide Risk Planning In Nilgiris Hills Of Tamil Nadu State

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**ABSTRACT**

Landslides are one of the most widespread concerns around the world, including in India. The Indian hill masses are prone to landslides, which range in severity from minor to severe. The Nilgiris district, located on the Western Ghats in southern India, has a High to Severe Landslide Hazard. Landslides have been more common in the Nilgiris in recent years. According to the findings, the eastern section of the research region is more vulnerable to landslides. Tourist attractions, banks, ATMs, educational institutions, hospitals, bus stops, and train stations are among the important infrastructure, transportation, and lifeline utilities that might be threatened in landslide-prone locations. During landslides, these are the elements that are at danger. The majority of landslides are caused by heavy rainfall, human and cultural activities, according to previous landslide inventories. Approximately 65 percent of key infrastructure and 36 percent of transportation and lifeline utilities in the research region are vulnerable to catastrophic landslides. The findings of this study may be used as first-hand knowledge by decision-makers and planners, as well as for future development operations in the Nilgiris district of India's landslide-prone areas.

**Keywords:** Landslide; hazard; mitigation; planning; Risk.

## I. INTRODUCTION

Landslides are defined as the downhill movement of consolidated and unconsolidated soils and rock materials from any geomorphic structure owing to natural or anthropogenic causes. Gravitational forces cause such motions or displacements. The presence of water substantially facilitates this occurrence by weakening and making the rocks and soil more movable. Landslides are one of the most common natural disasters in hilly areas, resulting in massive loss of life and property each year. The Nilgiris Mountain is a popular tourist destination in South India, attracting a huge number of visitors owing to its climate and scenery. Natural vegetation is being degraded as a result of development activities.

Landslides are one of the most dangerous risks that occur throughout India every year during the rainy season. Various hill ranges have varying degrees of landslide occurrence. The Nilgiris district of Tamil Nadu is classified as one of India's severe to very high landslide hazard-prone locations, according to the landslide hazard zonation atlas produced by the Building Materials and Technology Promotion Council (BMTPC). The hazard of landslides is well-known in the district.

In order to diminish the huge destructive potential of landslides and to minimise the resulting losses, the hazard must first be recognized, the risk assessed, and an adequate mitigation strategy devised at the national level. Increasing demands from all segments of society, as well as the desire to integrate isolated villages in remote highland areas into the mainstream, have resulted in an increase in all forms of building activity in these locations. It is necessary to design an effective framework for landslide hazard management in order to sustain the pace of growth and limit losses due to landslides.

## II. LANDSLIDES

The downward movement of masses of rock and dirt is referred to as a "landslide." Changes in slope gradient, increasing the load the land must carry, shocks and vibrations, change in water content, groundwater flow, frost action, weathering of shocks, removal or altering the kind of vegetation covering slopes are all variables that might trigger landslides. Landslide danger regions are found where the ground has particular qualities that increase the probability of debris moving downhill. These qualities include the following:

1. A slope that is more than 15%.
2. Landslides have been active or moved in the last 10,000 years.
3. Erosion induced by stream or wave action that has undercut or cut through a bank, making the surrounding area unstable.
4. The existence of snow avalanches or the possibility for them.
5. The presence of an alluvial fan, suggests that the area is vulnerable to debris or sediment flow.
6. The presence of impermeable soils combined with granular soils such as sand and gravel, such as silt or clay.

Other natural risks, such as rain, floods, and earthquakes, as well as human-made factors, such as grading, terrain cutting and filling, excessive development, and so on, can create landslides. Landslides can occur in developed regions, undeveloped areas, or any location where the terrain has been transformed for roads, housing, utilities, buildings, and other structures since the reasons causing landslides can be geophysical or human-made.

**Landslides are caused by a variety of factors.**

Landslides can be caused by a variety of factors. The following are some of the key causes:

1. Geologically Weak Material: Landslides can also be caused by flaws in the composition and structure of rock or soil.

2. Erosion: Erosion of the slope toe due to the removal of vegetation and the development of roads may enhance the terrain's sensitivity to sliding down.

3. Intense Rainfall: Landslides have been generated by storms that deliver intense rainfall for durations as brief as a few hours or that have a more moderate intensity for several days. Landslides are also caused by the heavy melting of snow in mountainous terrains.

4. Human excavation of the slope and its toe, slope/toe loading, reservoir drawdown, mining, deforestation, irrigation, vibration/blast, and surface water leaking

5. Landslides have been induced by earthquake shaking in a variety of geographical and geologic situations. The most common forms of landslides induced by previous earthquakes have been rock falls, soil slides, and rockslides from steep slopes involving relatively thin or shallow dis-aggregated soils or rock, or both.

6. The deposition of loose volcanic ash on slopes caused by volcanic eruptions is frequently followed by increased erosion and frequent mud or debris flows driven by heavy rainfall.

**Possibilities for risk reduction**

The following are landslide risk mitigation measures:

1. Hazard mapping identifies locations that are vulnerable to slope failure. This will aid in the prevention of establishing settlements in certain places. These maps will also be used to develop mitigating measures.

2. Degraded natural vegetation on upper slopes will be reforested with appropriate species.

3. Any development activity in the area should be undertaken only after a thorough assessment of the area has been completed.
4. When building roads, irrigation canals, and other structures, special care must be taken to prevent clogging natural drainage systems.
5. It should be made essential to avoid settling in the risk zone at all costs.
6. Relocate communities and infrastructure that may be in the landslide's path.
7. Buildings must not be constructed in regions with more than a particular degree of slope. To prevent land from sliding, retaining walls can be constructed (these walls are commonly seen along roads in hill stations). These are built to prevent minor and secondary landslides from occurring along the toe part of bigger landslides.

**III. METHODOLOGY**

The current study used a methodology known as the community vulnerability assessment tool (CVAT), which may be used by communities to evaluate which hazards may pose a threat to them and how vulnerable they are to those threats (CVAT 1999). To quantify the danger and susceptibility, this program uses environmental, social, and economic data. It's a simple overlay method in a geographic information system (GIS) that lets you assess a community's relative risk or susceptibility to a set of current hazards. The CVAT method is made up of seven main parts, including:

(1) hazard identification and prioritization;

(2) hazard analysis;

(3) critical facility analysis;

(4) social analysis;

(5) economic analysis;

(6) environmental analysis; and

(7) mitigation opportunities analysis.

The current research, on the other hand, concentrates on the danger and primary analysis of vital facilities, which will be the principal usage during any significant disaster. The study is focused on landslide dangers since the current study location has a history of landslide threats. Figures 1a, b shows the detailed approach, which included hazard analysis and important facility analysis. In addition, in Section IV of this work, the matrix used to quantify hazard and vulnerability is explained separately.

A database was developed using the locations of historical landslide histories, existing landslide hazard maps, and extant essential and lifeline facilities. To overlay all of the data sources, a GIS was employed. The GSI's landslide hazard map was utilized in this investigation for the landslide danger. The important facilities were divided into two groups for the geographical vulnerability analysis: vital facilities and high potential loss facilities. With minimal field tests, important facilities, transportation, and vital utilities such as tourist attractions, banks, ATMs, educational institutions, hospitals, bus stops, and train stations were identified using Google Maps and the Geofrik database. To undertake analysis, the hazard and vulnerability maps were overlaid in a GIS platform. The current research takes a quantitative approach.

## IV. RESULTS AND DISCUSSIONS

Understanding the conditions and processes that influence previous landslides in the region of interest is necessary for interpreting the likelihood of future landslides. The district of Nilgiris has a long history of devastating landslides. In the Nilgiris, landslides are most common from October to December. The majority of these landslides were caused by the district's high, intense rains.

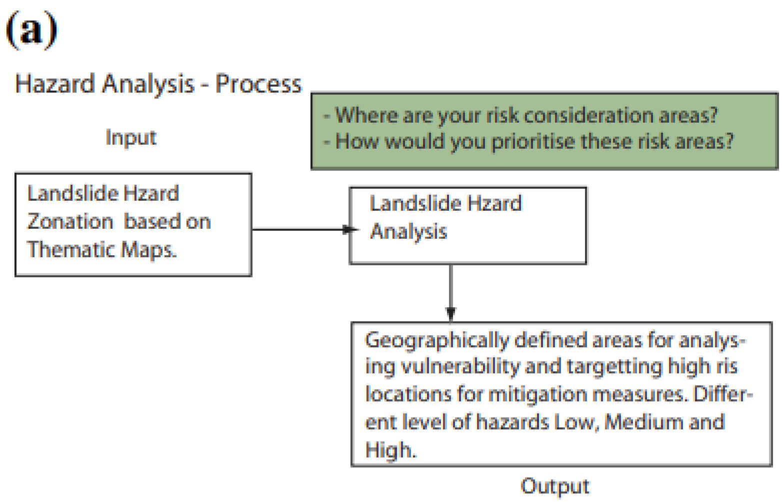


**Figure 1(a): Process of hazard analysis**

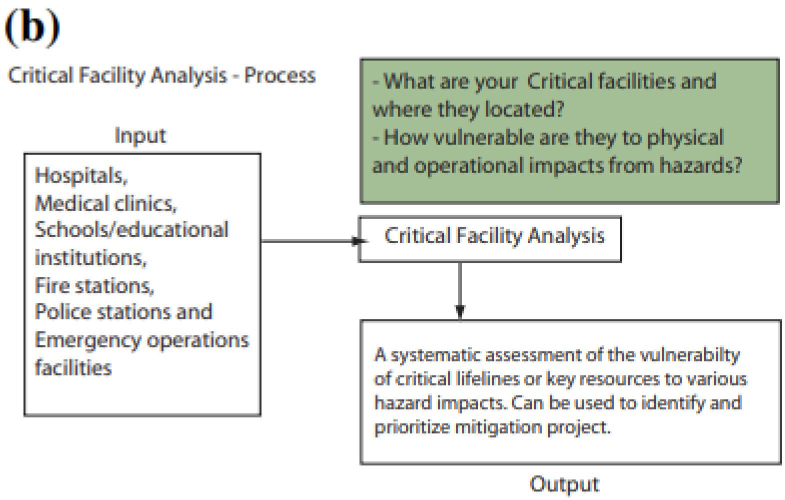


**Figure 1(b): Process of vulnerability analysis**

Heavy rains in November 1891 produced many landslips on the Coonoor ghat, causing extensive damage to the Kotagiri–Metuppalayam route. On November 5, 1978, several people died in Ooty due to home collapses, landslides, and drowning. During the 12–19 November 1979, there was continuous severe rain, with 102.2 mm in Coonoor and a huge landslide at Selas, burying a home and two women and three children. On November 11, 1993, another 'cloud burst' occurred in the upper reaches of the Marappalam in Coonoor Taluk, destroying roughly 18 cottages below the road and washing away the Coonoor MTP ghat road for about 1 km. For more than a fortnight, road traffic was halted. Twelve individuals were killed, and 15 were reported missing. Two buses were said to have swept away 21 people. A 300-meter segment of a major roadway and a rail line were shifted. Several landslides occurred early on November 14, 2006, killing one person and wounding three others, interrupting traffic on National Highway-67 and closing the mountain rail track between Mettupalayam and Coonoor.

**Figure 2: Lovedale Road view from Coonoor road on 11 November 2009 at Ooty**

**Figure 3: Severely damaged road and communication network at Ooty**

- **Mapping landslide hazard**

Landslide zoning for land-use planning is often needed at the local government level for urban development planning, but state governments may demand it for regional land-use planning or disaster management planning. The Government of India's Building Materials Technology Promotion Council released a 1:6 million scale small-scale landslide danger map of India. The Landslide Atlas 2003's landslide hazard zonation map of India is based on a rigorous review of the literature, information on the severity and geographical distribution of landslides, and the development and processing of thematic maps at a small scale of 1:6 million using a GIS platform. The atlas' maps, on the other hand, have limits. This atlas provides a regional overview of the Nilgiris district's many danger categories. In August 1979, the GSI began thorough geological investigations of the landslides in partnership with the State Geology Branch of the Tamil Nadu government. For the first time in the country, they have created a regional landslide susceptibility map for the Nilgiris district.

Various approaches for landslide hazard zonation mapping were available globally. These approaches may be divided into two categories: (1) LHZ mapping without taking into account landslide occurrences, and (2) LHZ mapping taking into account landslide incidences. Some organizations/individuals have adopted a third methodology known as data-driven statistical/mathematical methodology, such as logistic regression, discriminant analysis, and artificial neuron network (ANN), which also takes landslide incidences into account, since the availability of GIS technology in the late 1980s. The approach for creating a landslide danger zonation map is carried out on a macroscale, and it is mostly based on numerical superimposition. The following six primary causative elements (lithology, structure, slope morphometry, relative relief, land use/land cover, and hydro-geological conditions) causing slope instability have been taken into account independently or interdependently in this technique. For the themes, lithology (2), structure (2), slope morphometry (2), relative relief (1), land use/land cover (2), and hydro-geological condition (2), each element was assigned a maximum numerical landslide hazard evaluation factor based on its assessed relevance in producing slope instability (1). Each area's landslide susceptibility index (LSI) was computed, and the areas were graded based on the total LSI values. The region was classified into five zones, ranging from I to V in terms of landslide vulnerability. The least vulnerable zone is zone I, while the most susceptible zone is zone V.

- **Landslide vulnerability mapping**

During the lending season, an average influx of roughly 15,000 people per day is reported. The visitors that come to town are a diverse group. In a given year, around 29,000 international visitors visit. An estimate of risk can be obtained by determining the degree of susceptibility of buildings and lifeline utilities. Although building vulnerability is measured in terms of the degree of loss, absolute vulnerability ratings range dramatically.

As a result, vulnerability analysis is an integral part of catastrophe mitigation and one of the assessment process's links. The built environment, key infrastructure (essential and high potential loss), and transportation and lifeline utilities are all analysed in the Nilgiris district's spatial vulnerability. The vulnerability of essential infrastructure in landslide-prone locations may be assessed and reduced by mapping them. Essential facilities (hospitals, medical clinics, schools/educational institutions, fire stations, police stations, and emergency operation facilities) and high potential loss facilities (hospitals, medical clinics, schools/educational institutions, fire stations, police stations, and emergency operation facilities) are divided into two categories. Residential, commercial, educational, and communicational areas account for 15.71, 1.69, 2.19, and 5.69 percent of the total area, respectively. In addition, water bodies make about 1.07 percent of the total area.

Highways, railway stations, bus stops, ports, and public utility systems such as potable water, wastewater, natural gas, crude and refined oil, electric power, and communication infrastructure are among the transportation systems. Critical infrastructure, transportation, and lifeline utilities that might be harmed by landslides in locations with very high to severe landslide hazard levels have been identified. (Table 1).

**Table 1: Vulnerable facilities fall under high-to-moderate hazard areas in the Nilgiris**

| SI. no. | Facilities | Total | Number of units falls under high-to-moderate hazard areas | Percentage (%) |
|---|---|---|---|---|
| 1 | Essential | 114 | 24 | 21.0 |
| 2 | Lifeline | 96 | 7 | 7.3 |
| 3 | Transportation | 20 | 6 | 30.0 |
| 4 | Villages/towns | 42 | 7 | 16.7 |

## V. CONCLUSION

In both the northeast and southwest monsoons, the pattern and nature of landslide occurrence in the Nilgiri hills is similar. Landslides may occur on any slope, whether it is vegetated or non-vegetated, steep or mild. Ghat slopes with inward sloping litho units appear to be rather safe in comparison. The Nilgiri landslides are characterised by an increase in populations at hilltops, as well as slope and rock dipping outwards from the ghat sections, continual flooding after heavy rains, and clay layering intercalation in the weathered zone. In this case, the best course of action is to minimise new construction in high-risk landslide zones, limit current usage rights to rebuild, and restrict building use. The most feasible solution is to minimise future development and to ensure that the type of building (building type) used is appropriate for the amount of danger posed, with landslide hazard zones clearly marked on district plan maps.

## REFERENCES: -

1. A. Leventhal and G. Withycombe, “Landslide risk management for Australia,” The Australian Journal of Emergency Management, vol. 24 No. 1, February 2009.

2. APEGBC (2010) Guidelines for legislated landslide assessments for proposed residential developments in BC, Association of Professional Engineers and Geoscientists of British Columbia. Revised May 2010

3. G. P. Ganapathy, K. Mahendran, and S. K. Sekar, “Need and urgency of Landslide Risk Planning for Nilgiri district, Tamil Nadu State, India,” International

4. Journal of Geomatics and Geosciences, vol.1, no. 1. 2010, pp29-40, 2010

5. Ganapathy GP, Rajawat AS (2015) Use of hazard and vulnerability maps for landslide planning scenarios: a case study of the Nilgiris, India. J Nat Hazards 77:305–316

6. GSI (2013) Landslide investigation, standard operation procedure (SoP), Mission IV, Geological Survey of India, p 19

7. Jaiswal P, van Westen CJ, Jetten V (2011) Quantitative estimation of landslide risk from rapid debris slides on natural slopes in the Nilgiri hills, India. Nat Hazards Earth Syst Sci 11:1723–1743

8. Kayastha P, Dhital MR, De Smedt F (2012) Landslide susceptibility mapp

9. Nalina P, Meenambal T, Sathyanarayan SR (2014) Slope stability analysis of Kallar-Coonoor hill road stretch of the Nilgiris. J Comput Sci 10:1107–1114

10. WSDOT, “Road Side Manual, M25-30.01,” Washington State Department of Transportation Development Division, Design Office, Olympia, WA 98504-7329, pp.314, July 2012.