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IDENTIFICATION AND DELINEATION OF THE LANDSLIDE HAZARD ZONATION USING GEOSPATIAL TECHNIQUES: A CASE STUDY OF THE DINDIGUL DISTRICT, TAMIL NADU

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ABSTRACT:

Landslide is one of the natural disasters occurring in hilly areas. It is caused due to tectonic activities, erosion, weathering, pore pressure increases in weathered soil etc. In India,most of the landslides accrues inthe Himalayan Mountainin the North because of tectonic activities, in thenorth-eastern hill ranges in the eastern part due to tectonic activities, fluvial and weathering activities, in eastern ghats and central part of India by weathering processes, and western ghats in the southern portion caused due to weathered zone thickness and pore pressure increases during the rainy season. Kodaikanal is one of the hilly cities attracts tourists from different parts of the state country and abroad. The city reached the plain by two ghat road sections, one from vathalagundu and another from Palani. During the monsoon season, these two ghat roads are seriously affected by landslides. In this scenario, the present study attempted to identify the vulnerable zones for landslides, using various geosystem parameters like Geology, Lineament/faults, Geomorphology, Land use/Landcover, drainage systems, slope etc.

Keywords: Remote Sensing, Landslide Zonation, Geosystem Parameters.

INTRODUCTION:

Landslide is one of the most common natural hazards it has wide influence. This corresponds to damage in the road sector and hilly terrain in residential zones. Landslide Hazard zone mapping is significant to predict the possible vulnerable regions. With the development of remote sensing techniques and advanced data analysis methods in GIS, modern modelling techniques are becoming more efficient, merging all the data sources to predict the location of landslide hazard zonation. In this research, GIS tools were used in parts of the Dindigul District to collect detailed geology, slope, drainage density, soil, lineament, lineament density, geomorphology, land use/land cover and drainage details and to suggest suitable methods for landslide hazard zonation mapping. The data analysis techniques based on GIS offer ways and means to incorporate different spatial data. This research has utilised GIS software to understand slide processes in the Dindigul district.

STUDY AREA:

The study area (Fig. 1) is situated in the Dindigul district, which is part of mountainous terrain in the Tamil Nadu Western Ghats, with an area of 1039.46 km2. Around 77° 14' 26"and 77° 45' 28" E longitudes and 10° 6' 25"and 10° 26' 54" N latitudes it is geographically located

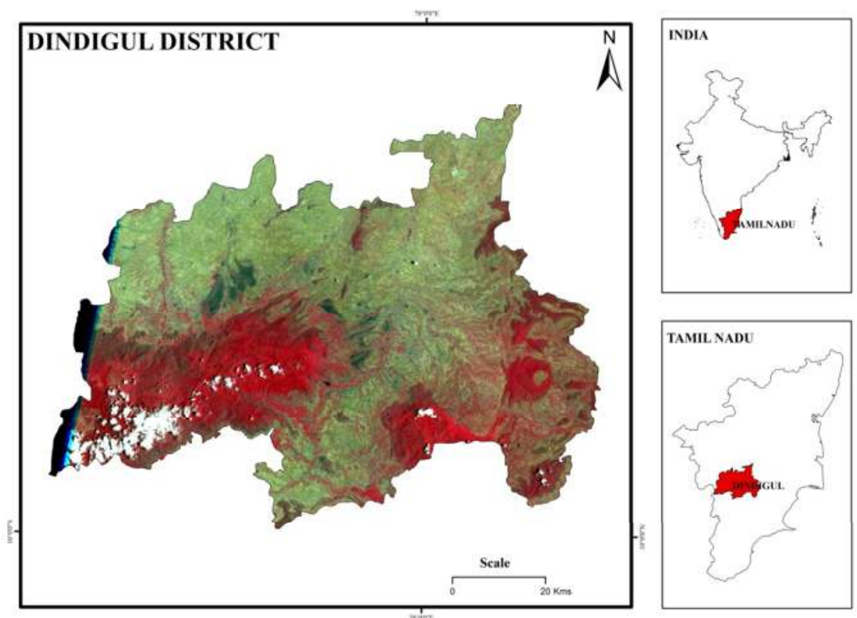

Figure 1. Study area map: Dindigul District

METHODOLOGY:

The database has been prepared for the various parameters that are used in the assessment. Parameters like: Geology, Slope, Geomorphology, Drainage,

Drainage density Map, Soil, Lineament Map, Land use / Land cover Map, Lineament density have been prepared in GIS software.The following methodology chart illustrates the steps and processes used to achieve the aim of this research.

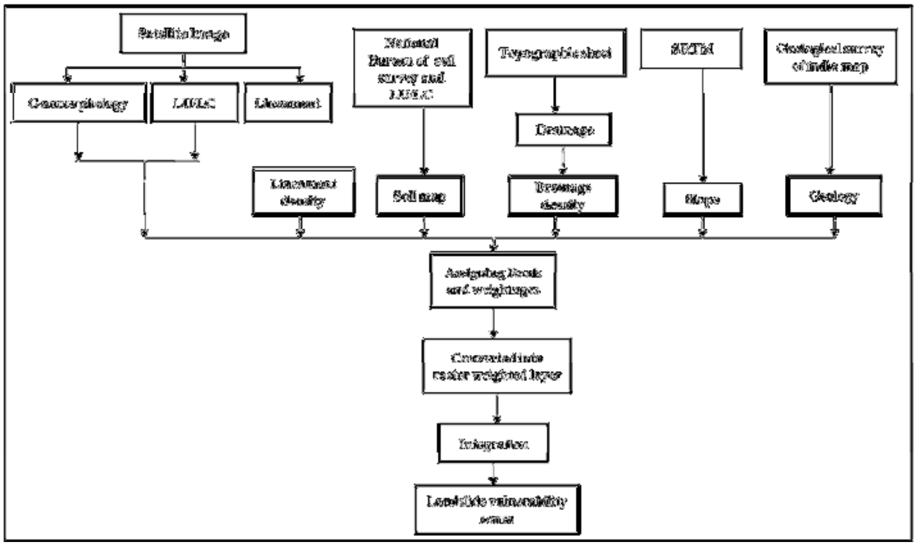

Figure 2. methodology used for identifying Landslide vulnerable zones

ASSIGNING WEIGHTS AND WEIGHTED RASTER LAYER:

A weighting rating is based on the relative importance of the different causative factors resulting from field expertise. For significance, the numerical rating was allocated to the variables in this scheme on a scale of 1-9.

Weights were also applied to the groups of variables on an ordinal scale of 0-9, where higher weights suggest a more significant impact on the frequency of landslides. The scheme multiple variations using different combinations of weights were suitably adjusted. The specific class in each theme is assigned a knowledge-based ranking. Then each thematic layer is assigned a weight based on its impact on the occurrence of landslides—the rating scheme listed below is given in the table.

Various variants of the scheme using different weight ratios were adjusted accordingly. The knowledge-based ranking is applied to the specific class within each theme. Then each thematic layer is assigned a weight based on its effect on the occurrence of landslides. The ranking scheme is shown in the table below. Lineaments are an essential factor because the intensely fractured and joined structure shows more significant potential for landslides. Here the full weight of the buffer is set to 100 m. Slope and angle have an indirect impact on unstable slopes. The slope usually facing south has lower vegetation than the slope facing North; thus, erosion activity is comparatively more significant in the former case. South-and east-facing slopes were considered to have more landslides based on the distribution of landslides. Considering these facts and observationsin the field, weights were given accordingly for slope and aspect class.

Weights have been given to different parameters and their classes based on each parameter's effect on landslide priority and rank. That is shown in the below table.

Table 1: Landslide vulnerability ranks & weightages of various classes of parameters

SI.no	Geology classes	Rank	Weightage	Total weightage
1	Anorthosite	9	2	18
2	Charnockite		1	9
3	Gneiss		1	9
4	Granitic/Acidic rocks		1	9
5	Magmatic complex		2	18
6	Quartzite		2	18
7	Sand and Slit		2	18
8	Limestone		1	9

SI.no	Soil classes	Rank	Weightage	Total weightage
1	Alffi soil	6	5	30
2	Enti soil		3	18
3	Forest unsurvey		2	12
4	Hill soil		3	18
5	Incepti soil		1	6
6	Reservoir		1	6
7	Verti soil		4	24

SI.no	LU/LC classes	Rank	Weightage	Total weightage
1	Town and cities	7	2	14
2	Rural settlements		3	21
3	Crop land		0	0
4	Fallow		0	0
5	Plantation		1	7
6	Evergreen / semi evergreen		2	14
7	Deciduous forest		3	21
8	Forest plantation		1	7
9	Scrub forest		1	7
10	Forest blank		3	21
11	Other forest		2	14
12	Marshy/swampy land		0	0
13	Land without scrub		0	0
14	Sat affected		0	0
15	Gullied		2	14
16	Land with scrub		0	0
17	Barren rocky		0	0
18	River / stream		0	0
19	Reservoir/lake/tank		0	0
20	Grass land		0	0

SI.no	Drainage Density class	Rank	Weightage	Total weightage
1	Very low	7	5	35
2	Low		4	28
3	Moderate		3	21
4	High		2	14
5	Very high		1	7

SI.no	Geomorphology	Rank	Weightages	Total weightages
1	Bajada	8	0	0
2	Deflection slope		5	40
3	Denudational hills		2	16
4	Hills and plateaus		3	24
5	Pediment		0	0
6	Pedi plain		0	0
7	Pediment zone		0	0
8	Plateaus		1	8
9	Rivers		0	0
10	Structured his		5	40
11	Valleys		1	8

SI.no	Slope classes	Rank	weightage	Total weightage
1	0-3	9	5	9
2	3-15		4	18
3	15-25		3	27
4	25-40		2	36
5	More than 40		1	45

SI.no	Lineaments classes	Rank	Weightage	Total weightage
1	Very low	8	1	8
2	Low		2	16
3	Moderate		3	24
4	High		4	32
5	Very high		5	40

INTEGRATION OF LANDSLIDE VULNERABILITY ZONE:

The distribution of current landslides (field data) was used to test the landslide hazard zone map. LHZ map digitised and overlaid the landslide spot. Such maps are prepared for each LHZ class as shown in Figure 10 in GIS-based analysis, Comparison of the present area and active landslide incidence. The extremely high danger region' covers only about 20 per cent of the total area but has a very high landslide incidence level (34 per cent). In addition, the level of landslides in the high danger zone is also high (26%) relative to the region (25%). The moderate region comprises 13 per cent of the country and has 13 per cent of the occurrence of landslides. Low and very low areas occupied 42 per cent of the study area and included only 24 landslides, comprising 25 per cent of the studied landslide. It is assumed that the landslides may be more controlled by local effects in Very mild, high and moderate danger zones.

Table 2. Distribution of the landslide vulnerability zones

SI.no	Area in sq km	Zones
1	24.7	Very high
2	663.5	High
3	1,293.4	Moderate
4	2,214.6	Low
5	1,531.2	Very low

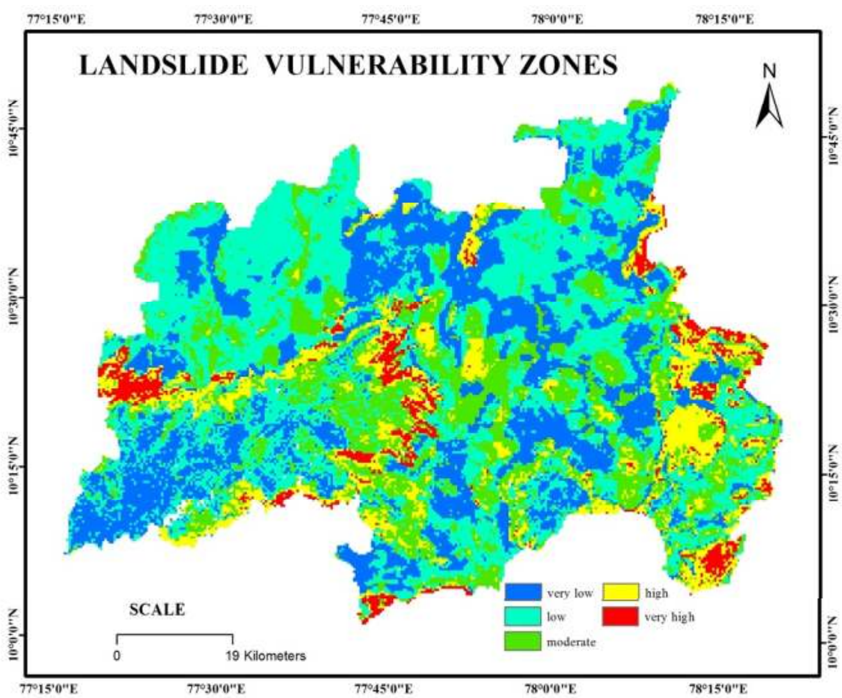

Figure 3. Landslide Vulnerability Zones in Dindigul District

CONCLUSION:

The numerical classification system is an appropriate technique for indexing landslide hazards. Remote sensing and GIS techniques have been used in the present study to create thematic layers and build a zonation map of Landslide hazards. Through reviewing the outcomes, the rating system process has been developed iteratively. However, the rating scheme was not suitable for other locations because the factor-involving landslide differed area by region. Finally,the vulnerability mapping to landslides is categorised into five different zones. The result was confirmed based on the distribution of the landslides.

The landslide Hazard Zonation maps aid decision-making, thus enforcing the construction of a hilly area. Nonetheless, the map quality improves to incorporate more variables and maps correlates with the area. In addition, any changes in the natural environment and human interference should be monitored regularly in the landslide danger zone region of the map.

REFERENCES:

1. Beaty C.B., Landslides and slope exposures, Journal of Geology, 64, 70-74 (1950)
2. Bengt B.B. and Torbjorn S., Landslides in sensitive clays, Proceedings, International Symposium on Landslides, New Delhi, 2, 39-61 (1980)
3. Christaras B., Slope stability investigations in relation to the neotectonic conditions along the South Western coast of Athos Peninsula (N.Greece) - the case of Simonos Petra Monestry, Proceedings of 7th International IAEG Congress, Rotterdam, 1577-1583(1994)
4. EmbletonC., Federici PR and Rodolfi G., Geomorphological hazards characteristics and Human response, Geogr.Fis.Dinam., Quarterly supplement, 11, 1-31(1989)
5. Varnes D.J., Types of slope movements, In Landslides: Analysis and control, Editors, Schuster R.L. and Krizek R.J., TRB Special Report, 176(1978)
6. Yudhbir, Engineering geologic aspects of earth structures, State - of - art - Report, IGS conference on Geotechnical engineering, 19-21 (1978)

7. Zhang X., Phillips C. and Marden M., Acomparison of Earth flow movement mechanism on forested and grassed slopes, Raukumara peninsula, North Island, New Zealand, Geomorphology, 6, 175–178(1993).
8. David, R., S.B. Godschalk and B. Raymond (2003). Public participation in natural hazard mitigation policy formation: challenges for comprehensive planning, Journal of Environmental Planning and Management. 46, 733-754.
9. 10. Rapp, A. and R. Nyberg (1981). Alpine debris flows in northern Scandinavia. GeografiskaAnnaler, vol.63A, pp.183–196.
10. 11. Varnes D.J., Types of slope movements, In: Landslides: Analysis and control, Editors, Schuster R.L. and Krizek R.J., TRB Special Report, 176(1978) 19
11. Remondo, J., A. González-Díez, J.R. Díaz De Terán and A. Cendrero (2003). Validation of landslide susceptibility maps; examples and applications from a case study in Northern Spain. Natural Hazards. vol.30, pp.437–449.
12. 13. Lin, P.S., J.Y. Lin, H. C. Hung and M. D. Yang (2002). Assessing debris flow hazard in a watershed in Taiwan. Engineering Geology, vol.66, pp.295–313.
13. De Joode, A. and van Steijn (2003). PROMOTOR-df: AGISbased simulation model for debris flow hazard prediction. In Rickenmann, & Chen (Eds.), Debris flow hazards mitigation: Mechanics, prediction and assessment. Rotterdam' Millpress, pp. 1173– 1184.
14. Gupta, R.P. (2003). Remote Sensing Geology, second ed. Springer-Verlag, Berlin, Heidelberg, Germany, pp. 655.
15. Sarkar, S and D.P. Kanungo, 2004, An integrated approach for landslide susceptibility mapping using remote sensing and GIS, Photogrammetric Engineering & Remote sensing , 70(5), 617-625.
16. 17. Sinha, B.N., R.S. Varma, and D.K. Paul, 1975, Landslides in Darjeelings District (west Bengal) and adjacent Areas, Bulletins of the Geological Survey of India, Series B, No. 36, Calcutta, India, 45p.
17. Dhakal, A.S., T. Amada, and M. Aniya, 2000, Landslide hazard mapping and its evaluation using GIS: An investigation of sampling schemes for a grid-cell based quantitative method, Photogrammetric Engineering & Remote Sensing, 66(8):981- 989.