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Topographic Data Base For Landslides Assessment Using GIS In Between Mettupalayam-Udhagamandalam Highway, South India

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Abstract-Landslide is a common geo-hazard, can result in huge economic losses and enormous casualties in mountainous regions. Analysis of Landslide is a complex which involving multiples of factors and it need to be studied systematically in order to locate the prone zones for landslides. The topographic features play an important role in deciding the areas prone to landslides. In this study, an attempt has been made to derive the landslide cause behind topographic features such as Drainage, Slope and Geology of Mettupalayam- Udhagamandalam road sector lengths of 47 Kilometers. The Survey of India toposheets on 1: 50000 scales were used to extract contours in 20m intervals. The all mentioned parameters were analyzed in GIS by assigning weightages and ranks to prepare the landslide Vulnerability zone map for the study area. The landslide vulnerability map indicates the whole study area which has been divided into three zones as High, Moderate and Low Landslide Vulnerability Zone. Through the landslide hazard zonation map, it can finale that the low landslide zones are the prior for higher landslide vulnerability in the study area. This research would be a basis of landslide vulnerability and hazard assessment.

Key terms- landslides, landslide vulnerable zone, GIS, hazard assessment

I. INTRODUCTION

Landslide hazard is one of the most common natural hazards, which has wide influence and strong destroys leading to tremendous economic loss every year. It is taken as a stratagem consideration in many countries all over the world. Landslide Vulnerability zonation is a very important content of landslide hazard prediction modeling. With the development of advanced data analysis tool, such as remote sensing and GIS technology, new modeling theories integrating all the data sources are provided for landslide hazard zonation (David R, 2003; Oštir. K., 2003).

Debris flows are a type of landslide events common to mountainous areas (Innes, 1983), usually described as the rapid movement of blocky, mixed debris of rock and soil by flow of wet, locate mass (Rapp & Nyberg, 1981), and as a rapid mass movement similar to viscous fluids (Varnes, 1978). Landslide susceptibility is in fact the relative spatial probability of a new landslide occurring in the future (Remondo et al., 2003) and its assessment in a given area should normally be based on the analysis of slope behavior and landslide occurrence in the recent past.

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Furthermore, it is generally assumed that areas sensitive to debris flow initiation require the occurrence of steep and bare terrain units where large amounts of unconsolidated material are present (de Joode & van Steijn, 2003; Lin et al., 2002). The GIS-based data analysis procedures provide ways and means to integrate diverse spatial data (Bonham-Carter, 1994; Carrara and Guzzetti, 1995; DeMers, 2000; Gupta, 2003). The advanced GIS computational tools offer numerous advantages in multi-geodata handling, as is evident from various geoenvironmental studies. However, these studies lack spatial level comparison of GIS derived maps. The focus of this paper is on comparative evaluation of spatial maps through different approaches.

II. STUDY AREA

Mettupalayam – Udhagamandalam road sector of length 47 kilometers has taken as the study area to identify the landslide prone areas. The Survey of India (SOI) Toposheets numbered 58 A/15 and 58 A/11 were used to preparation of base map at a scale of 1: 50000. The road was buffered to 10km on either side using ArcGIS software. The area encompasses a total of 982 square kilometer and bounded between 76° 43’ 30’’ and 76°54’ E longitudes and 11° 19’ 30’’ and 11° 30’ N latitudes. The elevation ranges between 280 m and 2620 m above MSL. The base map is shown in Fig.1.

III. METHODOLOGY

The Survey of India (SOI) Toposheets were used in the preparation of base map like Drainage, Drainage Buffer map, slope & Slope Aspect map at a scale of 1: 50000. Since this study is concerned with the use of GIS methods to identify landslide vulnerability zones, it involves the generation of thematic maps related to the causative factors. These thematic maps are in turn assigned ranks and weights and then analyzed in GIS domain shown in Fig: 2. The final landslide vulnerability map was prepared from various thematic maps by applying different weightages in GIS environment. The landslide vulnerability map indicates the whole study area has been divided into three zones as High Landslide Vulnerability Zone, Moderate Landslide Vulnerability Zone and Low Landslide Vulnerability Zone.

IV. RESULTS AND DISSCUSSION

A. Influence Of Drainage On Landslides

The under-cutting action of the river may induce instability of slopes. Hence, some of the detailed drainages were digitized to include the effect of this causative factor and buffered.

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The drainage with 50 m buffered map (Wang Jian et al. 2009) (Fig. 3 and Table1) of the study area is predominantly Dendritic pattern characterized by rapids, cascades and waterfalls. In this pattern, the junctions between streams become more acute in angle. Generally, the dendritic pattern indicates lack of structural pattern and relatively uniform bedrock. The drainage is northerly in the northern and western portions occupied by sigur and Mukurti Rivers and KrothaHalla. In the southern portion drainage is mainly by Bhavani River which flow south wards. In the eastern portion, Kateri River flows eastwards into the Bhavani river. A few East–West oriented streams may be controlled by structure shown in Fig. 3

Table.1 Result of Drainage buffer

Sl. No.	Drainage Buffer in (m)	Area in km^2	Area in Percentage	Ranking
1	< 50 m	135.73	31.80	3
2	> 50 m	883.45	86.68	1

B. Influence Of Slope & Aspect On Landslides

Slope is a very important parameter in any landslide vulnerability mapping. If the slope is higher then there is a chance of occurrence of landslide. Slope map has been created from the toposheets. The slope map for the study area was categorized into four classes based on its slope angle as gentle slope, moderate slope, steep slope and very steep slope and is shown in Fig.4. The area covered by each categories of slope along with its influence on landslide susceptibility is given in Table 2.

Table .2 Ranking for Slope

Sl.No.	Slope Class	Area in km^2	Area In %	Rank ing
1	0 – 20	976.92	95.85	1
2	20 - 30	32.40	3.18	2
3	30 - 50	7.32	0.72	3
4	>54	2.53	0.24	3

C. Influence Of Geology On Landslide

Geology map is prepared from the geological survey of India mineral map on a scale 1:50,000. Mostly cover by Charnockite and unclassified gneiss. Some granitic rocks also present in the study area. Chamockite group of rocks contain Black hypersthenes is accessory 1 mineral it play an important role the triggering the landslide Hypersthenesare created dentritic drainage pattern along with lineaments and bedrocks. The geology map the study area is shown in figure 5 and Table 3.

Fig.5 Geology Map

Table.3 - Ranking for Geology

Sl.No	Geology	Area in km^2	Area %	Ranking
1.	Dolerite	14.98	1.47	1
2.	Charnockite	643.16	63.11	3
3.	Magnetite quartzite	1.18	0.12	2
4.	Laterite	0.81	0.08	1
5.	Granite	7.73	0.76	2
6.	Pyroxene granulite	0.32	0.03	2
7.	Unclassifide gneiss	351.07	34.45	2

V.GIS ANALYSIS

The Weights And Ratings Of Each Data Layer

The final landslide vulnerability map was prepared from various thematic maps like Drainage Buffered Zone map, Slope map, and Geology map by applying weighted overlay analysis in GIS environment shown in Fig.6. Thus the landslide vulnerability map indicates the whole study area has been divided into 3 zones and the weights have been according to the table 4 (Wang Jian et al. 2009)

Table 4 - Landslide Hazard Zone (LSHZ) Results

Sl.No.	Class of LSHZ	Area in km^2	Ranking
1	HLHZ	19.52	3
2	MLHZ	18.87	2
3	LLHZ	980.79	1

VI. CONCLUSION

The obtained information value weightage for the class are summed up to produce the output map representing the spatial distribution of the landslide vulnerability zone. From this study it is interpreted that the distribution of landslides is highly governed by a combination of geoenvironmental conditions,

- The Drainage buffer zone is found to be highly vulnerable zone in **less than 50°.**
- Slope In greater part of the study area slope under **(0° – 20°) Gentle slope** category
- The geology of the study area under **Dolerite and Laterite.**
- Finally the landslide vulnerability zone of the study area under **low landslide zone.**

The GIS-based methodology for integration above parameters dataset seems to be quite suitable for developing a landslide vulnerability zonation map. This research would be a basis of landslide vulnerability and hazard assessment.

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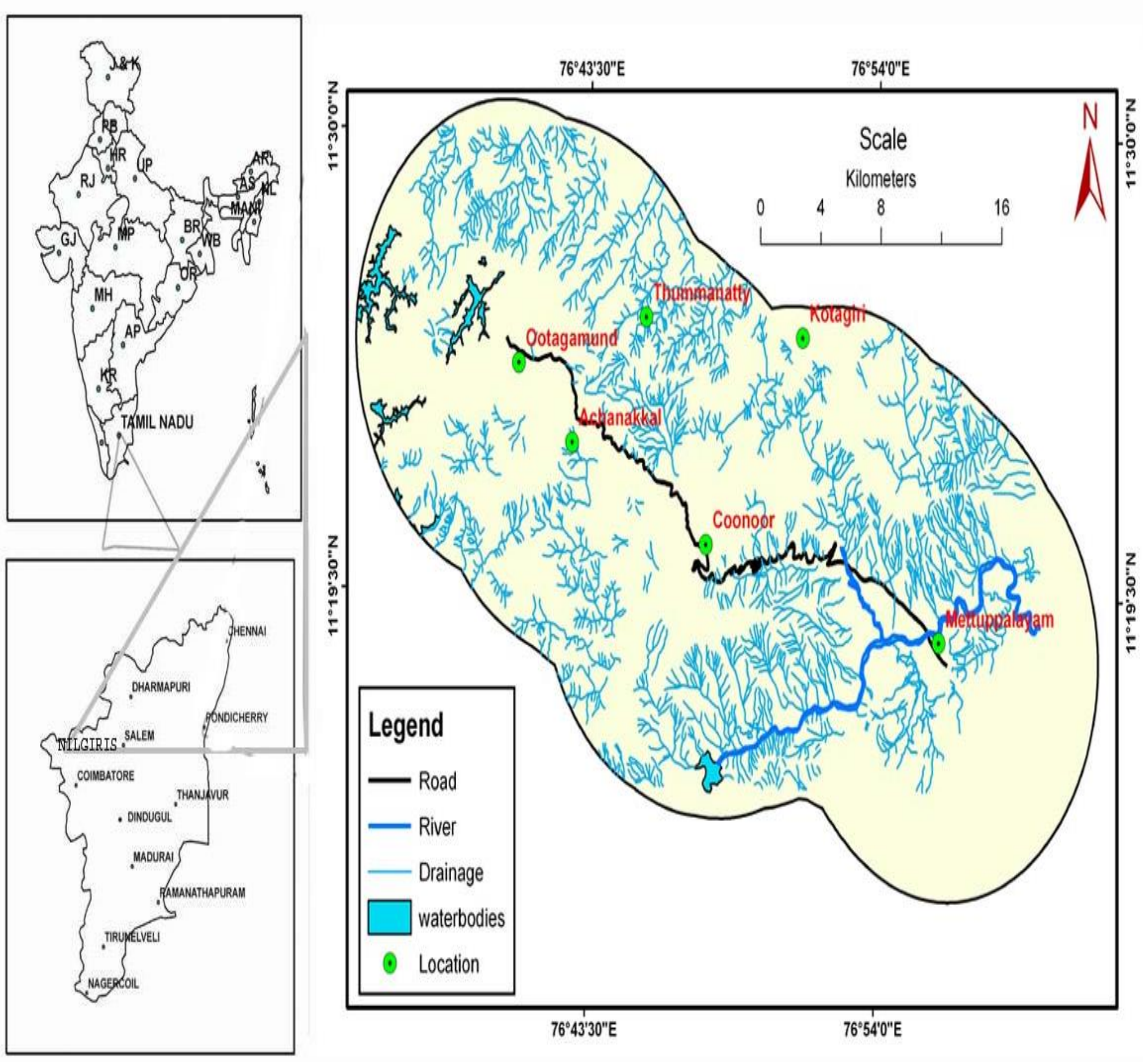

Fig.1 STUDY AREA

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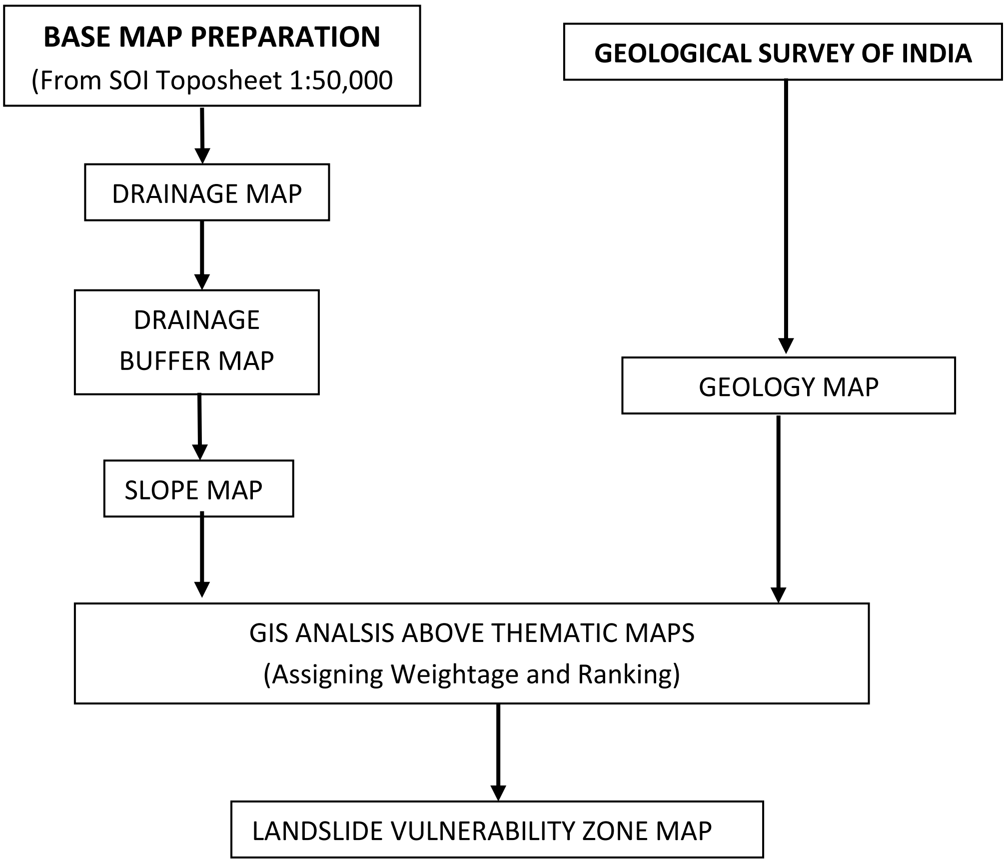

FIG.2 METHODOLOGY FLOW CHART

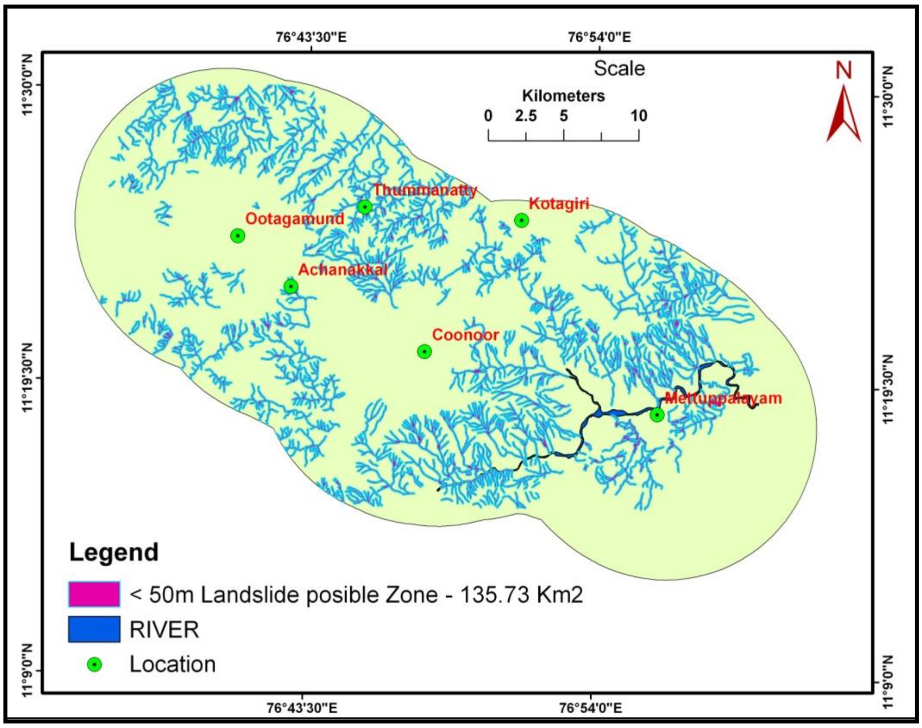

FIG.3 DRAINAGE BUFFER MAP

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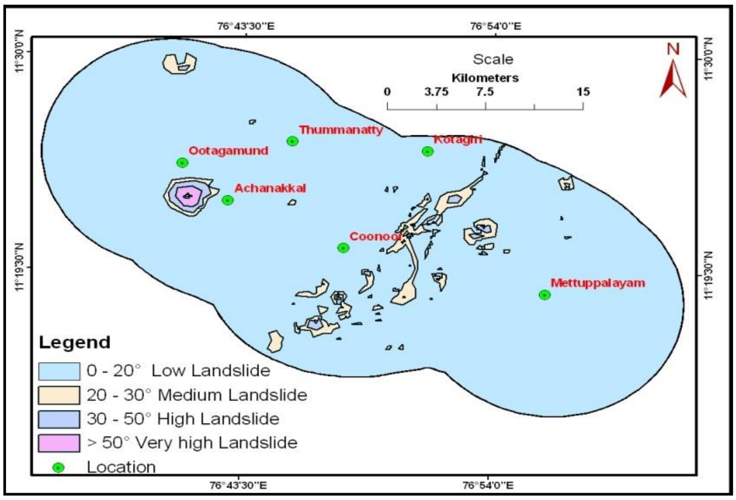

FIG.4 SLOPE MAP

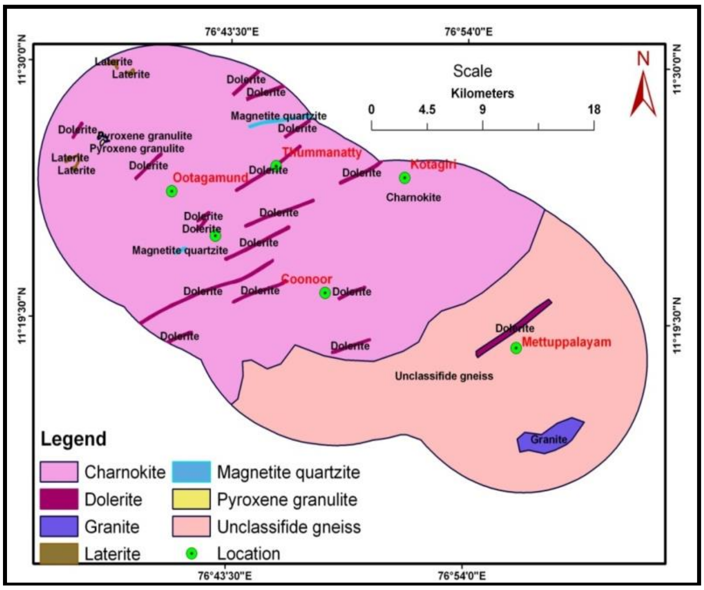

FIG. 5 GEOLOGY MAP

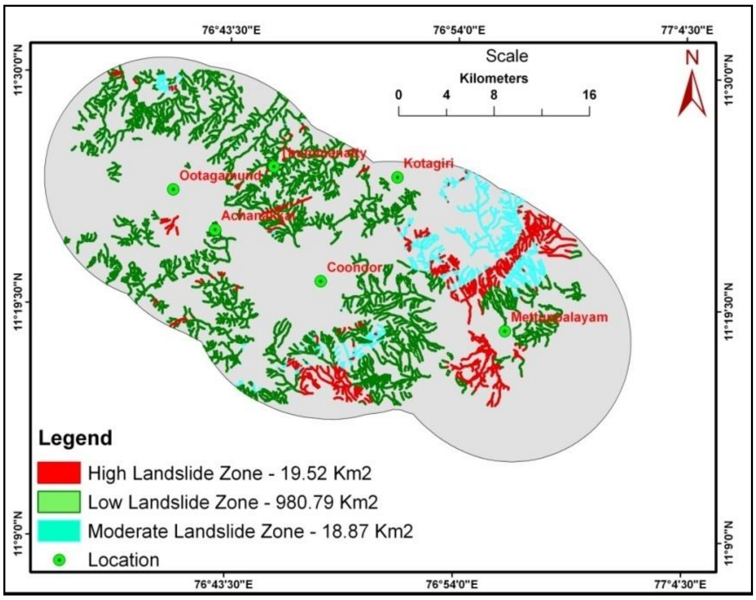

FIG. 6 LANDSLIDE HAZARD ZONATION MAP

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