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# Hydrological parameters Controls Vulnerable Zones in Calicut – Nilambur – Gudalur Ghat section, Gudalur, The Nilgiris, Tamil Nadu.

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**Abstract:** Calicut – Nilambur – Gudalur Ghat sections is one of the most important inter-state networks connection Tamil Nadu (Gudalur) and Kerala (Calicut) borders along the Western Ghats, It is located on Gudalur Taluk, Gudalur district. Calicut is one of the most popular tourist destinations. These Ghat section road slopes are very steep and rocks are fissile in nature. This can generate the problem of major and small landslides in this area. So, it is necessary to evaluate the present structure of hill slopes by carrying out a systematic study. The present paper emphasis a methodology to Landslide Hazard Zonation map using hydrological parameters. The thematic maps such as drainage map, buffer, drainage density, drainage intensity, run-off, rainfall intensity and slope of the study area were prepared on 1:25,000 scales. Relief has been traced from toposheet. Slope and aspect maps were prepared from the contour map. Drainage density drainage buffer and drainage intensity map has been derived from drainage. Thematic maps were digitalized with the help of ARC MAP software. Multicriteria analysis was done using all thematic layers by assigning proper weightages and scores for individual features based on their contribution to landslides. Based on the output, the study area was ranked into 5 different categories of hazard zones such as very low, low, moderate, high and very high. The hazard zonation map shows that 0.50% in very low, 13.30% low, 55.80% in moderate, 29.44% in high and 0.96% very high hazard zone. The landslide hazard zonation map is validated with landslide points which were collected from the field using high performance GPS. According to landslide inventory details 1.64% is located in very high, 29.50% in high, 62.30% in moderate, 4.92% in low and 1.64% in very low hazard zones. The study area was prioritized according to the hazard zones for future sustainable and developmental studies.
**Keywords:** Landslides, Remote sensing and GIS, Hydrological factors, Hazard Zonation.

## Introduction

Landslides and other mass movements are common phenomenon in the hilly region. The general introduction of the landslides, the various types of landslides and causes of landslides are deeply discussed[9]. Landslides are one of the major natural hazards that affects at least 15% of the land area of our country which around 0.46 million sq. km. Slope instability and landslides are one of the major natural disaster in many part of the country, particularly in Himalayas – NE states, Western and Eastern Ghats in South India. The Calicut – Nilamur – Gudalur ghats section in Nadugani village, Gudalur is facing major problems of tourism flow, heavy lorry traffic and hill slope plantation. The major reason can be attributed to the increased growth tourists and vehicle movement around 300 heavy-duty Lorries per day. The activity is rampant on the hills slopes. Many

times frequent slope failure, which totally paralyze the traffic flow during monsoon. Landslides occur frequent at particular a slope, which has to be given for restoration work. There are numerous approaches for hazard zonation mapping. The study area landslide types are mapped by large scale spatial data, pale scars and field survey, classified and landslide distribution in GIS environment. Many researchers on landslide hazard zonation have been done over the past three decades – BIS method [1,7], evaluating landslide prone area using GIS[4,8], probabilistic frequency ratio method [6], Frequency ratio model[5].

This paper tries to look into the various hydrological factors like drainage, drainage buffer, drainage density, drainage intensity, run-off, contour and slope to create a landslide hazard zonation map of CNG ghat section.

**Study area**

CNG ghat section lies at the Latitude 11°30'N to 76°15'N and Longitude 76°30'E to 11°15'E on the western portion of Nilgiris district at an altitude of 950m. In this section most of the area is covered by Hornblend biotite gneiss and small portion occupied by charnockites. The rocks are fissile in nature. The terrain slope is varies from 45° to 60°. Most of the cover by Tea plantation and south-eastern side dense forest are noticed. The study area falls under the survey of India topo sheet No. 58A/7 on 1:50,000 and 58A/7-NE on 1:25,000 scale and covers an area about 4.79 Km². Trellises drainage pattern was notice and most of the drainages flowing along fracture zones. The study area is shown in Figure 1.

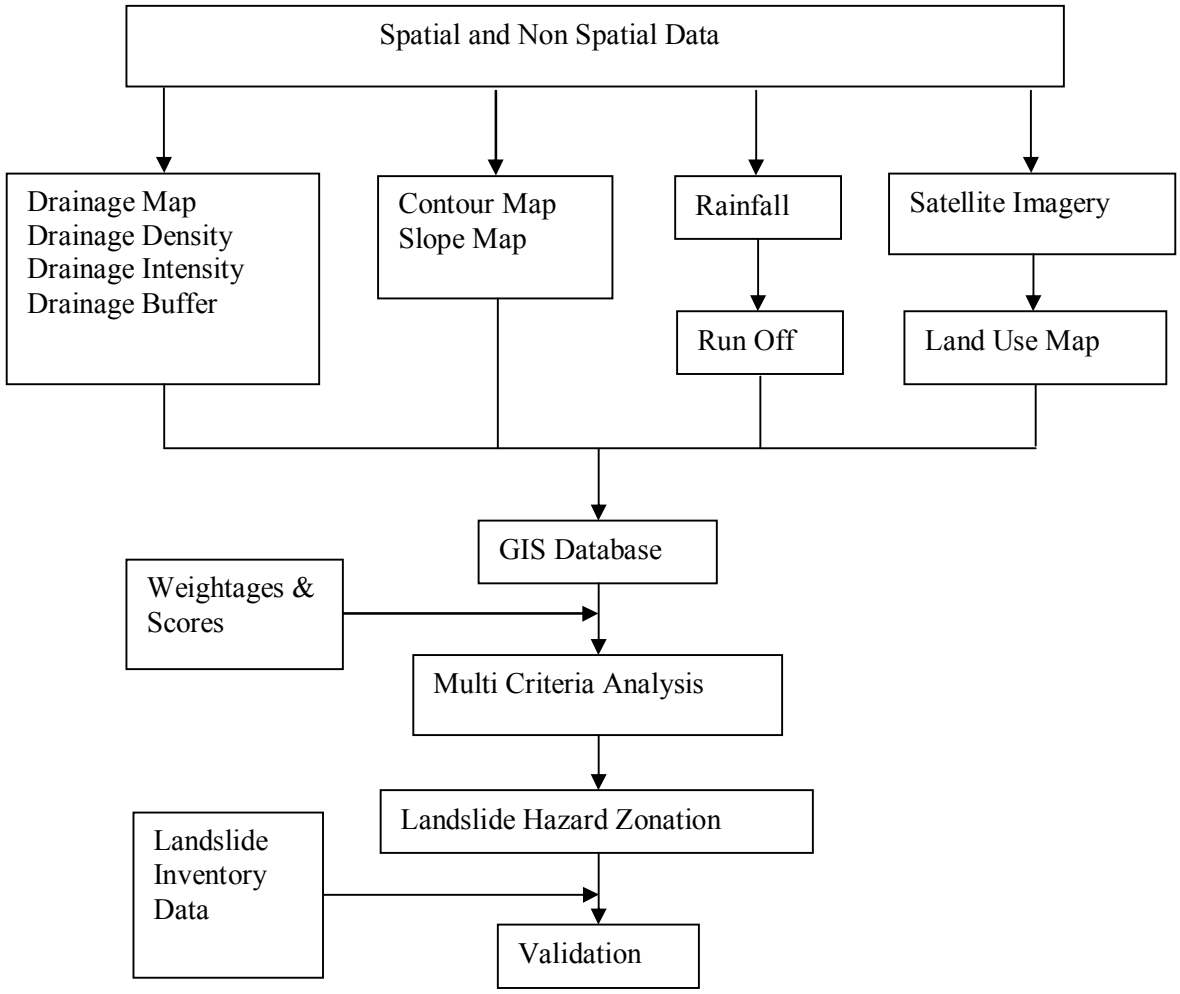


**Figure 2: Methodology Flow Chart Chart**

**Data products**

The following spatial data has been used for the study.

- Topo sheets No. 58A/7 (1:50,000) and 58A/7-NE (1:25,000)
- IRS RS2 LISS – IV Geocoded January 2014
- Rainfall data from Taluk office.

**Methodology**

The methodology adopted in the present study is explained with the help of a flow chart as shown in Figure 2.

- The themes like Drainage map (Figure 3a), Contour map (Figure 3b), and road were derived from SOI Toposheets.
- The Land use map is interpreted visually from satellite imagery (Figure 3c).
- Slope (Figure 3d), drainage density (Figure 3e), and drainage indensity (Figure 3f) were prepared from relief and drainage maps respectively.
- Using empirical formula for Tamil Nadu hills $Q= CM^{2/3}$, Run-off map (Figure 3g) was prepared [2].
- The above prepared maps were geo-referenced and digitized using ARC GIS software [3].
- Buffer zones (Figure 3h) were created for drainage map using ARC GIS software.
- The themes have been assigned with proper weightages and scores (Table 1).
- Multi-criteria analysis of the weighted themes was carried out with Overlay analysis in ARC GIS software to predict landslide vulnerable zones.

## Result and Discussion

The output landslide vulnerable map is shown in Figure 4. It classifies the vulnerable zones into very high, high, moderate, low and very low based on the weightage and scores assigned to the different themes. It is found from the output map that the vulnerable zones identified are proportional to the hydrological factors. The areas such nadugani betta, marala malai, Nadugani and Kil nadugani comes under high vulnerable zones. These areas have very steep slopes and low drainage density. Nadugani betta and marala malai areas possess elevation more than 800 m from MSL. The output map shows that the very high zones are very limited and occupies about 0.96% and high hazard zones occupies 29.44%. As per hydrological factors influence the moderate vulnerable zones occupies 55.80%. Low and very low occupies zones about 13.30%, 0.50%. The places having moderate slope of 15 – 25degree, low to moderate drainage density. Most of the slides are occurs in these zones. The low vulnerable zones are mostly found along low slope areas.

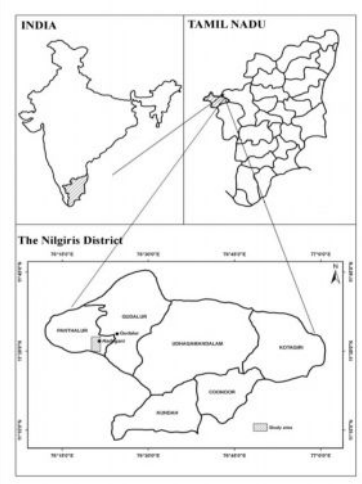


**Figure 1.Location Map**

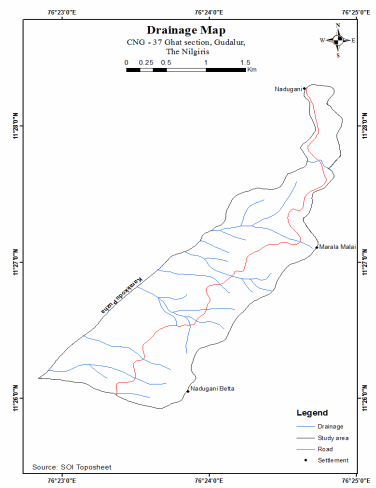


**Figure 3a.Drainage Map**

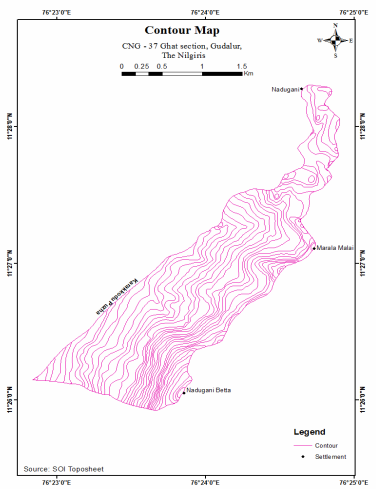


**Figure 3b.Contour Map**

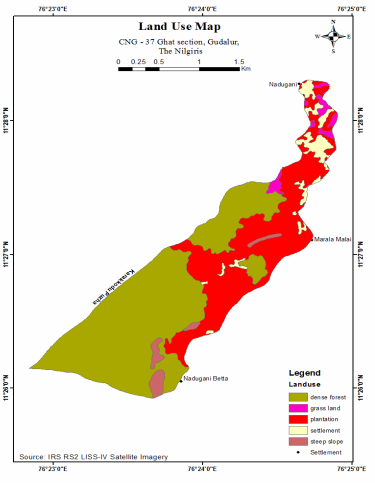


**Figure 3c.Landuse Map**

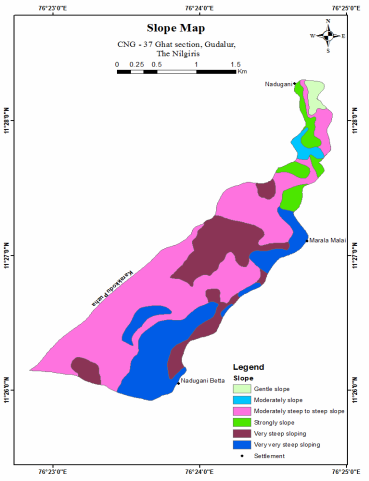


**Figure 3d.Slope Map**

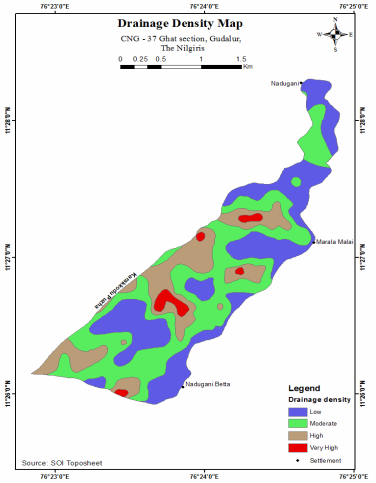


**Figure 3e.Drainage Density Map**

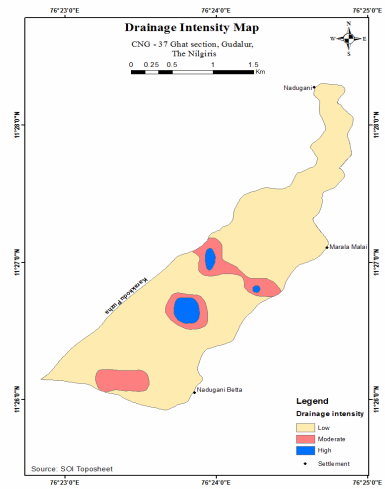


**Figure 3f.Drainage Intensity Map**

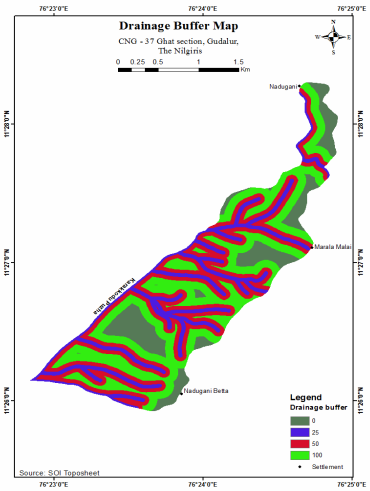


**Figure 3g.Drainage Buffer Map**

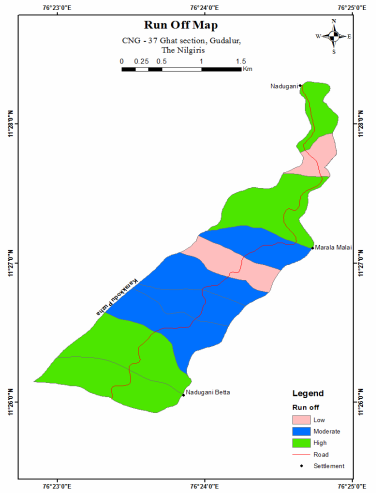


**Figure 3h.Run Off Map**

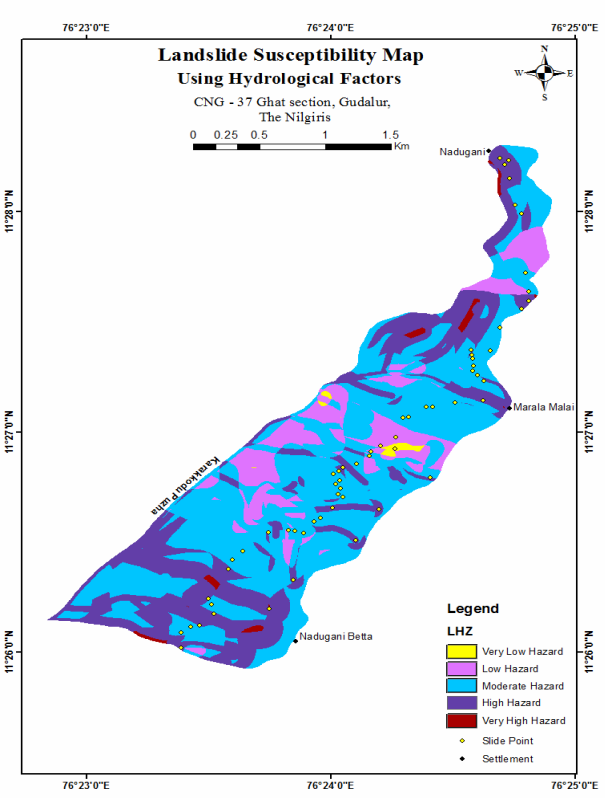


**Figure 4.Landslide Susceptibility Map**

**Table 1. Data layer and Landslide Susceptibility Zonation weight & Scores**

| S. No | Data Layer | Classes | Weightage | Score |
|---|---|---|---|---|
| 1 | Drainage Density | Low | 30 | 9 |
| | | Moderate | | 8 |
| | | High | | 6 |
| | | Very High | | 4 |
| 2 | Drainage Intensity | Low | 10 | 8 |
| | | Moderate | | 6 |
| | | High | | 4 |
| 3 | Drainage Buffer | 0 | 25 | 3 |
| | | 25 | | 9 |
| | | 50 | | 6 |
| | | 100 | | 4 |
| | Run Off | Low | 25 | 9 |
| | | Moderate | | 7 |
| | | High | | 5 |
| 5 | Slope | Gentle Slope | 10 | 8 |
| | | Moderately Slope | | 8 |
| | | Moderately Steep to Steep Slope | | 7 |
| | | Strongly Slope | | 5 |
| | | Very Steep Slope | | 6 |
| | | Very Very Steep Slope | | 6 |

## 7. Acknowledgment

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