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Development of Landslide Hazard Zonation Mapping in Kotagiri, India

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Abstract: *Landslides were one of the major damage disasters which occur in the world. It frequently leads to serious problems in Hilly areas during the rainy season. In this present study, the multicriteria analysis techniques were used to determine the landslide Hazard zonation and also the various factors of different thematic layers such as geology, type of soil, land surface temperature, land cover, Level slope aspects of underground water and inclination of slope were integrated in GIS to outline landslide hazards. The critical hierarchy was used to find out the various weightage's values of different factors of thematic layers. The development of Landslide Hazard zonation map for Kotargiri was created on different techniques such as Ranking and weightages and overlay techniques. The developed landslide Hazard map of Kotagiriarea in India was divided in to exposed zones such as high, moderate, poor, very high. The resulted landslides hazarded zonation was further confirmed with field study and geospatial technology analysis. The results confirm that the elevation range in Kotagiri are highly prone to landslides. The final landslides hazards Zonation map can be used for the preventing landslide in that area.*

Key words: *Landslide, Mapping, Kotagiri, Zonation, Hazard*

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I. Introduction

Landslide have become one of the world's important natural calamities for the past few years in mountain terrain in many countries. In mountainous terrain, the occurrence of landslides is influenced by various causative factors and triggered by several external factors, such as intense rainfall, earthquake shaking, water Received, level change, storm waves and rapid stream erosion [1]. During the landslides, it creates more impacts to the areas and nearby areas. Landslides have caused large numbers of casualties and huge economic losses in mountainous areas of the world.[2]

The population in the hill station has also increased due to urbanization. Every year thousands of people either died or injured and property worth millions of dollars affected by landslides [3]. The Nilgiris district has lengthy history of landslides and it created more damage to property and infrastructure, however the loss of life is less when compared to landslide impacts in other parts of India [4]. For estimating and managing the landslide, for taking mitigation measures, it is important to develop a map which will be very useful. For this Landslide Hazard Zonation Map is a technique which was developed.

Landslide hazard zonation (LHZ) is defined as the division of a land surface into homogeneous areas or domains and their ranking to degrees of actual/potential hazard caused by mass movement [5,6]. The Landslide hazard zonation (LHZ) of an area becomes important whereby the area is classified into different landslide hazard zones ranging from very low hazard zone to very high hazard zone [7].

Steep slope, steep dips of the litho types, presence of clay layer in weathered rock types, events of continuous heavy rains, flooding on the slopes and improper land use practices play a major role in the genesis of landslides in the Nilgiris District of Tamil Nadu [8,9].

During All zonation studies which was carried till date depends on three fundamental assumptions as below.

a) The slope failures in future will probably be in similar terrain conditions that have prompted over a timely failure.

b) In a given zone the fundamental conditions that cause land sliding can be distinguished.

c) An outline of the degree of potential hazard in areas can be developed, depending on the number of failures initiating factors present, their seriousness and their collaboration.

Landslide hazard is one of the most significant hazards that affect different parts of India every year during the rainy season. It has been observed that Himalaya ranges, North east India, Nilgiris, Western Ghats and Eastern Ghats, are affected by this hazard every year and suffer heavy losses in terms of life, infrastructure and property [10]. In LHZ studies, remote sensing along with GIS provides great advantages [11].

First, the LHZ maps assist planners in choosing favourable sites for development schemes, such as buildings, dams and road construction. Even if the hazardous areas cannot be avoided altogether, their recognition in the initial stages of planning may help adopt suitable precautionary measures. Secondly, the maps help identify and delineate hazard-prone areas, so that environmental regeneration programmes can be initiated adopting suitable mitigation strategies [12].

Data supplementation is done by using remote sensing products. The technology of obtaining all the information about the earth's surface and also the atmosphere is done by aerial photography or satellite imagery.Remote Sensing Techniques such as Aerial photography and satellite imagery can be utilized to find out the elevation, land use, vegetation, soil composition, water bodies, location of all streets and buildings locations, and different weather patterns.

The main purpose of this research study,

1. To form a spatial database in GIS environment.
2. To explain the comprehensive landslide prone areas in various level of zonation.
3. To imagine landslide prone areas in 3D view for hill area planning

II. Methodology

Study Area

Kotagiri is a panchayat town which is located east of Nilgris district in TamilNadu in Southern Part of India. It is located at 50km Northwest to the Coimbatore city of Tamilnadu. This study area is located in the Centre of eastern ghats and western ghats so it receives rainfall in both monsoon seasons. This area is chosen for study as it is prone to landslides. The elevation of Kotagiri is 1847 above mean sea level. It is located at 11.43°N 76.88°E.The map of the study area is shown in figure 1.

Figure 1 Kotagiri Map

Landslide Hazard Mapping:

Landslide studies can be prepared into three phases

1) Detection and classification of landslides

In this stage, the exact location of the landslides is being detected and it being noted. After noting the location, the type of landslide to be noted.

2) Monitoring activity of existing landslides

In this stage, all the existing landslides occurred in the particular should be investigated. After the investigation, existing landslide and the present landslide should be compared. The landslides should be monitored seriously case by case.

3) analysis and prediction of slope failures in space (spatial distribution) and time (temporal distribution) based on the importance of the factor's zonation using Landslide Susceptibility Index.

a. The existing landslides should be marked on the map and the permanent factors which include bedrock, slope steepness, and, when available, the hydrologic factors are to be combined into individual map units and prepared as a map.;
b. The landslide inventory is overlaid on the map which was developed with combined factor.
c. Analysis should be prepared for all combinations of the factors and these group combinations of these factors in a way that defines the four levels of landslide hazard; and
d. Four landslide hazard zones from the grouped combinations are prepared as a maps.

III. Result

Ranks & Weights

The whole area or region is then divided into the following landslide vulnerability zones. These are may be very unstable, Moderately unstable, Moderately stable and stable zone.
The zones may be classified according to ranks and weights. The divided zones are being shown in the map in figure 2.

Figure 2 Landslide Zonation Map – 3D View.

Monitoring Landslide Movement

Next stage in study of landslide is to monitor the movement of a landslide. In this stage, it contains the assessment of how the landslide over time occur which includes the aerial view of landslide, the speed of movement, and the surface change in the topography. In this stage, the investigation of landslide is done commonly several Remote Sensing Techniques. Few of the Remote Sensing techniques which are used are Global Positioning System (GPS), Satellite imagery, RADAR imagery, Stereophotogrammetry, Soft copy photogrammetry.

Global Positioning System (GPS)

GPS plays a very convenient tool for identifying the first stage disaster and further mitigation of landslide. It can also be used to measure the movement of landslides in cm/yr, and this can help in determining the boundary of the landslide area. Monitors are to be placed anywhere, where you can access and they are very easy to operate. While using GPS, it is noted that there are few drawbacks involved in it. Some of the drawbacks are accuracy is affected by the number of visible satellites which is present, the block of the observation point and the monitoring of installed GPS receivers which have been placed out in the field.

Satellite imagery/RADAR imagery

There are many different types of visible band satellite imagery that can help to recognize where slides have happened or where they are going to happen. Change detection images can be taken when there is occurrence of movement. From the spotted images the surface disruption can be often seen. Radiometric and geometric calibration is very much required to make changes in the pictures which have been stand out from those that have not.

Stereophotogrammetry

Stereophotogrammetry is a method of Remote Sensing, in which a satellite can obtain two images of the same ground science within a short time period, so that it can sight surface features which have not changed significantly. These images can be treated to get topography from the stereo pair of images. The series of stereo

pairs offers a 3-dimensional evolution of the landslide over time. The elevation range of Kotagiri is shown in 3 D view in figure 3.

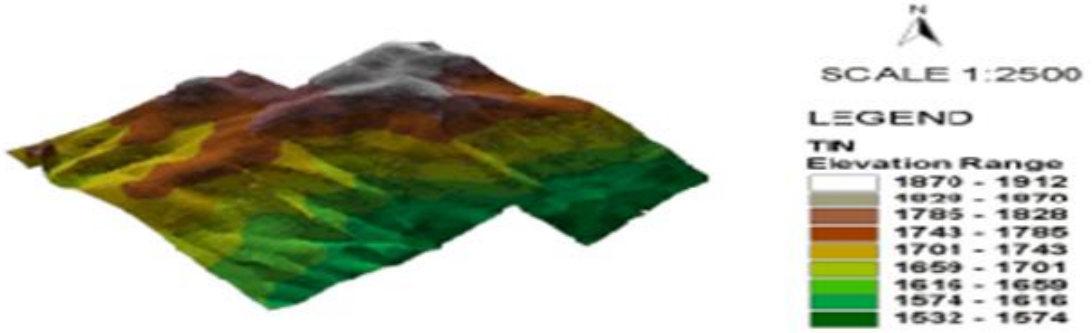

Figure 3 3D VIEW OF AN AREA

IV. Conclusion

The techniques such as Remote sensing and GIS have played a vital role in monitoring of zonation of landslides. The detection of landslide can be done very well especially with aerial photography, which will act as a key parameter for any regional landslide threat assessment. Joined with aerial photos, GIS is an excellent tool for displaying landslide spatial distribution along with its features. But preparation of landslide map should be checked and confirmed with ground checks.

Remote sensing techniques assists and help in investigation of landslides at both local and regional scale. These techniques do not substitute investigation, interdisciplinary research strategies and observe the reliability of prediction models which is used to predict occurrence of landslides. These techniques provide an additional tool from which we can extract information on causes and occurrences of landslides.

The main argument was to reveal the importance of early consideration of landslides in the planning study and to include one plan that can be used at all stages of the planning process. Danger maps allow the developer to have the knowledge of terminology, definitions and important refection which are related to landslides and hazard mapping of landslides.

References

[1]. Anbazhagan, S., Ramesh, V. Landslide hazard zonation mapping in ghat road section of Kolli hills, India. *J. Mt. Sci.* **11,** 1308–1325 (2014). https://doi.org/10.1007/s11629-012-2618-9.

[2]. Dai, F. C., Lee, C. F., & Ngai, Y. Y. (2002). Landslide risk assessment and management: an overview. *Engineering geology*, *64*(1), 65-87.

[3]. P. V. S. P. Prasada Raju and J. Saibaba, "Landslide hazard zonation mapping using remote sensing and geographic information system techniques-a case study of Pithoragarh area, U.P," IEEE 1999 International Geoscience and Remote Sensing Symposium. IGARSS'99 (Cat. No.99CH36293), Hamburg, Germany, 1999, pp. 577-579 vol.1, doi: 10.1109/IGARSS.1999.773570.

[4]. Thennavan, E., Pattukandan Ganapathy, G. Evaluation of landslide hazard and its impacts on hilly environment of the Nilgiris District - a geospatial approach. *Geoenviron Disasters* **7,** 3 (2020). https://doi.org/10.1186/s40677-019-0139-3.

[5]. Bera, A., Mukhopadhyay, B.P. & Das, D. Landslide hazard zonation mapping using multi-criteria analysis with the help of GIS techniques: a case study from Eastern Himalayas, Namchi,South Sikkim. *Nat Hazards* **96,** 935–959 (2019). https://doi.org/10.1007/s11069-019-03580-w.

[6]. Varnes DJ (1984) Landslide hazard zonation: a review of principles and practice. UNESCO Press, Paris.

[7]. M. K. Arora, A. S. Das Gupta & R. P. Gupta (2004): An artificial neural network approach for landslide hazard zonation in the Bhagirathi (Ganga) Valley, Himalayas, International Journal of Remote Sensing, 25:3, 559-572. http://dx.doi.org/10.1080/0143116031000156819 .

[8]. Kumar, M. K., & Annadurai, R. (2013). Mapping of landslide susceptibility using geospatial technique—A case study in Kotagiri Region, Western Ghats, Tamil Nadu, India. *International Journal of Engineering Research & Technology (IJERT)*, *2*(12), 1-12.

[9]. Manimaran.G, Antony Ravindran.A, Selvam.S Manimaran.D and Sugan.M (2012), "Characterization and disaster management of landslides in the Nilgiris mountainous terrain of Tamil Nadu, India", International Jounral of Geomatices and Geosciences, vol.3, No.1 pp 1-12

[10]. Mahesh Kumar Tripathi, Himanshu Govil, P.K.Champati ray, I.C. Das LANDSLIDE HAZARD ZONATION MAPPING OF CHAMOLI LANDSLIDES IN REMOTE SENSING AND GIS ENVIRONMENT. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-5, 2018 ISPRS TC V Mid-term Symposium "Geospatial Technology – Pixel to People", 20–23 November 2018, Dehradun, India.

[11]. Anbalagan, R., Kumar, R., Lakshmanan, K. *et al.* Landslide hazard zonation mapping using frequency ratio and fuzzy logic approach, a case study of Lachung Valley, Sikkim. *GEOENVIRON DISASTERS* **2,** 6 (2015). https://doi.org/10.1186/s40677-014-0009-y

[12]. K. Saha, R. P. Gupta & M. K. Arora (2002) GIS-based Landslide Hazard Zonation in the Bhagirathi (Ganga) Valley, Himalayas, International Journal of Remote Sensing, 23:2, 357-369, DOI: 10.1080/01431160010014260

[13]. Sarkar, S., Anbalagan, R. Landslide hazard zonation mapping and comparative analysis of hazard zonation maps. *J. Mt. Sci.* **5,** 232–240 (2008). https://doi.org/10.1007/s11629-008-0172-2.
[14]. Saranathan, E., Kannan, M., & Victor Rajamanickam, G. (2012). Assessment of landslide hazard zonation mapping in Kodaikanal, Tamil Nadu–India. *Disaster Advances*, *5*(4), 42-50.
[15]. Dhakal, A. S., Amada, T., & Aniya, M. (2000). Landslide hazard mapping and its evaluation using GIS: an investigation of sampling schemes for a grid-cell based quantitative method. *Photogrammetric Engineering and Remote Sensing*, *66*(8), 981-989.
[16]. Abdul Rahamana, S., Aruchamy, S., and Jegankumar, R.: Geospatial Approach on Landslide Hazard Zonation Mapping Using Multicriteria Decision Analysis: A Study on Coonoor and Ooty, Part of Kallar Watershed, The Nilgiris, Tamil Nadu, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XL-8, 1417–1422, https://doi.org/10.5194/isprsarchives-XL-8-1417-2014, 2014.
[17]. Preparation of Landslide Hazard Zonation maps in mountainous terrains-guidelines, part 2 Macro-zonation, Bureau of Indian Standard, IS 14496 (1998).
[18]. Mathew, J., Jha, V. K., & Rawat, G. S. (2007). Weights of evidence modelling for landslide hazard zonation mapping in part of Bhagirathi valley, Uttarakhand. *Current science*, 628-638.
[19]. Anbalagan, R. (1992). *Landslide hazard evaluation and zonation mapping in mountainous terrain. Engineering Geology, 32(4), 269–277.* doi:10.1016/0013-7952(92)90053-2.

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