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Analysis of Landslides Hotspots in Western Ghat (Patan Taluka, Maharashtra) by using GIS and Remote Sensing

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Abstract: *Landslides are one of the most dangerous natural hazards in hilly terrain. The region around a previous landslide in Patan, Satara district, Maharashtra, has been chosen as the research location. Landsat8, Google Earth, Google Maps, and other satellite images, as well as Survey of India (SOI) topographical sheets, serve as the foundation for obtaining baseline information on different metrics such as NDVI slope, relative relief, drainage density, and geology/lithology. The purpose of this research is to understand the importance of mapping geological ligaments and landscape characteristics including streams, slope, and aspect. Rainfall is one of the primary causes of landslides. Any corrective action must include one or both of the following characteristics. Thus, landslide hotspots are identified using GIS and remote sensing. The pictures for the analysis were collected in FEBRUARY 2021, and the analysis is completed in the months of May and June. In August 2021, a real landslide happened on the areas indicated in the research.*

Key Words: Landslide, GIS, Remote Sensing , Mapping, Survey of India etc.

1.INTRODUCTION

A landslide, also known as a landslip or mudslide, is a type of mass wasting that involves a variety of ground motions such as rock falls, deep slope collapse, and shallow debris flows. Landslides are a major concern in virtually every area of the world because they create economic or social damages on private and public property. Natural calamities have shown the devastating potential of rapid mass movements during a landslide, which cost lives and inflict significant damage to property and infrastructure on an annual basis. Remote Sensing (RS) and Geographic Information Systems (GIS) play critical roles in the effective mitigation and management of disasters, providing a framework for monitoring, evaluation, detecting deficiencies, and suggesting suitable disaster management methods. RS and GIS have become important tools in geology for predicting and estimating natural hazards. s. GIS may be used to build hazard analysis models that can be utilised to save lives and property, ranging from better monitoring of prospective crises to better monitoring of potential disasters. Although natural disasters have grown in scale and frequency over the last several decades, there has also been a significant rise in technical capacity to mitigate them. As a result, the economic damage caused by natural disasters is growing with time. These human settlement disturbances, new urbanism, and engineering contractions consume a portion of the natural budget. Hazard assessment is required to identify any examined area with a degree of hazard, which may then be used for land-use planning. The Patan area is distinguished by its arid climate, low population, natural vegetation, low quality soils, varied geomorphology, and severe slope gradient. Any sustainable development strategy in Patan Taluka (western ghat) faces significant environmental challenges like as landslides, shortage of water supplies, flash floods, and groundwater contamination. Furthermore, hazardous behaviours brought about by the quick rate of development may endanger the area's natural and cultural assets indefinitely. Patan and its surrounding area have been selected as a pilot study on district natural hazards and planning for the entire Western Ghat region. Landslide risks represent a serious threat to life, property, and infrastructure, and can constitute a major impediment to the area's growth.

2. STUDY AREA

One of Patan's most significant drainage basins is under examination. The examined region is located between latitudes 17°37'35" N and longitudes 73°54'00" E, and it covers an area of about 1385.82 square kilometres (Fig. la). It has an elevation of 582 metres on average (1909 feet). Patan (Patan T; 17° 20' N, 73° 50' E; RS Karad 24 m. SE; p. 3,630) is located on the Karad-Kumbharli road, approximately 25 miles south-west of Satara, near the confluence of the Koyna rivers. In general, the area under examination has dry to semi-arid climatic conditions, with lengthy wet summers and severe winters. The majority of the precipitation falls in the form of heavy showers that last for an extended period of time. Tarali and Koyana dams Both dams are located in the study region and were built on the Koyana and Tarali rivers, respectively. Because the Sahyadri Mountain range is located between the study area and receives considerable rainfall, the probability of a landslide in the area is high.

3. MATERIAL AND METHODS

In the current study, LHZ methodology is used to identify the type and degree of risk by studying possible hazards and evaluating existing vulnerability situations that might represent a potential danger or harm to people, property, livelihoods, and the environment on which they rely. This part discusses data collecting and data processing techniques, the approach for preparing distinct thematic maps, and the criteria used to remove and identify the LHZ of the research region using image processing and GIS. Several materials, methodologies, and mapping approaches were utilised in the current study to create the environmental LHZ of Patan, Satara, Maharashtra, India. Various forms of data have been utilised, including RS, geo-referenced data, tabular data, and other auxiliary geological data.

In the current study, GIS methods were used to represent the study area's LHZ susceptibility. The main and secondary data were transformed into digital layers before being overlaid and integrated to create the LHZ map. GIS capabilities like as manipulation, combination, overlay, integration, and reattribution have been utilised frequently with GIS systems to create the necessary logical procedures. Thematic information was extracted and produced using improved ETM+7 pictures, geo-reference, and other auxiliary geological data as characteristics of points, lines, and polygons coverages, and was then assembled into an expandable database.

Spatial database generation for analysis

Several variables and criteria, including drainage, contour, slope, aspect, height elevation, and land-use/land-cover, were established for LHZ in the current study as the following.

Establishment of analysis maps

DEM provides a novel way of provide information on landslides. In the current investigation, DEM files are created using ARC/GIS software. The DEM reflected spatial altitude variation, and it was utilised to produce slope, stream, and NDVI maps. Slope is a measure of the change in height over time. Slope is an important metric to consider when considering stability. It is the first derivative of elevation, with each pixel representing the slope angle at a specific location. Shear stress in soil and other unconsolidated material typically increases as the slope angle increases. Digital evolution model

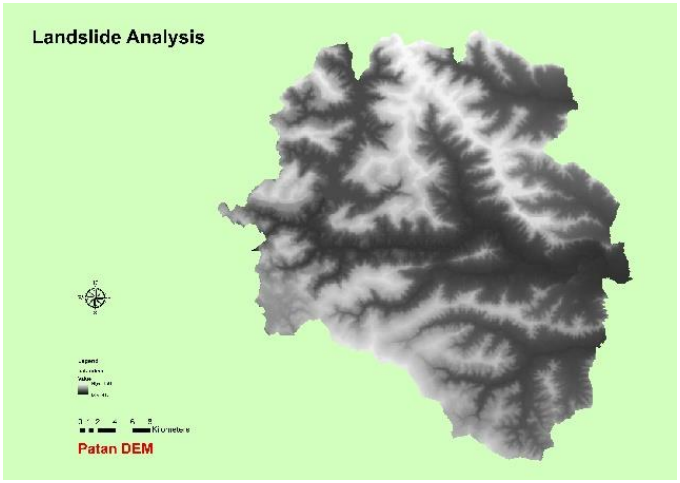

Fig. 1 DEM

Slope map of the study area

Although it is directly connected to landslides, the slope angle is the most important element in landslide susceptibility mapping. Using ArcGIS V9.3 software, the slope map was categorised into nine groups based on the conventional categorization for hill land.

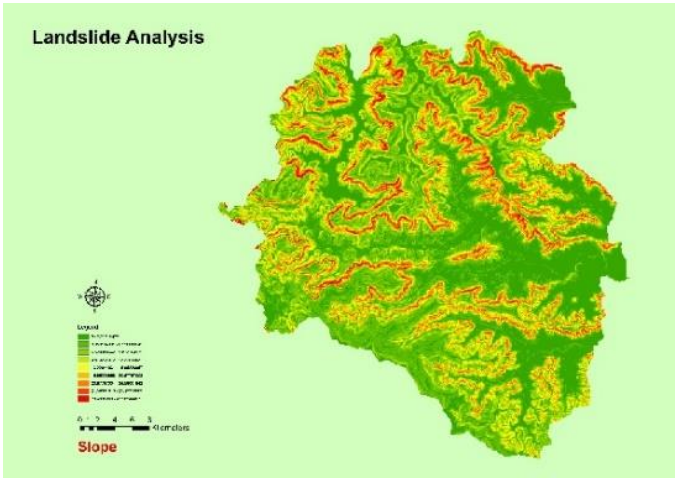

Fig. 2 Slope

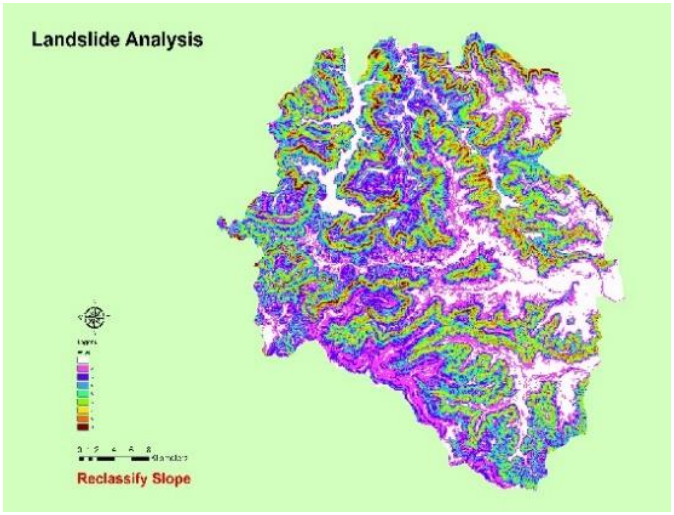

Fig. 3 Reclassify Slope

Stream map of the study area

The proximity of streams near landslides is an important regulating element since it can generate major erosion processes. Streams of second or higher order, according to Strahler's categorization, were chosen and treated by establishing a 50 m buffer zone.

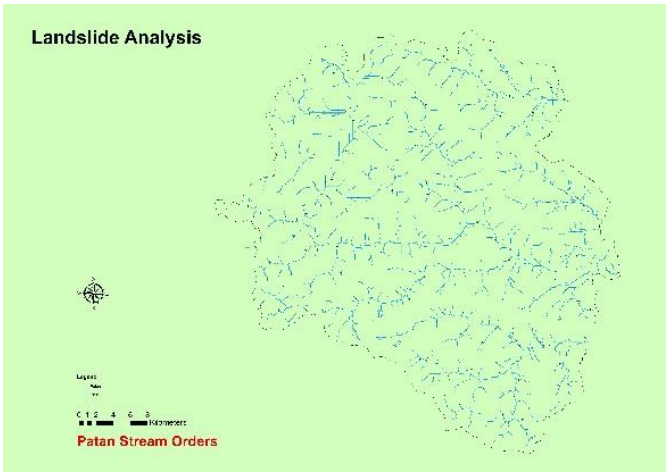

Fig. 4 Streams

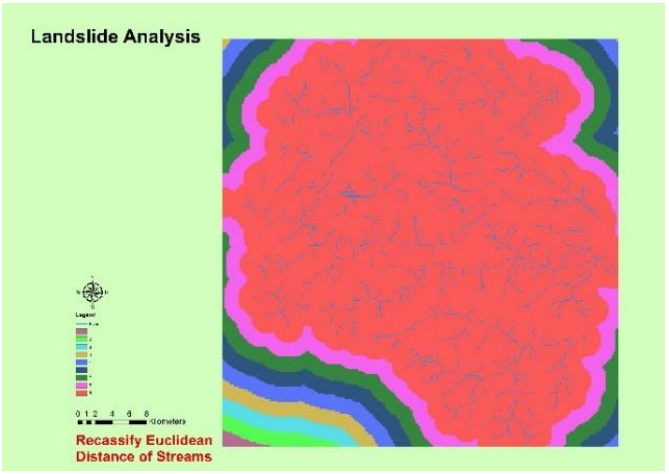

Fig. 5 Reclassify Euclidean

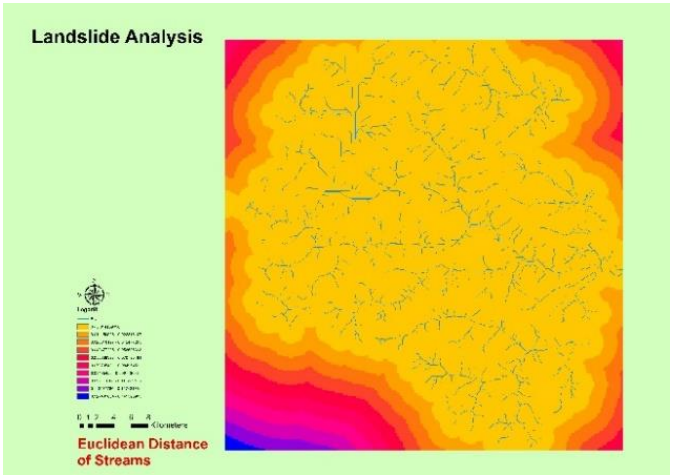

Fig. 6 Euclidean Distance

NDVI map of the study area

The NDVI (Normalized Difference Vegetation Index) is a flexible vegetation index that may be used to assess the vegetation and the dynamic of vegetation coverage change. Over the years, this index has been examined and assessed with several satellites, altering its calculus technique in response to the number and kind of bands on the satellite.

In Landsat 8, NDVI = (Band 5 – Band 4) / (Band 5 + Band 4).

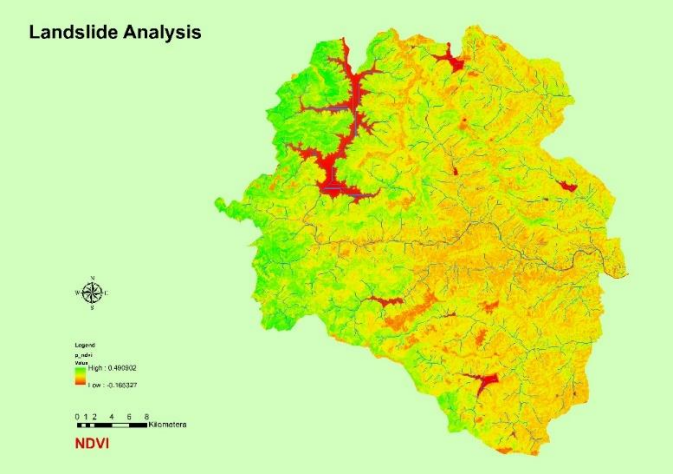

Fig. 7 NDVI

4. CONCLUSIONS

Landslide Hazard Zonation (LHZ) scenario map of the study area, Results from recent study focused on identification of critical LHZ in the Patan and surroundings area, Satara dist. This also highlights the importance of multidisciplinary studies of landslides hazards, combining subjects as diverse as geology and geomorphology, RS and GIS. Following specific conclusions are drawn from the study:

1.The area is classified into four parts

a. Low b. medium c. High d. Very high

2.The most of the identified hotspot are on the steep slope at hilly Regions.

3.The analysis done on the satellite image LANDSAT-8 dated at February 2021 and analysis done in the month of June 2021 we got the information about the various landslides occurred in Patan talukain month of August 2021 so that we visited the Landslide location, the location of spots identified and actual location of landslide are matched.

4.Thus in this present work we can identify the probability locations of the landslides with the use of various maps in the Arc-GIS software.

5. REFERENCES

1. Shahabi, H., & Hashim, M. (2015). Landslide susceptibility mapping using GIS-based statistical models and Remote sensing data in tropical environment. Scientific reports, 5(1), 1-15.

2. Arnous, M. O. (2011). Integrated remote sensing and GIS techniques for landslide hazard zonation: a case study Wadi Watier area, South Sinai, Egypt. Journal of Coastal Conservation, 15(4), 477-497.

3. Ramakrishnan, D., Ghose, M. K., Chandran, R. V., & Jeyaram, A. (2005). Probabilistic techniques, GIS and remote sensing in landslide hazard mitigation: a case study from Sikkim Himalayas, India. Geocarto International, 20(4), 53-58.

4. Chen, T., Niu, R., Du, B., & Wang, Y. (2015). Landslide spatial susceptibility mapping by using GIS and remote sensing techniques: a case study in Zigui County, the Three Georges reservoir, China. Environmental earth sciences, 73(9), 5571-5583.

5. Pradhan, B., Mansor, S., Pirasteh, S., & Buchroithner, M. F. (2011). Landslide hazard and risk analyses at a landslide prone catchment area using statistical based geospatial model. International Journal of Remote Sensing, 32(14), 4075-4087.

6. Reis, S., Yalcin, A., Atasoy, M., Nisanci, R. E. C. E. P., Bayrak, T., Erduran, M. U. R. A. T., ... & Ekercin, S. (2012). Remote sensing and GIS-based landslide susceptibility mapping using frequency ratio and analytical hierarchy methods in Rize province (NE Turkey). Environmental Earth Sciences, 66(7), 2063-2073.

7. Gaikwad, S., Chandak, P. G., Kumthekar, M. B., & Deshpande, P. K. Pictorial Informative Support to Landslide Hazard Management Maps of Uttarakhand, India.

8. Rai, P. K., Mohan, K., & Kumra, V. K. (2014). Landslide hazard and its mapping using remote sensing and GIS. Journal of Scientific Research, 58, 1-13.

9. Sarkar, S., & Kanungo, D. P. (2004). An integrated approach for landslide susceptibility mapping using remote sensing and GIS. Photogrammetric Engineering & Remote Sensing, 70(5), 617-625.

10. Ayalew, L., & Yamagishi, H. (2005). The application of GIS-based logistic regression for landslide susceptibility mapping in the Kakuda-Yahiko Mountains, Central Japan. Geomorphology, 65(1-2), 15-31.

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