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Analysis of Landslide Prone Area of Shahuwadi Tehsil Using Geo-informatics

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Introduction:

Landslides are one of the most frequent natural occurrences in mountainous regions, with the Himalayan range being one of them, according to Chakraborty and Pradhan (2012). The word "landslip" refers to a wide range of mechanisms that result in the sliding down a slope and spreading outward of slope-forming material, such as rocks, soil, artificial fills, or a combination of all of these. The potential zone that is susceptible to slope collapse may be located by using Landslip Hazard Zonation (LHZ) mapping, hence decreasing vulnerability."

Slope, precipitation, LULC, elevation, soil type, drainage potential, development of transit networks, lineaments, and additional anthropological factors. Remote sensing and GIS have been used to extract specific details about the preparatory factors, such as slope angle, slope aspect, geological condition, drainage information, road alignment, lithological structure (faults and thrust), and land use, which influence and initiate landslides along the western Kolhapur district.

In order to reduce the risk associated with landslip hazards, it is essential to create landslip susceptibility maps and conduct hazard analyses and risk assessments using contemporary and cutting-edge techniques like high-resolution satellite data, digital elevation models (DEM), and geographic information systems (GIS). This paper provides a landslip susceptibility analysis for the region of western Kolhapur district in an effort to reduce potential landslip damages. The research area are selected because it are one of the worst-affected by landslides over the previous four rainy seasons. This study aimed to map areas susceptible to landslides and pinpoint dangerous regions where future landslides are likely to occur.

Objective:

1. To study the landslide analysis and risk management of the study area using RS and GIS.
2. To identify Landslide vulnerability in study area.

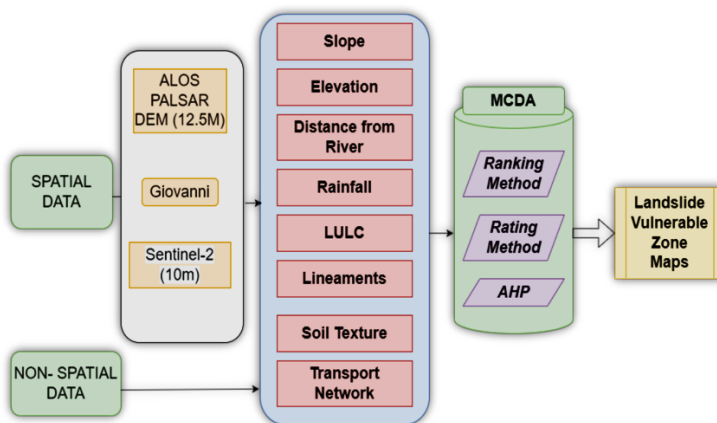
Database:

1. DEM: SRTM - Resolution 30 m
2. Land Use Land Cover,2021: ESRI Services
3. Road Map: Diva-GIS

4. Rainfall past occurrence data: Giovanni portal (GPM IMERG)

In any geographical study, choosing and creating the right theme layer is essential. The primary data sources for the current investigation were satellite data products and their derivatives. The majority of the layers were created using ASTER GDEM and LANDSAT ETM+ data. Primary layers and secondary layers have been produced utilising these data sources. Secondary layers are those created with the use of some other collateral data, such as an existing lithology map, Google photos, historical records, and literature reviews. Primary layers are those created directly from a data set using GIS tools.

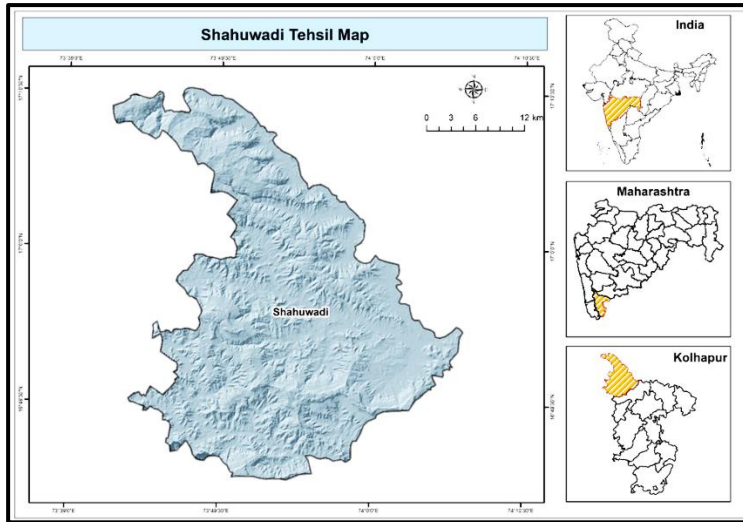
Methodology:



Study Area:

The Kolhapur District of Maharashtra contains the Town and Tehsil of Shahuwadi. Shahuwadi Block (CD) has the sub-district code 04283 according to census 2011 data. The Shahuwadi tehsil has a total area of 1,025 km², consisting of 1,023.33 km² of rural land and 1.94 km² of urban land. There are 1,85,661 people living in Shahuwadi Tehsil, of which 5,339 live in urban areas and 1,80,322 in rural ones. The population density in Shahuwadi is 181.1 people per square kilometer. The sub-district has roughly 39,975 homes, including 1,138 urban homes and 38,837 rural homes. In terms of literacy, 72.18% of the male population and 56.78% of the female population in Shahuwadi Tehsil are literate. In Shahuwadi Tehsil, there are roughly 145 villages.

Map No. 1 Location Map: Shahuwadi Tehsil



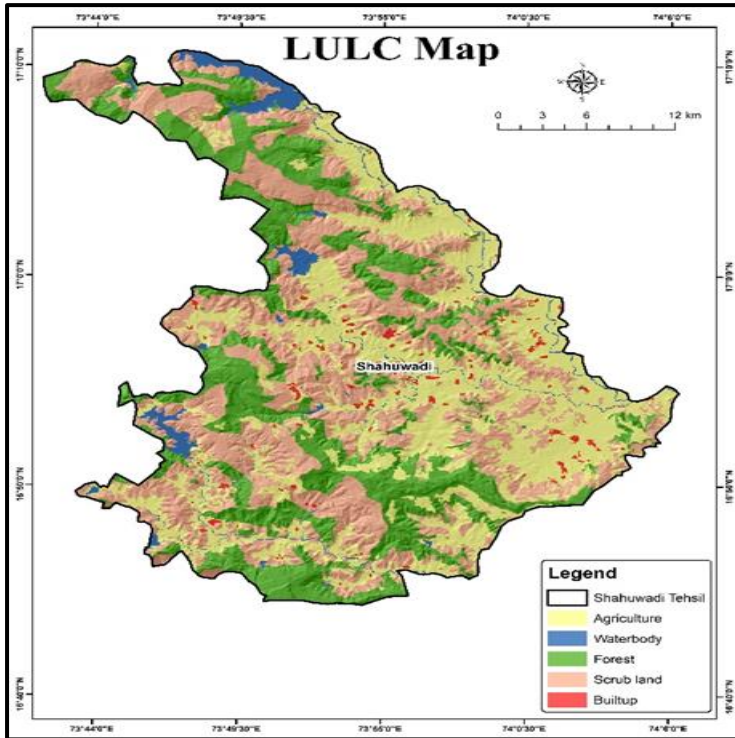
Source: Diva-GIS

Result and discussion:

Table No. 1 Land Use Land Cover:

Sr. No.	Category	Area in <u>hec.</u>
1	Agriculture	32485.3
2	Waterbody	3327.07
3	Forest	27670.2
4	Scrubland/ Barren land	37368.7
5	Built-up land	1135.32

Map. No. 2 Shahu wadi Tehsil: Land Use Land Cover



Source: Bhuvan website

Weighted Categories:

Reclassification is based on the rank given by considering the conditions that will trigger the landslide possibility. In the given study area, the ranking has already been assigned with the help of experts as the following table. Mostly the classification is done according to the risk associated with the factor. If necessary, reclassify the layer to assign the value to five classes. 1 for low risk, 2 for moderate risk, 3 for high risk, 4 for very high risk, and 5 the extreme risk.

Shahuwadi Tehsil: Weighted Categories

Landslide Triggering Factor	Value	Classification	Weightage
Slope (indegrees)	<5	1	35
	5-15	2	
	15-30	3	
	30-45	4	
	>45	5	
Rainfall (In mm)	<1500	1	25
	1500-1700	2	
	1700-2000	3	
	2000-2500	4	
	>2500	5	
Land Use and Land Cover	Forest	1	20
	Waterbodies	4	
	Agricultural Land	3	
	Barren Land	2	
	Built-up Area	5	
Distance From River (meters)	<100	5	10
	100-250	4	
	250-500	3	
	500-1000	2	
	>1000	1	
Distance From Road(meters)	<25	5	10
	25-50	4	
	50-75	3	
	75-100	2	
	>100	1	

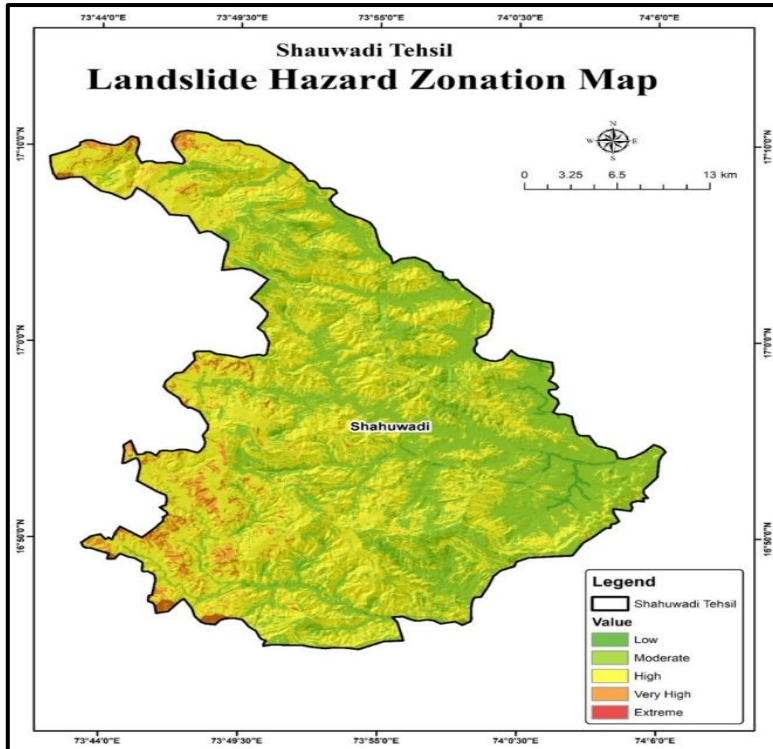
Table No. 2: Landslide Zonation Map

Sr. No.	Zone	Area in hec.
1	Low	877.86
2	Moderate	41796.9
3	High	52681.9
4	Very High	3720.33
5	Extreme	1.44

The research region spans a total area of 99078.43 square hectores. Area of minimal danger, 877.86 sq. hec., accentuated by low land and the Sahayadri mountain

range's foothills. Its 41796.9 sq hec of confined space is designated as a moderate risk region. The majority of the area (52%) showed high risk areas with significant rainfall. It has 52681.9 hec. and are produced because of the region's height and steep slopes. A very high-risk area currently occupies 3720.33 hec of land overall. Due to the 1.44 hector area's extremely hilly terrain, valleys, steep slopes, and stony and rocky ground, it is considered an extremely risky environment. region totaling 56403.67 hec are also marked as a landslide danger region.

Map. No. 3 Shahuwadi Tehsil: Landslide Hazard Map



Source: Arc GIS

Conclusion:

In the Shahuwadi tehsil, about 55 percent of the territory is above the high-risk zone. Heavy rainfall and other anthropogenic factors have enhanced the risk. The main problems in hilly areas are unstable slopes. It are determined that in soft structurally damaged and high relief portions of the hilly regions like Shahuwadi tehsil, the excavation for a road is the primary cause of a landslide. In most cases, stabilizing the slope will require the application of multiple techniques rather than just one.

By adding up all the information values, the final map is calculated. It is successful in creating the map of landslide susceptibility. Positive information values for any parameter class in the output of statistical analysis may be interpreted that the

parameter class has high influence on landslide hazard.

Recommendations:

In order to avoid road-induced landslides, it is necessary to establish an economical method of designing the road section without any excavation in slide hazard zones. Through this case study, it is discovered that remote sensing, together with the other geoinformatics tools, is particularly useful in danger zonation mapping.

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