LANDSLIDE SUSCEPTIBILITY OVERVIEWAND MAPPING

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Abstract: Landslides are determined as the motion of debris, mass of rock, or earth down a slope due to gravity effect. They are classified among the most dangerous and catastrophic natural hazards, being a significant threat to property and human life, moreover causing several indirect implications such as blocking of streams and aggregation of rivers, flash-flood occurrence, destruction of agricultural land, etc. Engineering geology mapping includes basic previously derived information for urban development decision making in a territory, and it can facilitate important socioeconomic savings if a prior decision consider the area's natural hazards and spatial distribution. Prediction or identification of a landslide is an area is essential to minimize or control intensity of landslide hazard. Usually, it is done using costly procedures as surveying, monitoring, or soil testing, which are not affordable or feasible in rural areas with very little resources. The objective of geotechnical mapping is to analyses the data and suggest preventive measures before hazards like landslides. Several kinds of maps are used to depict danger from landslides. Landslide susceptibility maps describe the relative likelihood of future land sliding based solely on the intrinsic properties of a locale or site. Remote sensing and Geographic Information System (GIS) techniques are useful for landslide susceptibility mapping and can help identify the areas best suited for developmental activities Therefore, landslide susceptibility maps represent a powerful tool since they provide coherent information on potentially unstable slopes. It is an important step prior to landslide assessment planning, management and disaster mitigation.

Keywords: Landslides, Landslide susceptibility, Mapping**.**

I. INTRODUCTION

Landslides are determined as the motion of debris, mass of rock, or earth down a slope due to gravity effect. Landslides can cause severe problems to the social and economic wellbeing. In order to effectively mitigate landslide hazards, the development of detailed susceptibility maps is required, towards implementing targeted risk management plans. Geotechnical mapping is a phenomenon which involves the identification of different landforms and geomorphological activities. The objective of geotechnical mapping is to analyze the data and suggest preventive measures before hazards like landslides. Several kinds of maps are used to depict danger from landslides. These maps might be as simple as a map that uses the locations of old landslides to indicate potential instability, or as complex as a map incorporating probabilities based on variables such as rainfall, slope angle, soil type, and levels of earthquake shaking. Remote sensing and Geographic Information System (GIS) techniques are useful for landslide susceptibility mapping and can help identify the areas best suited for developmental activities Therefore, landslide susceptibility maps represent a powerful tool since they provide coherent information on potentially unstable slopes

II. RESEARCH METHODOLOGY

In this paper we analyzed the various methods of landslide mapping. Also, the hazards caused by it and its remedies. Landslide mapping using aerial and satellite images (F. Fiorucci, 2011): In this research, investigators tested the possibility of using digital, aerial and satellite images to map recent landslides in Italy. To identify the landslides, the investigators adopted the interpretation criteria commonly used to identify and map landslides on aerial photography. The different dates of the aerial (March 2005) and the satellite (June 2005) images allowed to temporal segmentation of the landslide information. The new mapping showed 145% more landslides and 85% more landslide area than a pre-existing. As it's result to the improved mapping, the rate of landslide mobilization for the 2004–2005 landslide season was determined to be $\varphi L = 27.1$ mm year − 1, 30% higher than a previous estimate for the same period.

I. Landslide hazard evaluation and zonation mapping in mountainous terrain (R. A balagan, 1992): Landslide hazard zonation (LHZ) maps are of great help to planners and field engineers for selecting suitable locations to implement development schemes in mountainous terrain, as well as, for adopting appropriate mitigation measures in unstable hazard-prone areas. A new quantitative approach has been evolved, based on major causative factors of slope instability. A case study of landslide hazard zonation in the Himalaya, adopting a landslide hazard evaluation factor (LHEF) rating scheme, has been presented.

II.GIS-based landslide mapping for the 2005 Kashmir earthquake (Ulrich Kamp, 2008): Thousands of landslides throughout the Himalaya of northern Pakistan and India occurs due to the Kashmir earthquake at 8 October, 2005. A spatial database, which included 2252 landslides, was developed and analysed using ASTER satellite images and geographical information system (GIS) technology. They indicated that lithology had the strongest influence on land sliding, particularly when the rock is highly

II. Object-oriented mapping of landslides using Random Forests (Andre Stumpf, 2011): In object-oriented image analysis (OOA) and machine learning algorithms, a supervised workflow is proposed in this study to reduce the manual labor and objectify the choice of significant object features and classifications. A sequence of image segmentation, feature selection, object classification and error balancing were developed and tested on a variety of sample datasets of four sites in the northern hemisphere were affected by landslides. Approximately 20% of the data for training, the proposed workflow resulted in accuracies between 73% and 87% for the affected areas, and approximately balanced commission and omission errors

III. Shallow surface soil landslide forecast method (Yu Bin, 2016): This invention discloses a shallow surface soil landslide forecast method. In this method by calculating slope factor S, an upper relief factor U, calculating topographical factor T, calculating hydrological factor R, clay index factor N, measuring a solid coefficient factor F, permeation index K and determining a shallow surface soil landslide inducing possibility grade, and performing landslide forecast. This measurement and calculation result better conforms to a landslide formation mechanism; the landslide forecast accuracy and efficiency are high; and the disaster prevention applicability is greatly improved.

IV. Regional landslide susceptibility analysis using back-propagation neural network model at Cameron Highland, Malaysia (Biswajit Pradhan, 2010): This paper presents landslide susceptibility analysis around the Cameron Highlands area, Malaysia using a geographic information system (GIS) and remote sensing techniques. The landslide susceptibility indices were calculated using the trained backpropagation weights, and finally, the landslide susceptibility map was generated using GIS tools. Landslide locations were used to validate the results of the landslide susceptibility map, and the verification results showed 83% accuracy. The validation results showed sufficient agreement between the computed susceptibility map and the existing data on landslide areas.

III. METHODOLOGY

Implementation of all interpretations of Remote sensing data and field data by using applications like Geographic heat map, Map cite, 3D maps. In this stage we are going to do mapping of Landslide susceptibility map of Indian region in Geographic heat map, Map cite, 3D maps. In this stage we are going to do mapping of Landslide susceptibility map of Indian region in Geographic heat map, Mapcite, 3D maps by using above information collected in different stages.

IV. INPUT DATA

Landslide's data of India

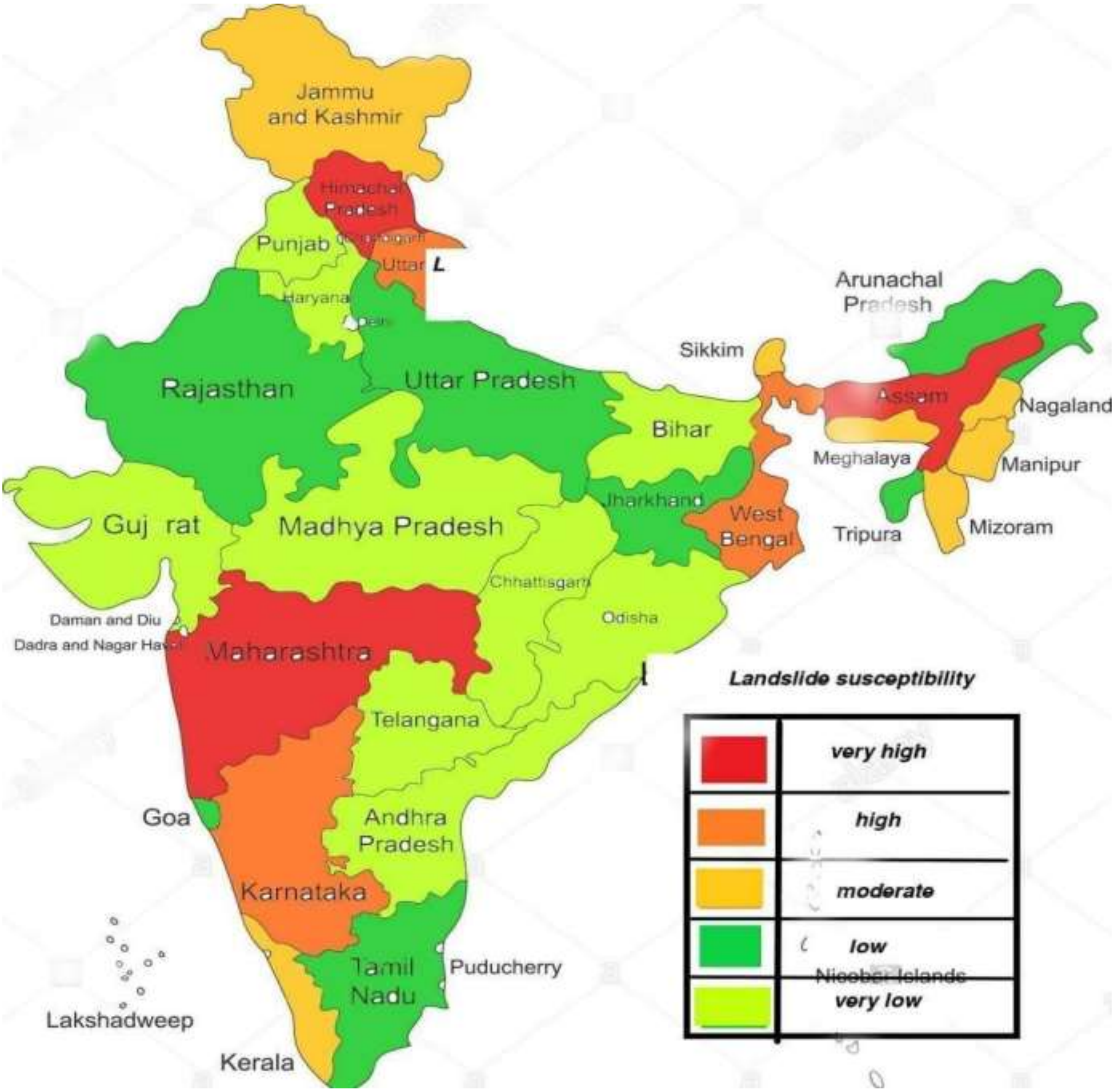
Sr. No	Landslide Name/Type	Location				Source	Date
		Latitude	Longitude	City	State		
1	Landslide incidence in Maharashtra	19.076090N	72.877426E	Mumbai	Maharashtra	www.gsi.gov.in	3rd sept 2009
2	Landslide incidence in Assam	26.2006N	92.9376E	North Cachar	Assam	www.gsi.gov.in	28th aug 2009
3	Landslide incidence in Kerela	11.2588N	75.7804E	Kozhikode	Kerela	www.gsi.gov.in	3rd oct 2009
4	Landslide incidence in Goa	14.9976N	74.0411E	Canacona	Gao	www.gsi.gov.in	2nd oct 2009
5	Lanslide incidence in Karnataka	21.167223N	79.121336E	Madibagh	Karnataka	www.gsi.gov.in	2nd oct 2009
6	Lanslide incidence in Maharashtra	19.0726N	72.8845E	Kurla	Maharashtra	www.gsi.gov.in	19th june 2010
7	Landslide incidence in Meghalaya	25.5788N	91.8988E	Shilong	Meghalaya	www.gsi.gov.in	28th june 2010
8	Landslide incidence in West Bengal	27.0410N	88.2663E	Darjeling	West Bengal	www.gsi.gov.in	16th june 2010

9	Landslide incidence in Himachal Pradesh	31.1048N	77.1734E	Shimla	Himachal Pradesh	www.gsi.gov.in	9th june 2010
10	Landslide incidence in Uttarakhand	30.4598N	78.0644E	Mussoorie	Uttarakhand	www.gsi.gov.in	9th june 2010
11	Landslide incidence in Jammu and Kashmir	33.1457N	75.5480E	Doda	Jammu & Kashmir	www.gsi.gov.in	18th april 2011
12	Landslide incidence at Guwahati	26.1445N	91.7362E	Guwahati	Assam	www.gsi.gov.in	23rd march 2011
13	Landslide incidence in Himachal Pradesh	31.9592N	77.1089E	Kullu	Himachal Pradesh	www.gsi.gov.in	26th feb 2011
14	Landslide incidence in West Bengal	26.8833N	88.2833E	Kurseong	West Bengal	www.gsi.gov.in	27th march 2011
15	Landslide incidence in Uttarakhand	29.5829N	80.2182E	Pitthoragarh	Uttarakhand	www.gsi.gov.in	17th june 2013
16	Landslide incidence in Maharashtra	19.1613N	73.6884E	Malin	Maharashta	www.gsi.gov.in	30th july 2014
17	Landslide incidence in Meghalaya	25.5760N	91.8697E	Mawbah	Meghalaya	www.gsi.gov.in	30 sept 2014
18	Landslide incidence in Himachal Pradesh	21.7645N	72.1519E	Bhavanagar	Himachal Pradesh	www.gsi.gov.in	26 August 2014
19	Landslide incidence in Mizoram	23.7307N	92.7173E	Aizawl	Mizoram	www.gsi.gov.in	27th aug 2015
20	Landslide incidence in Maharashtra	18.7557N	73.4091E	Lonavala	Maharashtra	www.gsi.gov.in	19th july 2015
21	Landslide incidence in Manipur	24.6637N	93.9063E	Jaumol	Manipur	www.gsi.gov.in	1st aug 2015
22	Landslide incidence in Darjeeling	26.8853N	88.1828E	Marik	West Bengal	www.gsi.gov.in	1st july 2015
23	Landslide incidence in Jammu and Kashmir	34.0837N	74.7973E	Shri-nagar	Jammu & Kashmir	www.gsi.gov.in	22nd sept 2015
24	Landslide incidence in sikkim	27.5330N	88.5122E	Bhoteybhir	Sikkim	www.gsi.gov.in	14th jan 2016
25	Landslide incidence in Arunachal Pradesh	24.8649N	92.3592E	Karimgang	Arunachal	www.gsi.gov.in	23rd april 2016
26	Landslifde incidence on NH5	31.1048E	77.1734E	Shimla	Himachal Pradesh	www.gsi.gov.in	2nd sept 2017
27	Landslide incidence at Kotrupi	31.5892N	76.9182E	Mandi	Himachal Pradesh	www.gsi.gov.in	13th aug 2017
28	Landslide incidence at Hathi Parvat	30.2937N	79.5603E	Chamoli	Uttarakhand	www.gsi.gov.in	13th aug 2017
29	Landslide incidence at Jorabat	26.0989N	91.8623E	Guwahati	Assam	www.gsi.gov.in	24th aug 2018
30	Landslide incidence in Kodagu	12.3375N	75.8069E	Kodagu	Karnataka	www.gsi.gov.in	15th aug 2018
31	Landslide incidence in Jaipur	26.9124N	75.7873E	Jaipur	Rajasthan	www.gsi.gov.in	19th aug 2018
32	Landslide incidence on NH-22	26.0306N	81.4554E	Salon	Himachal Pradesh	www.gsi.gov.in	14th aug 2018
33	Landslide incidence at Bhandari	26.0910N	94.2509E	Wokha	Nagaland	www.gsi.gov.in	30th july 2019
34	Landslide incidence at NIT campus	25.9091N	93.7266E	Dimapur	Nagaland	www.gsi.gov.in	26 Oct 2019
35	Landslide incidence at BSUP Complex	23.7307N	92.7173E	Aizawl	Mizoram	www.gsi.gov.in	2nd july 2019
36	Landslide incidence at Amiya Nagar	26.1918N	91.7759E	Guwahati	Assam	www.gsi.gov.in	16th july 2019
37	Landslide at TNEEB colony	11.4916N	76.7337E	Nilgiri	Tamil Nadu	www.gsi.gov.in	6th aug 2020
38	Landslide incidence at Talacauvery	12.3836N	75.4942E	Kodagu	Karnataka	www.gsi.gov.in	6th aug 2020
39	Landslide incidence at	24.8547N	93.6167E	Noney	Manipur	www.gsi.gov.in	15th july

	Noney area						2020
40	Landslide incidence at Kabi village	27.4058N	88.6174E	North sikkim	Sikkim	www.gsi.gov.in	24th may2020

V. OUTCOMES

Landslide susceptibility mapping of India using the past 10 years data.



VI. CONCLUSION

The landslide prone zone map is obtained from various overlying techniques it divides the zones of India into several zones like :
1.Very high
2. High
3. Moderate
4. Low
5. Very low
And after analyzing we got to know that the high susceptibility areas are those where the slopes are high and drainage is more. The susceptibility maps are prepared by finding out the location of landslide. 3D maps by using below information collected in different stages.

VII. REFERENCES

1. Skempton A. W. (1985): Residual Strength of Clays Landslides, Folded Strata and the Laboratory, Geotechnique 35 (1), 3-18.

2. Stark, T. Eid. (1994): Drained residual shear strength of cohesive soils. Journal of Geotech. and Geoenv. Engineering, ASCE, 120 (1), 269-273.

3. Tiwari, B., and Marui, H. (2004): Objective oriented multi-stage ring shear test for the shear strength of landslide soil. Journal of Geotech. and Geoenv. Engineering, ASCE, 130
(2), 217222.

4. Tiwari., and Marui, H. (2003): Estimation of residual shear strength for bentonite -kaolin Toyoura sand mixture. Journal of Japan Landslide Society, Vol. 40, No.2, pp.124-133.

5. Tiwari, B., and Marui, H. (2002: Mechanism of shear zone formation and its effect in residual shear strength, Proceedings of 3rd International Conference on Landslides, Slope Stability andSafety of Infrastructures, 1, 4-13.

6. Gorsevski, P.V.; Gessler, P.E.; Boll, J.; Elliot, W.J.; Foltz, R.B. Spatially and temporally distributed modelling of landslide susceptibility. Geomorphology 2006, 80, 178–198. [CrossRef]

7. Hadmoko, G.S.; Lavigne, F.; Sartohadi, J.; Hadi, P.; Winaryo. Landslide hazard and risk assessment and their application in risk management and landuse planning in eastern flank of Menoreh Mountains, Yogyakarta Province, Indonesia. Nat. Hazards 2010, 54, 623–642. [CrossRef]

8. Van Westen, C.J.; Rengers, N.; Soeters, R. Use of geomorphological information in indirect landslide susceptibility assessment. Nat. Hazards 2003, 30, 399–419. [CrossRef]

9. Van Westen, C.J.; Soeters, R. Landslide hazard and risk zonation— Why is it still so difficult?Bull. Eng.

10. Geol. Environ. 2005, 65, 167–184. [CrossRef]

11. Raymond C. Wilson, (1983): Analysis of a slope failure from earthquake at the Coyote Lake, California

12. R. Anbalagan, (1992): Landslide hazard evaluation and zonation mapping in mountainous terrain

13. Ulrich Kamp, (2008): GIS-based landslide mapping for the 2005 Kashmir earthquake

14. Biswajeet Pradhan, (2010): Regional landslide susceptibility analysis using back propagation neural network model at Cameron Highland, Malaysia

15. Andre Stumpf, (2011): Object-oriented mapping of landslides using Random Forests

16. F. Fiorucci, (2011): Landslide mapping using aerial and satellite images