ISSN: 2456-9348
Vol (02) _Issue (02) Impact Factor: 4.520

iJETRM
International Journal of Engineering Technology Research & Management

LANDSLIDE SUSCEPTIBILITY MAPPING OF SECTOR SHIMLA-BILASPUR-KULU-MANALI

Eshan Gupta,
DivyaGautam
Asst.Prof. Amity University Madhya Pradesh

ABSTRACT
A landslide commonly called landslip, is a topographical inevitable accident. Analysis and mapping of which will provide us with some propitious information for cataclysmic loss reduction. In the following study Geographic Information System (GIS) based Landslide susceptibility map is developed using Analytical Hierarchy Method for the Sector Shimla-Bilaspur-Kulu-Manali (200 Km) in Himachal Pradesh. The data was collected with the help of Linear Imaging and Self Scanning Sensor (LISS-III) mounted on IRS-P6 (RESOURCESAT-1). Based on conjecture, expert advice and literature review the factors considered for the assessment of this catastrophic accident are slope, distance from fault, distance from road, distance from river, land use/land cover and lithology. From the map generated eventually it is observed that about 58% of the total study area is highly sensitive toward this disastrous event.

Key words:
LISS-III, AHP, GIS, NRSC, Remote Sensing, DEM

INTRODUCTION

The most common hazard of Himachal Pradesh is landslide, which causes huge risk to life and property. Landslide occur in this region almost every year influencing it in many ways. The most common cause of occurrence of landslide in this region are (a) Increase in pore water pressure, seepage force and reduction in the effective stress of soil due to heavy rainfall and snowmelt runoff. (b) Disturbance in natural slope due to the activities like cutting, filling for the construction and widening of road (c) Frequent earthquakes, uneven mountain topography, the complex and weak nature of geological structure together with soft soil cover etc favors landslide. Maling (1968), Kinnaur (1982), Luggarbhati (1995) are some of the major landslides that have occurred in Himachal Pradesh that results in huge loss of life, houses, roads, means of communication, agricultural land etc. Landslide hazard mapping is therefore advantageous in this regard, providing much of the basic information essential for hazard mitigation through proper project planning and mitigation. In this study data like Landuse/Landcover Map, DEM, is collected with the help of LISS-III sensor mounted on IRS-P6 (RESOURCESAT-1) and Topological sheets of the study area are collected from Survey of India. Factor considered for this mapping are: slope, distance from fault, distance from road, distance from river, land use/land cover and lithology. All these factor maps were developed and analyzed using AHP in the GIS environment. The resulting map was divided into 6 classes naming Negligible, Very Low, Low, Medium, High, Very High.

STUDY AREA

The study has been done on a sector Shimla-Bilaspur-Kullu-Manali (200 km road stretch) in Himachal Pradesh as shown in the fig1.1. This study area lies between latitudes 3102' N -32016' N and longitude 76044' E -77015'E.
Himachal Pradesh is predominantly a mountainous state located in North-West India. It shares international border with China. The state has highly dissected mountain ranges interspersed with deep gorges and valleys. It is also characterized with diverse climate that varies from semi tropical in lower hills, to semi arctic in cold deserts areas of Spiti and Kinnaur. Altitude ranges from 350 meters to 6975 meters above mean sea level.Himachal Pradesh with its complex geological structures presents a complicated topography with intricate mosaic of mountains ranges, hills and valleys. Composed of recent Alluvium, Shiwalik hills are made up of rocks such as sandstone, shale and clay that came into existence during the Eocene, Miocene and Pliocene period. The climate varies across the state with the altitude as shown in table 1.1

ISSN: 2456-9348
Vol (02) _Issue (02) Impact Factor: 4.520

iJETRM
International Journal of Engineering Technology Research & Management

METHOD OF ANALYSIS

The analytical hierarchy process (AHP) method, developed by Saaty (1980), is a Mathematical method for analyzing complex decisions with multiple criteria. The multicriteria Decision uses hierarchical structures to represent a decision problem, and then develops Priorities for the alternatives based on the decision maker's judgments throughout the system. Its special value to managers is that it can be used to incorporate judgments on criteria. In this study, AHP is used to give the preferences to the different classes considered i.e. slope, drainage, landuse etc. Degree of preferences between two layers is given on the basis of 1-9 scale

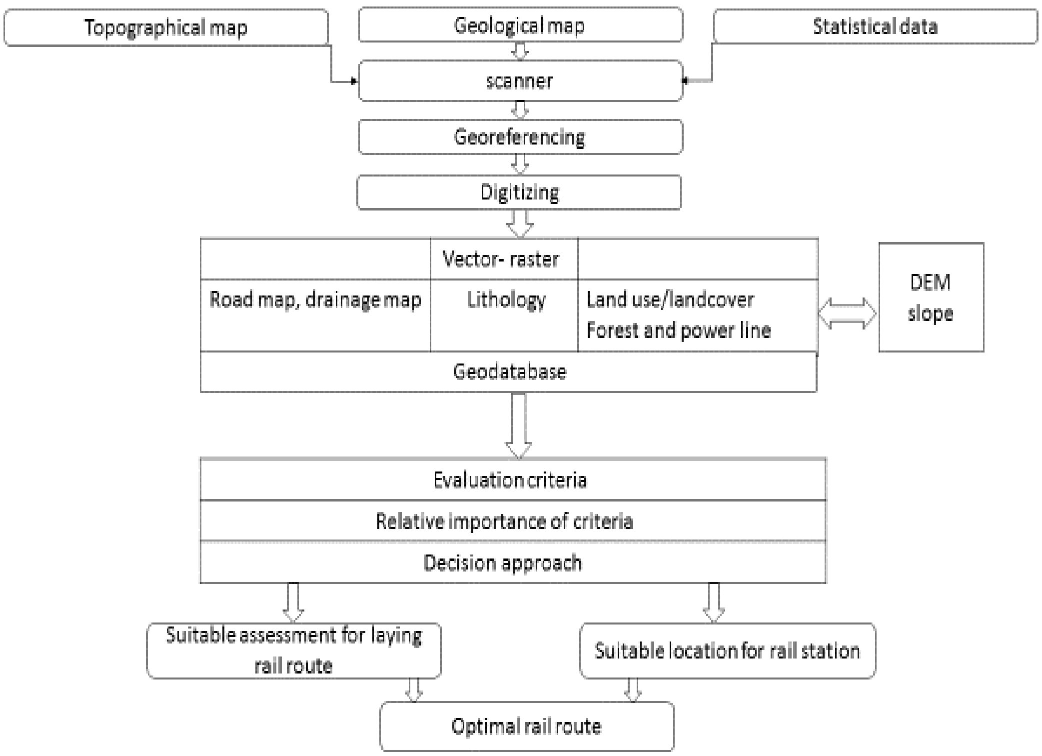

FIG: METHOD OF ANALYSIS

PROCEDURE

Generation of GIS database

In landslide susceptibility mapping lot of spatial data is to be handled. GIS is a tool that can handle huge amount of spatial and non-spatial data. It can store, integrate and manipulate the spatial and non-spatial data. Generation of GIS database is a important step in landslide susceptibility mapping. The data in the GIS is to be stored in form of layers at one place along with specific coordinates and attributes. The various type of data i.e. maps, photographs, tables etc are to be stored in the system. The whole data is then geo-referenced to make a relationship of these data in computer with the data on the ground. The maps are scanned and stored in system. The whole data in the system is then digitized so that GIS software can understand this data. The different data is stored in the form of thematic layers in a single coordinate system. This data is analysed using the spatial analyst tools.

RESULTS

The final output of the study that is the landslide susceptibility map is shown in the Figure 6.1. It is divided into six zones. The six zones of susceptibility are negligible, very low, low, moderate, high and very high susceptibility zones. It is seen from the pairwise comparison matrices that the slope has highest value of weight and it is considered the most important factor that is responsible for landslides in the area. Lithology and land use also have significant effect on occurrence of landslides. Lithology is second most significant factor that is responsible for the occurrence of landslides. Distance from the drainages considers the effect of water on the slope stability. Distance from the fault take into account the effect of seismic forces on the landslide occurrence, but it has least weights that is assigned to it.

Lithology and land use of the study area has a significant effect on the occurrence of landslides. It is found that maximum landslides have occurred in the alluvium material. The reason is that the alluvium is soft and easily susceptible to failure. Metavolcanics, granite, quartzite and phyllite covers a very small part of the study area and hence has the least effect on occurrence of the landslide.

A final landslide susceptibility map is prepared and it is shown in Fig. 6.1. From the map, it is observed that about 47% of the total study area lies under high susceptibility. While a small area i.e. about 13% is very highly susceptible to landslides. Hence this 60% area is highly sensitive and occurrence of landslides in this area is most probable. It is also found that most of the landslides take place on the curves. It is necessary to take care of such area that is under high and very high susceptibility. The mitigation measures should be taken for such areas. The area that is moderately susceptible to landslides can get converted into high susceptibility if mining and construction activities take place there in future.

CONCLUSION

The obtained results of static and dynamic analysis in OMRF & SMRF are compared for different columns under axial, torsion, bending moment and displacement forces. The results in graph-1 shows that there is equal values obtained of axial forces in static and dynamic analysis of OMRF structure. The results in graph-2 shows that the values are obtained for torsion in static analysis are negative and dynamic analysis values are positive. The results in graph-3 here we can observe that the values for bending moment at dynamic analysis values are high in initially for other columns it decreased gradually as compared to that of static analysis. The results in graph-4 we can observe that the values for displacement in static analysis of OMRF values are more compared to that of dynamic analysis values of same columns. The results in graph-5 shows that the values obtained of axial forces in dynamic analysis of SMRF structure values are high compare to static analysis. The results in graph-6 shows that the values are obtained for torsion in static analysis are negative and dynamic analysis values are positive with more difference. In the results graph-7, we can observe that the values for bending moment at dynamic analysis values are more as compared to that of static analysis SMRF structure. In the results graph-8, we can observe that the values for displacement in dynamic analysis of SMRF values are gradually increased compared to that of static analysis values of same columns. The static and dynamic analysis of OMRF & SMRF values are observed. Finally it can conclude that the results of static analysis in OMRF & SMRF values are low when comparing to that of dynamic analysis in OMRF & SMRF values. Hence the performance of dynamic analysis SMRF structure is quiet good in resisting the earthquake forces compared to that of the static analysis OMR.

REFERENCES

[1] Phukon, P., Chetia, D. and Das P., "Landslide Susceptibility Assessment in the Guwahati City, Assam using Analytic Hierarchy Process (AHP) and Geographic Information System (GIS)," International Journal of Computer Applications in Engineering Sciences, Vol II, Issue I,pp. 1-6, March 2012,.

[2] Soyoung P, Chuluong C, Byungwoo K and Jinsoo K, "Landslide susceptibility mapping using frequency ratio, analytic hierarchy process, logistic regression, and artificial neural network methods at the Inje area, Korea," Springer-Verlag, pp. 1443-1464, 2012

[3] He-Chun Q and Byung-Gul L, "GIS-Based Landslide Susceptibility Mapping Using Analytic Hierarchy Process and Artificial Neural Network in Jeju (Korea)," Springer, Vol. 16(7),pp. 1258-1266, November 2012.

[4] Hamid R. ,Biswajeet P and Candan G, "Application of fuzzy logic and analytical hierarchy process (AHP) to landslide susceptibility mapping at Haraz watershed, Iran," Springer, pp.965-996, 2012.

[5] Mohammad R and Mansouri D, "Landslide susceptibility zonation using analytical hierarchy process and GIS for the Bojnurd region, northeast of Iran," Springer-Verlag Berlin Heidelberg, pp. 1079-1091, 2013.

[6] Rozos. D, Bathrellos .G and Skillodimou. H, "Comparison of the implementation of rock engineering system and analytic hierarchy process methods, upon landslide susceptibility mapping, using GIS: a case study from the Eastern Achaia County of Peloponnesus, Greece," Springer-Verlag, pp. 49-63, 2010.

[7] Sujit M and Ramkrishna M, "Landslide Susceptibility Analysis of Shiv-Khola Watershed, Darjiling: A Remote Sensing & GIS Based Analytical Hierarchy Process (AHP)," Indian Society of Remote Sensing, pp. 483-496, 2011.

[8] Reis. S, Yalcin .A, Atasoy.M, Nisanci. R, Bayrak. T, Erduran. M, Sancar. C, and Ekercin. S, "Remote sensing and GIS-based landslide susceptibility mapping using frequency ratio and analytical hierarchy methods in Rize province (NE Turkey)," Springer-Verlag, pp.2063-2073, 2011.

[9] H. R. Pourghasemi, H. R. Moradi and S. M. FatemiAghda, "Landslide susceptibility mapping by binary logistic regression, analytical hierarchy process, and statistical index models and assessment of their performances," Springer Science+Business Media Dordrecht, pp. 749-779, 2013.

[10] Sujit M and Ramkrishna M, "Integrating the Analytical Hierarchy Process (AHP) and the Frequency Ratio (FR) Model in Landslide Susceptibility Mapping of Shiv-khola Watershed, Darjeeling Himalaya," Int. J. Disaster Risk Sci. Vol. 4(4), pp.200-212, 2013.

[11] Vahidnia .M, Alesheikh. A, Alimohammadi.A and Hosseinali.F, "Landslide Hazard Zonation Using Quantitative Methods in GIS," International Journal of Civil Engineerng. Vol. 7(3), September 2009.

[12] Jaewon C, Hyun-Joo .O, Joong-Sun .W and Saro .L, "Validation of an artificial neural network model for landslid susceptibility mapping," Springer-Verlag, pp. 473-483, 2009.

[13] Tsangaratos. P andBenardos. A, "Estimating landslide susceptibility through a artificial neural network classifier," Springer Science+Business Media Dordrecht, pp. 1489-1516, 2014.

[14] Zeng-wang .X, "GIS and ANN model for landslide susceptibility mapping," Journal of Geographical Sciences, Vol.ll (3),2001.

[15] Marrapu. B and Ravi. S, "Landslide Hazard Zonation Methods: A Critical Review," International Journal of Civil Engineering Research, Volume 5(3),pp. 215-220, 2014.

[16] D. P. Kanungo, M. K. Arora, S. Sarkar and R. P. Gupta, "Landslide Susceptibility Zonation (LSZ) Mapping - A Review," Journal of South Asia Disaster Studies, Vol. 2 (1) June 2009

[17] Kundu. S, Sharma. D, Saha. A, Pant.C and Mathew. J, "GIS-Based Statistical Landslide SuseptibilityZonnation: A Case Study in Ganeshganga Watershed, The Himalaya," 12th Esri India User Conference 2011.

[18] Chau. K, Sze. Y, Fung. M, Wong. W, Fong. E and Chan. L, "Landslide hazard analysis for HongKongusing landslide inventory and GIS," Computers & Geosciences 30, pp. 429-443, (2004) .

iJETRM
International Journal of Engineering Technology Research & Management

[19] Sarkar. S and Kanungo .D, "Landslide SuseptibilityZonnation in india: A Review," International Conference on Geotechnical Engineering for Disaster Mitigation & Rehabilitation.

[20] Divya Gautam, Dr. Vrinda Tokekar, "An approach to analyze the impact of DDOS attack on mobile cloud computing" , IEEE 2017 International Conference on Information, Communication, Instrumentation and Control