Landslide Hazard Zonation Using the Bivariate Statistical Models in Nazlochai Basin

Ahmad Najafi Eigdir[1*], Shahram Roostaei[2], Asadollah Hejazi[3], Masomeh Rajabi[4], Nader Jalali[5]

1- Geomorphology Ph.D, Student, Department of Geomorphology, Tabriz University, Tabriz.
2- Geomorphology Professor, Department of Geomorphology, Tabriz University, Tabriz.
3- Geomorphology Associate Professor, Department of Geomorphology, Tabriz University, Tabriz.
4- Geomorphology Professor, Department of Geomorphology, Tabriz University, Tabriz.
5- Geography Assistant Professor, Soil Conservation and Watershed Management Research Institute, Iran.

1-Introduction

Landslides are influential factors in human life that are not well-known. Several factors have contributed to the occurrence of landslide that could increase the risk of landslide in any area. Identifying these factors and their value can help to appropriate landslide zonation. The classification of areas susceptible to sliding and hazard zoning is an important step in assessing environmental hazards and plays an indelible role in the management of catchment areas (Sakar, 1995). Therefore, knowing the most important factors affecting slip instability and slipping will help us to make developmental plans using appropriate methods. Therefore, by using statistical models, their vulnerability to landslide is identified and zoned by assessing and validating them. Landslide inventory map is the best method for designing a landslide hazard map based on aerial photo interpretation, field surveys, and historic landslides. Then, the spatial distribution of mass movements is presented as a point or polygon on the map. The purpose of this research is to investigate various and effective factors in the occurrence of landslides, as well as to evaluate and compare the effectiveness of statistical models in landslide hazard zonation in Nazlochai basin and introducing the most appropriate methods.

2-Methodology

In order to investigate the landslide susceptibility zonation, the provision of a landslide inventory map is the most important part of the work, which can be done by using of geographic information systems with high accuracy. The accuracy of landslide zonation is largely dependent on this stage. So, at first, the existing landslides were identified by using various tools including aerial photos, satellite imagery (Google Earth), existing information, GPS, and in particular field surveys. In the present study, ten factors affecting the occurrence of landslides were considered: elevation, slope, gradient direction, distance from the waterway, distance from the road, distance from the faults,

* Corresponding Author; **E-mail:** Najafieigdir@ITC.nl

lithology, land use, rainfall and vegetation index .For landslide zonation, bivariate statistical models, including Gupta-Joshi model with its correction method, information value method, and surface density method have been used.

3-Results and Discussion

For landslide hazard zonation using the Bivariate Statistical Models, various factors including elevation, slope, gradient direction, distance from the waterway, distance from the road, distance from fault, lithology, landuse, rainfall and vegetation index were studied. Existence and density of landslides in the western slopes show the role of geological formations, the distance from the waterway and precipitation in the occurrence of landslide. To evaluate the accuracy of the Bivariate Statistical Models, the density ratio index and the quality sum index were used. The more distinction between risk classes is, the model is more capable, and the quality sum index is used to compare the performance of different models. Finally, with respect to the resulting values, the zoning with the information value and surface density models were found to be desirable for the studied area.

4-Conclusion

According to the results of zoning (using the Bivariate Statistical Models), lithology, distance from the waterways and precipitation are the most important factors controlling the landslide occurrence in the studied area. Particularly lithologic factors are of great importance. Most of the landslides in the study area occurred on limestone and conglomerate, which are similar to the results of the research Amir Ahmadi who worked for Iran, while these formations do not have enough area in the basin. Limestone and a small amount of dolomitic limestone with an occupancy level of 15.5% of the basin, contain more than 30% of landslides. More importantly, limestone is coinciding with north orientation that confirms the role of gradient direction in occurrence of landslides. Although some scholars ignore the role of gradient direction (A. Gemitzi, 2011), other researchers (Carrara et al., 1991; Roostaei et al., 2017) have taken it into account in their research. The impact of the human factor mainly depends on changing environmental conditions, such as road construction, inappropriate plowing, excessive grazing and water diversion for agricultural use. Therefore, by studying the researches in Iran and in different parts of the world, the slipping factors in different basins and regions are not the same and in fact, different slip conditions are present in different regions.

Keywords: Bivariate Statistical Models, Geographical Information System, landslide hazard zonation, Nazlochai basin, West Azarbaijan

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