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Prioritization of Affecting Factors on the Landslide Occurrence using the Logistic Regression Model (Case Study: Nazlochai Basin)

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Abstract

1-Introduction

Several factors have contributed to the occurrence of the landslide that could increase the risk of landslide in any area. Identifying these factors and their value can help to appropriate landslide zonation. The aim of the study is to find ways to reduce the damages caused by them, which makes it necessary to zoning the susceptible areas that play an undeniable role in watershed management. Therefore, by using statistical models and assessing them, the sensitive areas to the occurrence of landslide are identified. In this research, the landslide hazard zonation was performed based on the data-driven method. Based on this method, the zoning was done based on the use of slope data, aspect, elevation, precipitation, vegetation, geology, land use, distance to fault, distance to river, and distance to road. To validate the model, the ROC curve has been used which is a new and efficient method for verification. The purpose of this research is to investigate various influencing factors that affect the landslide occurrence in the Nazlochai basin.

2-Methodology

In the methodology section, the satellite imagery processing (to identify and extract landslides, vegetation extraction, and land use) and logistic regression model have been discussed for landslide hazard zonation. In this study, by reviewing the previous sources (Mir Nazari, et al., 1393,

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Abedini, et al., 1393, Ayalew, et al., 2004, Ebadinejad, et al., 2007) and by investigating various factors (morphometric, climatic, and human) in Nazlochai basin, ten effective factors (elevation, slope, aspect, distance to river, distance to road, distance to fault, lithology, landuse, precipitation, and vegetation) on the landslide occurrence in the area were considered. The ArcGIS software was used to digitize and provide information layers for landslide hazard zonation, and the ENVI software was used for image processing, vegetation extracting, and land use mapping. Existing landslides were identified and characterized using various tools including aerial photos, satellite imagery (Google Earth), existing information, Global Position System (GPS), and field surveys.

3-Results and Discussion

The obtained coefficients indicated that the occurrence of landslide in the studied area had a direct relation with lithology, slope, and aspect factors, and weak relation with landuse, distance to fault, precipitation and distance to river. Lithology investigation of the region indicated that the more landslides have occurred on calcareous and conglomerate stones, which could be due to the development of the slopes and the accumulation of destructive materials on them. Slope is one of the slippery factors due to gravity and decreasing shear strength of soil in slopes of more than 10% to 45% leads to instability which in most researches is considered as an effective factor, too. Also, north slopes are more susceptible to landslide than the southern slopes due to the reduction of normal pressure and shear strength of the soil. By considering the Pseudo R-square index (equal to 0.34), which is greater than the threshold (0.2), this model shows acceptable fit. The area under the ROC curve was equal to 0.958, which shows a strong correlation with predicted landslides by the logistic regression model. Finally, the study area was classified into 5 landslide hazard classes include very low, low, medium, high, and very high.

4-Conclusion

In this research, landslide hazard zonation has been done using the logistic regression model in the Nazlochai basin. The coefficients of variables indicated that the occurrence of landslide in the study area had a direct relationship with the lithology, slope, and aspect factors; and weak relationship with landuse and distance to fault. Thus this indicates the probability of landslide occurrence increases by changing in lithology, slope, and aspect.

Keywords: Landslide Hazard Zonation, Geographical Information System, Logistic Regression Model, Nazlochai Basin, West Azerbaijan

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