

Landslide hazard zonation using AHP model and GIS technique in Khoram Abad City

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Extended abstract

1- Introduction

The increasing growth of urban and rural development has caused some natural anomalies in the Earth's inhabitants. Mass movements, especially landslides, are one of the most damages of them that have had the increasing momentum together human manipulation in natural systems in recent decades. So that it is one of the principal geomorphic processes in the mountainous areas. Landslide phenomenon occurring in many parts of the world and Iran in the favorable conditions causes the destruction of vegetation, orchards, farmlands, and even human casualties. According to estimates, landslides have imposed much financial damages about 500 milliard Rials to Iran, annually.

Burying of Abikar village of Charmahal-o-Bakhtiari Province in spring 1997 year is one of the clear samples of landslide human damage. Among these, the Lorestan Province is one of the most susceptible sites of landslide occurrence in Iran. The occurrence about 274 landslides in Lorestan Province, with extent 1400km² equivalent %4.8 of its area confirm this claim. Since the exact predication of landslides occurrence isn't possible by human sciences, thus, we can prevent from the damages of this phenomenon by identification of landslide susceptible areas and prioritizing them. Landslide hazard zonation maps can help the environmental designers and engineers to select a suitable place for development projects implementation. The results of these studies can be used as fundamental information by environmental managers and planners.

The purposes of this study are the recognition of effective factors in landslide and the zonation of Khoram Abad City in terms of the occurrence of this phenomenon using the AHP model

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and GIS technique. Therefore, selection of criteria and standards, providing of factors raster layers, determining of relative and final weight of factors, overlaying of layers and preparing landslide hazard zonation map are the major objectives of this research to determine sensitive sites that have the maximum occurrence probability of landslide.

2- Methodology

The studied area is Khoram Abad City, center of Lorestan province, which has been located in the 32°, 45' to 34° North latitude and 47°, 30' to 49° East longitude (Fig. 1).

At first, study area was investigated and determined its extent using satellite images of Google Earth and 1:50000 topographic maps. Then, according to Geological, Geomorphologic, Hydrological, Climatic, Human and Environmental characteristics of study area and using comparative studies and results of other researchers, 5 criteria, 13 sub-criteria and 77 classes were identified to achieve the goals. The needed Layers of landslide hazard zonation were prepared using Arc GIS 9.3 software. These layers are elevation class, slope, aspect, distance from stream, stream density, distance from way, distance from fault, distance from settlement, lithology of Earth material, landuse, land unit, isohyets and isotherm maps (Fig. 2). Also, effecting factors were evaluated through AHP model, and their weights were determined. Finally, the landslide hazard zonation map of study area was presented using weight exertion of factors in their layers and integration of them by Arc GIS software. In the end, the presented model and zonation map were compared with observed landslide, and

landslide index values and model accuracy were calculated.

3- Discussion

The AHP is a structured technique for dealing with complex decisions that was developed by Thomas L. Saaty in the 1980 year. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions.

First step in AHP is the decomposing of decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. Overall form of hierarchy can be as following:

1. Goal, criteria, sub-criteria, alternative.
2. Goal, criteria, factor, sub-factor, alternative.

Present study has been used first structure for landslide hazards zonation of Khoram Abad City that its result include figure (3).

Once the hierarchy is built, the various elements are evaluated by comparing them to one another two at a time, with respect to their impact on an element above them in the hierarchy. The AHP converts these evaluations to numerical values that can be processed and compared over the entire range of the problem. These evaluations are converted to numerical values between 1 and 9 by Saaty (1980) that have been presented in table (1). The obtained result of weighting, comparative matrixes and relative weight calculation of factors affecting landslide hazard zonation in study area is presented in tables (2) to (6).

In the final step of the process, numerical priorities are calculated for each of the alternatives. These numbers represent the alternatives' relative ability

to achieve the goal, so they allow a straightforward consideration of the various courses of action. The obtained results of final weight calculation of priorities have been showed as equations (4) to (9).

4- Conclusion

Once the significant of criteria matrix is confirm, final weight of factors is multiplied in their layers to prepare zonation map. For correct application of the obtained weights, and presentation of final model, Raster Calculator and Weighted Sum methods have been used respectively. Figure (4) is final result that shows landslide hazard zonation map in Khoram Abad City.

Results of integration of landslide hazard zonation map with observed landslide map and calculation of landslide index have been showed in table (9). The values of mentioned index represent the ascending trend of this index from very low risk to very high risk zone. The ascending trend illustrates the accuracy of landslide hazard zonation model. The results of table (9) show that very low risk zone busies %16.8 of Khoram Abad City area, but is included %10.4 of landslide area. Furthermore, very high risk zone is included %6.17 of Khoram Abad City area and %7.9 of landslide area.

5. Discussion and Conclusion

The landslide phenomenon is one of environmental hazards which occur in Khoram Abad City in most times. Therefore, creation of one regional strategy is very necessary to reduce its damages and maintains natural and human resources. Furthermore, landslide hazard zonation map can help research centers in environmental management and planning. In this study, GIS technique and AHP model have been used to

achieve goals. The results showed that integration of GIS technique and AHP model is a mighty method for preparation of landslide hazard zonation map in study area.

According to effective factors in landslide occurrence, the study area was zoned as various layers. Finally, landslide occurrence zones were recognized from very low risk to very high risk. The investigations showed the zones of very high and high risk are often coinciding with settlement sensitive areas. This represents the factors such as unsuitable site selection of the settlement centers and communication ways and the changing of landuse by humans in Khoram Abad City.

Among the effective factors, sub-criteria of distance from way, distance from stream, stream density and distance from fault, respectively, with weights 0.2043, 0.1717, 0.1545 and 0.1076 have been identified as the most important factors in the development of landslide in study area. The role of other factors reduces according to their weights in landslide that has been showed in table (3). According to presented model and final zonation map, about 25.51 percent (1603.8 Km²) of the Khoram Abad City area have the occurrence of very high risk (%6.17 equal to 387.9 Km²) and the occurrence of high risk (%19.34 equal to 1215.9 Km²). The great extent is showing the landslide occurrence importance in the future that doubles the necessity of its management issues. The results obtaining accuracy evaluation of the model, illustrate ascending trend of the landslide index from very low risk to very high risk zone.

Keywords: Landslide, Zonation, Khoram Abad, AHP Model, GIS technique.

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