Evaluation and Zoning the Risk of Rock Falls in the Band Area of Urmia (Urmia-Silvana Road Path) using Anbalagan Method

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1 Introduction

Hillside instabilities, including the separation of rock fragments from heights and their displacement are under the influence of various forces of natural phenomena which occur abundantly in Rocky Mountains every year. The Uremia–Silvana road with approximately 14 kilometers in length passes through Band village, which has lost almost its rural form. Band is a mountainous village and is located in a mountainous region and it has great sights that have turned this promenade to the natural attraction for Uremia city. In addition to this, the river of Chai city passes through the middle of this village and also the dam of the Chai city which is one of the most beautiful dams in Iran lies in the west of this village and adds to the beauty sights of this area. From the villages around study area, we can mention to the Mir Abad village in the north of it, as well as the villages of Nowshan Sefli and Nowshan Alia in west and the village of Shamlakan in the south of the promenade. We saw major natural hazards, including Hillside instability, such as creep, rock falls, debris and the presence of loose alluvial deposits in the place of trenches using the (GPS) device by scientific literature, library resources, indigenous knowledge, interviews with

2 Materials and Methods

Various methods have been proposed by scientists and researchers for zoning, each of which has been presented for a specific purpose and for a specific region. In this research, was used of the Anbalagan zoning method that is one of the most common methods for zoning of Natural hazards. This method helps designers and engineers significantly for implementation of development plans in mountainous areas. The mentioned method depends on the major factors that have effect on Hillside instability, such as geology, gradient, land use and land cover, height difference, and so on. In this research, first data collection was done from the exact position of the hazards, including creep, rock falls, debris, and the presence of loose alluvial deposits in the place of trenches using the (GPS) device by scientific literature, library resources, indigenous knowledge, interviews with

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residents of the area and extensive scaling in the study area and after field surveys and studying satellite images, prepared points in field have been provided as a separate layer in (Arc GIS) software and to avoid computational error of software, we reviewed the scope of the study area and identified it with polygon. And in this paper, weighted values that are considered for classification of maps of different factors are from 1 to 10. In this paper, the number 1 has been chosen as the maximum risk for each unit, and the number 10 is our optimal one. The characteristics of the effective parameters in the risk evaluation and how to value them, has been done as follows.

3 Results and Discussion

Rocks fall in mountainous areas is a natural phenomenon and their occurrence is a natural event. But when rocks fall threatens human lives (financially and mortally) becomes a natural hazard, and are considered as natural disasters in a situation where there are many mortal and financial losses as a result of their occurrence, however, the collapse of hard and connected to Hillside rocks threats the stability of the area due to the climatic territory and the type of rocks and their characteristics. This instability is for urban and rural housing, recreational and tourist facilities and industrial plants located on subcutaneous or roads that cross mountainous areas. As can be seen in (Fig. 5) and has been shown on the satellite map of the study area with points (3, 4, 7, and 6) (Fig. 6). The fall of rocks has threatened rural buildings and roadway and gas and electricity pumping stations in the region. Severe fluctuations in round the clock temperature, especially at elevations above 1600 meters, lead to intensified chyroclasty activity. In this way, in addition to rural houses and vital facilities, roads were bounded on one side or on either side by a very steep wall of the slopes are continually threatened with the risk of falling large and small rock pieces. In particular, if the earth-forming rocks have several grooves and joints and dialects. Water penetration in the grooves and temperature changes to the point where it is suitable for freezing and melting are led to gradual dismemberment and the provision of coarse fragments and debris. The resulting fragments are collected at the down of the slopes which often have slope cuts or on slopes with gradient less than 35 degrees or 40 degrees. But if the balance of the gradient of the debris collapses for any reason or the gradient of slope is greater than 40 degrees, the fragments obtained from mother rock fall only under the influence of gravity as soon as they are separated from its wall.

1- The fractures of the studied area are the most noticeable tectonic effects, as has been shown at the points (10, 11, and 12) in the satellite image (Fig. 6) jointing along with erosion leads to the crushing of lava on the roadway. Rock falls can attack large structures such as dams and bring damages to their secondary facilities. that of course, rock falls in the 21 point and surrounding areas of the Chai city dam (pebble soil reservoir dam with clay core with a height of 119 meters from the foundation and 84 meters high from the bed and a crown length of 550 meters has been located in the west of the village of Nowshan Alia) has been shown in the satellite image of figure 6. That in this regard, the necessity of using rock falls stabilization methods should be on the agenda to prevent possible damages (Fig. 8). Rocks have become to large and small fragments and as a result of gravity has fallen to the down the hillside. Figure (7), So that they have been formed with steep gradients towards layers that indicate mild flaking in the region and
show good correlation with the condition of flaking of the rock units in many cases. Most of these fractures are tectonically young.

2- Extreme motility of drift and hidden faults has caused severe crushing of rocks and has created fractures and join on the Uremia- Silvana road.

3- Due to climate change during the year in the study area, the climate along with tectonic factor have caused severe erosion of the outcrops in the area and have increased the volume of debris at down the mountains.

4- Tectonization of the study area is the main reason for rock falls in the region, therefore, as shown in the map of zoning of the risk level in the region, villages and communication routes are affected by faults and hillside falls in high risk areas.

5- According to the zoning the risk level map in the studied area, engineering structures with foundation point such as power distribution stations and very large engineering structures such as Chai city dam are located in areas with medium to very high risk. Therefore, hillside stabilization operation should be done in these areas.

6- In addition to rock falls, the phenomenon of creep has been seen in some parts of the villages in the area and communication paths due to the high groundwater level and the presence of loose alluvials with a height of more than 7 meters in the studied area. That the villages and communication paths should be moved into lower risk areas according to the zoning of hazard levels map.

4 Conclusion

The Uremia - Silvana road is located in the southwest of the city of Uremia. This road has been started from the beginning of the Band road and has been extended from the promenade and tourist area of Band of Uremia. The purpose of this study is to determine the high risk areas using software (ArcGIS 10) and the Anbalagan zoning method from the point of view of hillside instability in the above axis and villages in the region. For this purpose, 14 layers (fault, height, stream, slope, slope direction, detrial rocks (OMS), alluvial deposits, vegetation, hazard points, village, city, dam, road and rural roads) were prepared. And by weighting to risk factors and using the rock fall hazards zoning map of the study area we divided the results into five groups: According to the desired map, from the total of 7441.07 hectares from the study area, 1509.73 hectares are in a very high risk area, 2330.47 hectares are in a high risk area, 1980.14 hectares are in the medium risk range, 1150.66 hectares are in a low risk area and 470.07 hectares are in a very low range. All villages (Band, Janesloo, Nowshan Alia and Sefli) have been located in high-to-middle risk areas. The highest concentration of high-risk areas is in the west, south-west. Most rural roads are located in low-to-middle risk areas and only 2 kilometers from the main road of 14 kilometers are located in a low-risk and safe range. By adapting the map of the incident points with the zoning map, we conclude that most rock falls and debris are located in a medium-to-very high risk zone. Chai city dam has been located in a medium-risk range, but the hillsides around the dam are high-risk areas that rock falls in them threatens the Chai city dam.

Keywords: Rock fall, Zoning, Anbalagan method, Band of Uremia
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