International Journal of Computational and Experimental Science and Engineering (IJCESEN)
Vol. 3-No.2 (2017) pp. 1-4
http://iakkurt.dergipark.gov.tr/ijcesen

ISSN: 2149-9144

Research Article

Evaluation of Rock Fall Risk in Kilis (Turkey) City by Using GIS and Remote Sensing

Mehmet Ali ÇELİK[1]*, Ali Ekber GÜLERSOY[2]

[1]Kilis 7 Aralık University, Science and Arts Faculty, Geography Department, 79000, Kilis-Turkey
[2]Dokuz Eylül University, Buca Faculty of Education, Social Studies Department, 35150, İzmir-Turkey

* Corresponding Author : mehmetalicelikk@gmail.com

(First received 25 November 2016 and in final form 20 May 2017)
[#] Presented in "3rd International Conference on Computational and Experimental Science and Engineering (ICCESEN-2016)"

Keywords
GIS
Natural disaster planning
Rock fall
Kilis
Remote sensing

Abstract: Rapid increase in population results in rapid but not planned growth of residential areas and subsequently residential areas shift from their initial position to various risk including regions. Natural disasters are inevitable once the cities are not properly planned in countries like Turkey characterized with geological, geomorphological and climatological diversity. It is worthy to note that disaster risk profile in Turkey is very high according to the natural disasters historical data. Of the natural disasters, rock fall is one of threats for Turkey. The definition of rock fall may be simplified as quantities of rock falling freely from a cliff face. In order to monitor the possible and potential rock fall risks, base maps of the study area (Kilis, Turkey) was obtained using geographical information system (GIS) techniques and remote sensing data. The base maps were produced considering the parameters affecting the rock fall. Finally, rock fall risk map for the region was obtained by overlapping the maps using GIS techniques. The results exhibit that 3.22 % of the regions has high potential risk of rock fall. Based on the results, local decision makers concerned with urbanization plans should consider the regions with high rock fall risks. Otherwise, the loss of life and property is inevitable as consequences of natural disasters.

1. Introduction

The rapid increase in World population in rapid growth of residential areas and subsequently residential areas shift from their initial position to various risk including regions (Değerliyurt, 2014: 656). Natural disasters are inevitable once the cities are not properly planned in countries like Turkey characterized with geological, geomorphological and climatological diversity. It is worthy to note that disaster risk profile in Turkey is very high according to the natural disasters historical data. Of the natural disasters, rock fall is one of threats for Turkey. The definition of rock fall may be simplified as quantities of rock falling freely from a cliff face. Between1950-2005, 899 residential areas were exposed to rock fall (Polat and Güney, 2013: 208).

In the recent technological and scientific advances, the evaluation and map productions with respect to the rock fall are performed using GIS techniques. This technique provides great conveniences in relation to the saving data in digital media, map production and presentation of data to the users (AFAD, 2015: 7). In this context, the most preferred method is to produce sensitivity maps. Herein, it is targetted to monitor the dangerous and risky areas with the maps and then make predictions concerned with reduction of rock fall in the present and possible future rock fall risk evaluation are interests of the current study.

In order to monitor the possible and potential rock fall risks, base maps of the study area (Kilis, Turkey) was obtained using geographical information system (GIS) techniques and remote sensing data. Finally, rock fall risk map for the region was obtained by overlapping the maps using GIS techniques. The created risk map of rock-fall would function effectively in decision-making mechanisms for many state institutions in Kilis city.

Thus, the possible rock fall would be prevented and it should be highlighted that the potential risk of rock fall is the consequence and dependent on the unplanned establishment of residential areas.

2. The Study Area and Its Geographical Characteristics

The study area is surrounded with regions of Mediterranean and Southeastern Anatolia and Syrian border and the study area is at transition point among climate zones of Mediterranean, steppe and arid (Figure 1). Therefore, in the restricted and short distances, climate, vegetation, slope and geomorphological characteristics differ and this influences the extent of rock fall in the study area.

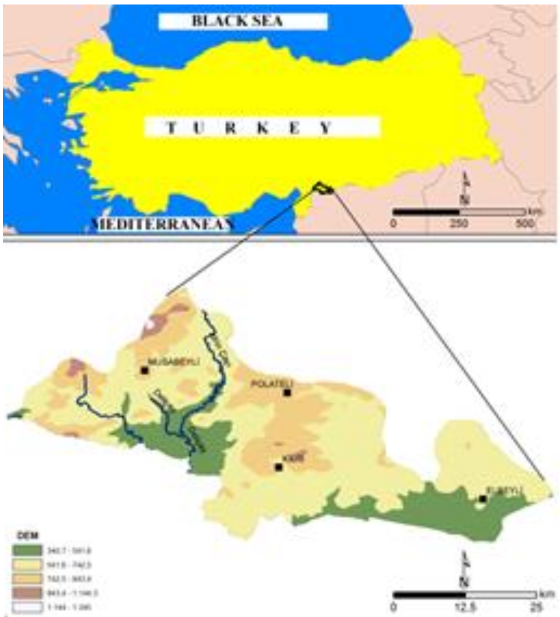

Figure 1. *Location of Kilis City.*

3. Material and Method

Various method and techniques are used in preparation of risk maps of rock fall. In addition to the conventional methods (Polat and Güney, 2013), GIS techniques are used (Lee et al., 2005) in the present. GIS and RS-based modelings are of the most common methods. By means of those modellings, the possible influential factors and their extent on rock fall as well as probability of rock fall anywhere can be predicted.
Therefore, ''Multi-Criteria Decision-Making'' model was performed using GIS and RS methodologies. For the model, altitude, slope, lithology, geomorphology, land cover closure, rainfall and aspect were used in order to determine possible rock-fall risk of the study area. 1:25.000 scale topography maps for each parameter (of altitude, geomorphology, slope and aspect) was digitized using GIS and databases of these parameters were composed. Of the factors representing the rock fall risk, lithological database was composed using similar methods. The 1:25.000 scale geology map of the study area provided from MTA (Mineral Research&Exploration General Directorate) in order to determine the lithological features was used as a base map (Table 1).

Base	Classes	Class value	GIS weight value
Lithology	Clastic Rocks	5	6
	Unaltered Volcanits	4	
	Sedimentary Rocks	3	
	Alluvion	1	
Slope (Incline)	9≥	4	5
	06-9	3	
	03-06	2	
	0-3	1	
Distance to Fault Line	≤100	5	4
	100-500	4	
	500-1000	3	
	1000-2000	2	
	1000≥	1	
Aspect (Exposure)	S-SE-SW	5	3
	N-NE-SW	3	
	E-W	2	
	Straight (Flat)	1	
Closure for Land Cover	Bare	5	3
	Medium	3	
	Dense	1	
Altitude	1200≥	5	2
	900-1200	4	
	700-900	3	
	500-700	2	
	300-500	1	
Geomorphology	Slope (Side)	5	2
	Mountain	3	
	Plateau	2	
	Plain	1	
Precipitation (Rainfall)	600≥	5	1
	500-600	3	
	400-500	1	

Table 1. *GIS class and weight values of layers which are used as base for risk map of rock-fall in Kilis city.*

Land cover closure was determined using land use map. Landsat OLI data belonging to 2015 was used for land use map classified according to the Corine

Method. ISO-DATA algorithm was applied to Landsat OLI data. Finally, accuracy rate of the created land use map was calculated according to the kappa statistic method. Accordingly, kappa coefficient of 0.9 was obtained. This rate is suitable for land use map to be used in the study (Jensen, 1996).

4. Results and Discussion

In the present study, the areas characterized with mountainous above 900 m in general, slope over 9° and the areas including wear resistant rocks and volcanits but having south-facing and relatively north-facing aspects were determined to possess very high rock fall risk potential. The precipitation is above 600 mm and vegetation cover is bare regarding with degree of closures and is characterized with medium-dense.

Moreover, the areas characterized with mountainous above 750-900 m in general, slope between 6-9° and the areas including wear resistant rocks and volcanits but having south-facing and relatively north-facing aspects were determined to possess high rock fall risk potential. The precipitation is above 500 mm and vegetation cover is bare regarding with degree of closures and is characterized with medium-dense.

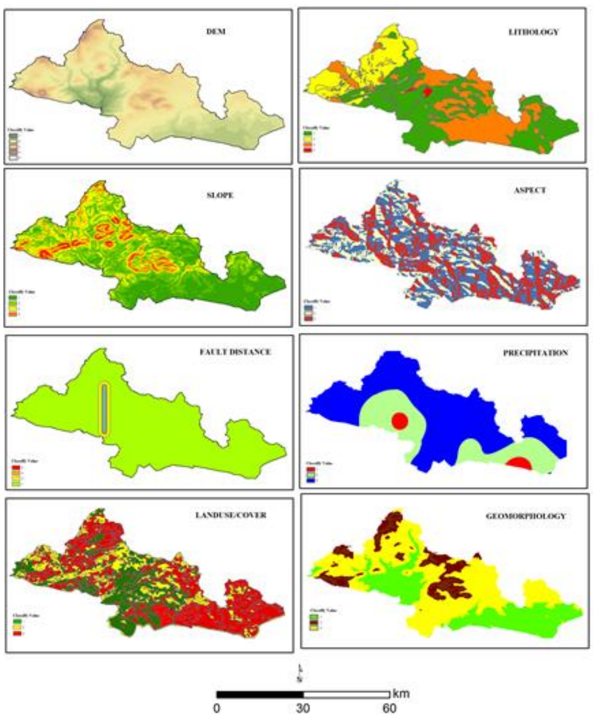

Figure 2. *Layers which were used as base for risk map of rock-fall.*

Furthermore, the areas characterized with mountainous above 550-750 m in general, slope between 3-6° and the areas including wear resistant rocks and volcanits but having south-facing and relatively north-facing aspects were determined to possess moderate degree rock fall risk potential. The precipitation is between 400-600 mm and vegetation cover is bare regarding with degree of closures and is characterized with medium-dense.

But the areas with low degree risk of rock fall were found to be characterized with 350-550 altitude plains, slope between 0-3° and the areas including alluvions but having south-facing aspects. The precipitation is between 400-500 mm and vegetation cover is bare regarding with degree of closures and is characterized with dense vegetation around central and western parts of the city (Figures 1, 2, 3; Table 1).

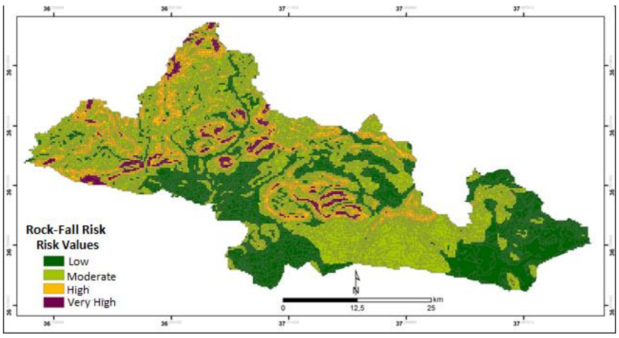

Figure 3. *Risk map of rock-fall in Kilis city.*

5. Conclusion

In conclusion, it can be deduced –but for the present study and examined areas- the areas characterized with mountainous above 750 m in general, slope between 6- 9° and the areas including wear resistant rocks and volcanits but having south-facing and relatively north-facing aspects possess high and very high rock fall risk potential. The precipitation is between 500-600 mm and vegetation cover is bare regarding with degree of closures and is characterized with medium-dense.

The results exhibit that 3.22 % of the regions has high potential risk of rock fall. Based on the results, local decision makers concerned with urbanization plans should consider the regions with high rock fall risks. Otherwise, the loss of life and property is inevitable as consequences of natural disasters.

References

[1] AFAD "Bütünleşik Tehlike Haritalarının Hazırlanması Heyelan-Kaya Düşmesi Temel Kılavuz" AFAD Ankara, (2015)1-151.

[2] Değerliyurt, M. "İskenderun-Arsuz İlçelerinin (Hatay) CBS Tabanlı Zemin Hareketleri Duyarlılık Analizi", Turkish Studies, 9(5), (2014)655-678.

[3] Jensen, J.R. "Introductory Digital Image Processing: A Remote Sensing Perspective. 2nd

edition", Prentice Hall, Upper Saddle River, New Jersey, USA. (1996).

[4] Lee S., Choi J., Min K. "Probabilistic landslide Hazard Mapping Using GIS and Remote Sensing Data At Boun, Korea", International Journal of Remote Sensing, 25 (11), (2004)2037-2052.

[5] Polat S. ve Güney Y. "Bağbaşı Köyü'nde (Uşak) Kaya Düşmesi", Uşak Üniversitesi Sosyal Bilimler Dergisi 6 (1), (2013)207-222.