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DETERMINATION OF ROCKFALL POTENTIAL SOURSE AREAS OF YEŞİLBAŞKÖY VILLAGE; BURDUR TÜRKİYE

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ABSTRACT

The management of rockfall risk and mitigation of its effects are gaining importance as an effective strategy in the fight against disasters. Geographic Information Systems are used as a powerful tool in rockfall risk mapping and susceptibility analysis. The aim of this study is to determine the rockfall source areas of Yeşilbaşköy village in Burdur province by using Geographical Information Systems and Conefall software and to classify these areas as low-medium and high-risk areas. In the first step, a digital elevation map was produced by digitizing the 1/25000 scale topographic maps of the study area. Potential rockfall source areas were determined by using digital elevation model and slope map was created. Considering the critical slope angles, low-medium and high-risk rockfall areas were mapped in the Yeşilbaşköy region. Low-risk areas represent areas where slopes are lower and less problematic in terms of stability. On the other hand, high-risk areas indicate steep slopes, loose soils and susceptibility areas in terms of geological structure. The results of this study provide an important basis for understanding the distribution of rockfall risk in Yeşilbaşköy village and for developing disaster management strategies. Thanks to the analytical and visualization capabilities provided by Geographic Information Systems, it becomes easier to create disaster risk maps and to use them in decision-making processes. This helps local governments and decision makers to allocate resources effectively and plan risk reduction measures.

1. INTRODUCTION

Disasters represent serious events worldwide that pose threats to human life and property. Among them, rockfalls occurring especially in steep areas constitute one of the most significant and devastating types of disasters [1]. Identifying areas potentially affected by rockfalls and creating disaster risk and vulnerability maps are critical processes in disaster management [2].

Geographic Information Systems (GIS) have evolved into a fundamental tool used for such mappings. GIS is a technology and discipline that enables the collection, management, analysis, and visualization of geographic data [3]. The effective use of GIS plays a vital role in identifying potential hazardous areas related to rockfall disasters and in enhancing disaster management processes [4]. This study aims to use GIS to determine potential rockfall source areas and map areas with low, moderate, and high rockfall potential in Yeşilbaşköy village, located in Burdur province, Turkey. Yeşilbaşköy has been selected as the study area due to its frequent occurrences of rockfalls.

By emphasizing the importance of rockfalls in disaster management and the role of GIS in this context, this article presents an example of creating rockfall susceptibility maps in Yeşilbaşköy village. The study endeavors to provide guidance for local authorities and assist in the development of protective measures in potentially risky areas.

2. METHODS

Yeşilbaşköy is a settlement located in the Burdur province, situated in the Western Mediterranean region of Turkey. Geographically, it is positioned at 37° 36' north latitude and 30° 03' east longitude (Figure 1).

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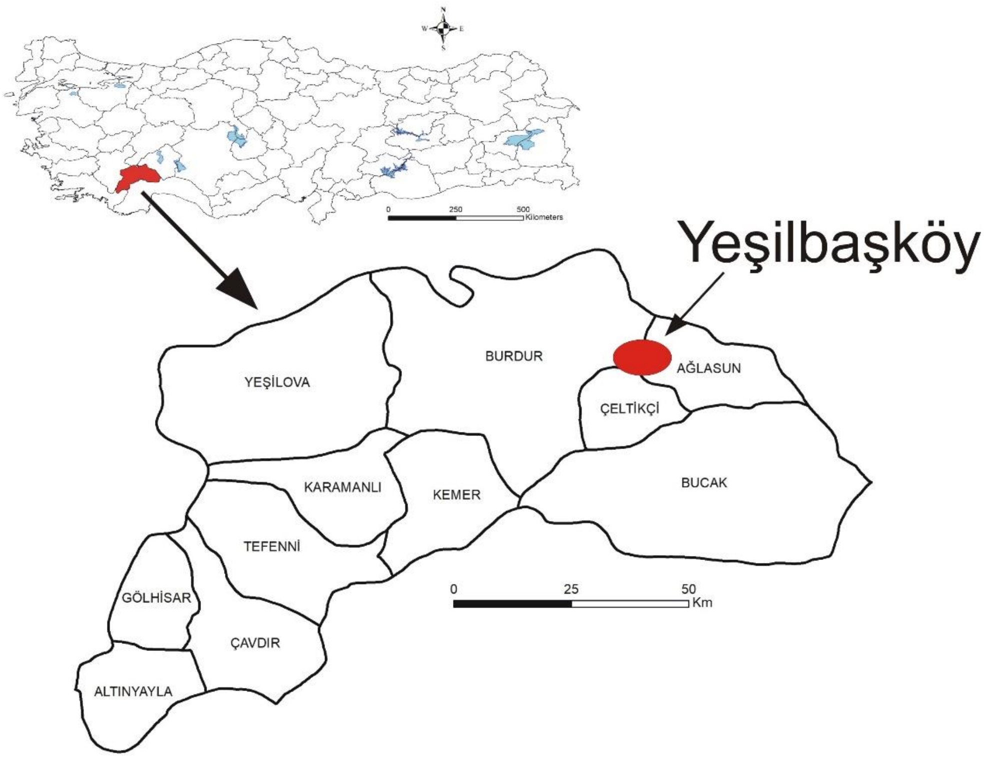

Fig. 1. Study area

Due to its topographical features and geological characteristics, Yeşilbaşköy is a region susceptible to rockfalls. Factors such as steep terrain, loose material accumulations, and inherent vulnerability to natural disasters contribute to this susceptibility. Therefore, it provides a suitable area for rockfall susceptibility mapping studies.

The occurrence mechanism of rockfall events suggests that active source areas are expected to be present in regions with steep topography. Therefore, in regional-scale studies, areas with a certain slope, as derived from the Digital Elevation Model (DEM) produced from the topographic maps, are considered as potential active zones for rockfalls. For this purpose, a DEM with a cell size of 5 meters was generated using the ArcGIS software, utilizing 1/25000 scale topographic maps that encompass the study area. The higher the resolution of the DEM, the more accurately the terrain slope is represented [5]. To identify potential rockfall source areas in Yeşilbaşköy, the following formula was employed [6].

$\alpha = 55 * RES\text{-}0.075$ (1)

α (degrees): threshold slope value for potential source areas
RES: resolution of the DEM

In this study, the resolution of the DEM used was 5, and when substituted into the formula, a critical slope angle value of 49o was obtained. Areas above this value constitute potential source areas where rockfalls may occur. To identify these source areas, an elevation map of the region was generated using the DEM, and a reclassification process was conducted to determine the source areas and areas with no rockfall potential (Figure 2).

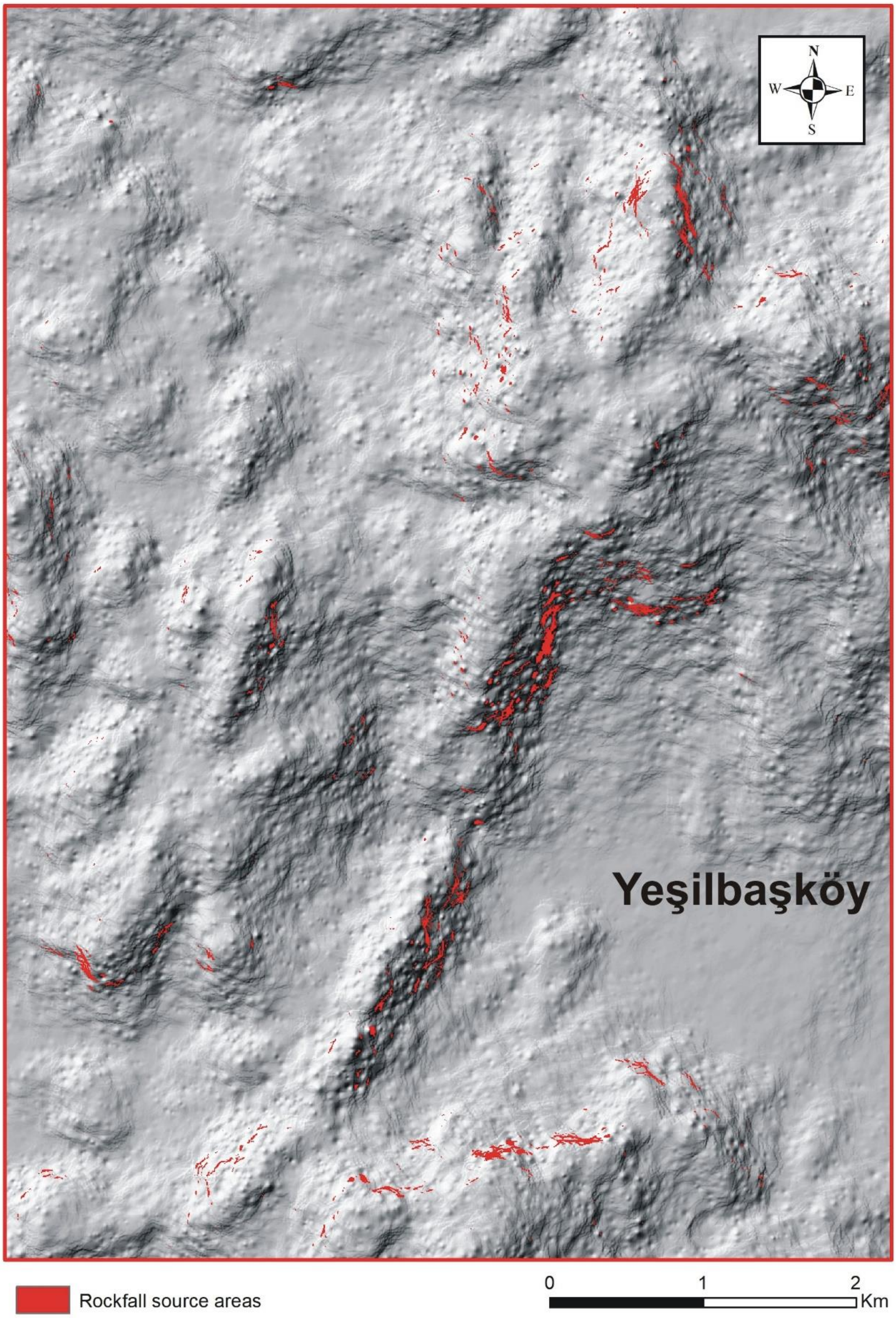

Fig. 2. Rockfall source areas

The identified source areas were transformed and converted to ASCII format within the ArcGIS program to be usable in the CONEFALL software. Rockfall runout areas can be determined using a simple geometric rule known as the shadow angle or energy line method, which relies on a basic Coulomb friction model applied in the Conefall computer program [7]. This process involves utilizing topographic features, the DEM map, rockfall source areas, and the cone spread angle. The shadow angle represents the angle value of the energy line between the section of decreasing slope and the farthest point reachable by the rock block [8]. Previous studies have shown that the shadow angle can vary between 22° and 38° depending on the assumptions made [9-10]. However, for the determination of rockfall susceptibility maps in this study, the shadow angle boundary values were set as 32° (low), 35° (moderate), and 38° (high) based on considerations of existing literature. These susceptibility classes were transformed back into raster format within the ArcGIS 10 program for further analysis. The susceptibility maps obtained for three different levels of rockfall susceptibility were then combined arithmetically (Figure 3).

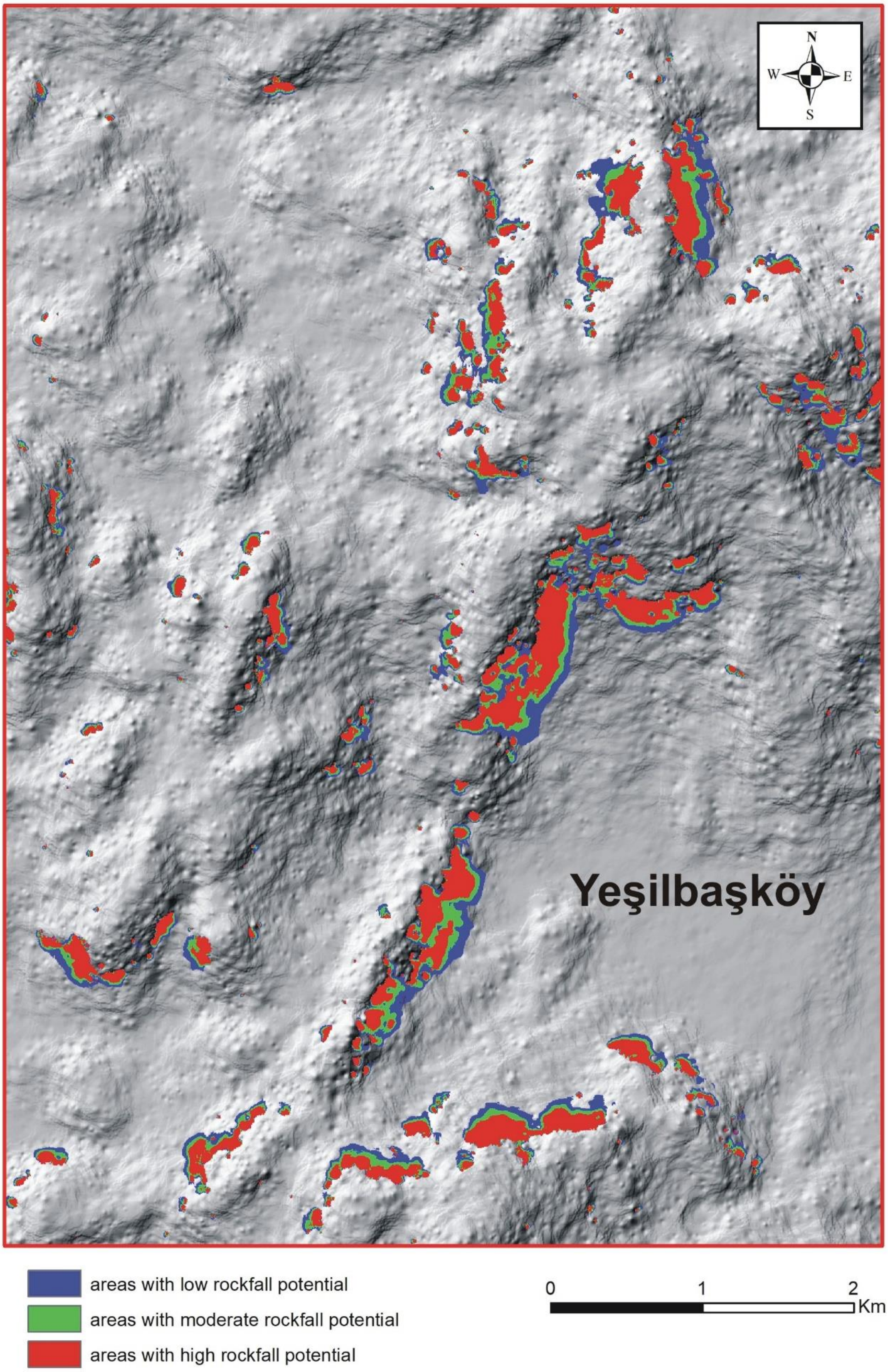

Fig. 3. Rockfall susceptibility levels

In the final stage, the map obtained in raster format was transformed into the KML format to enable its integration into the Google Earth program. This facilitated the determination of the relationship between rockfall occurrences and settlement areas using up-to-date satellite imagery (Figure 4).

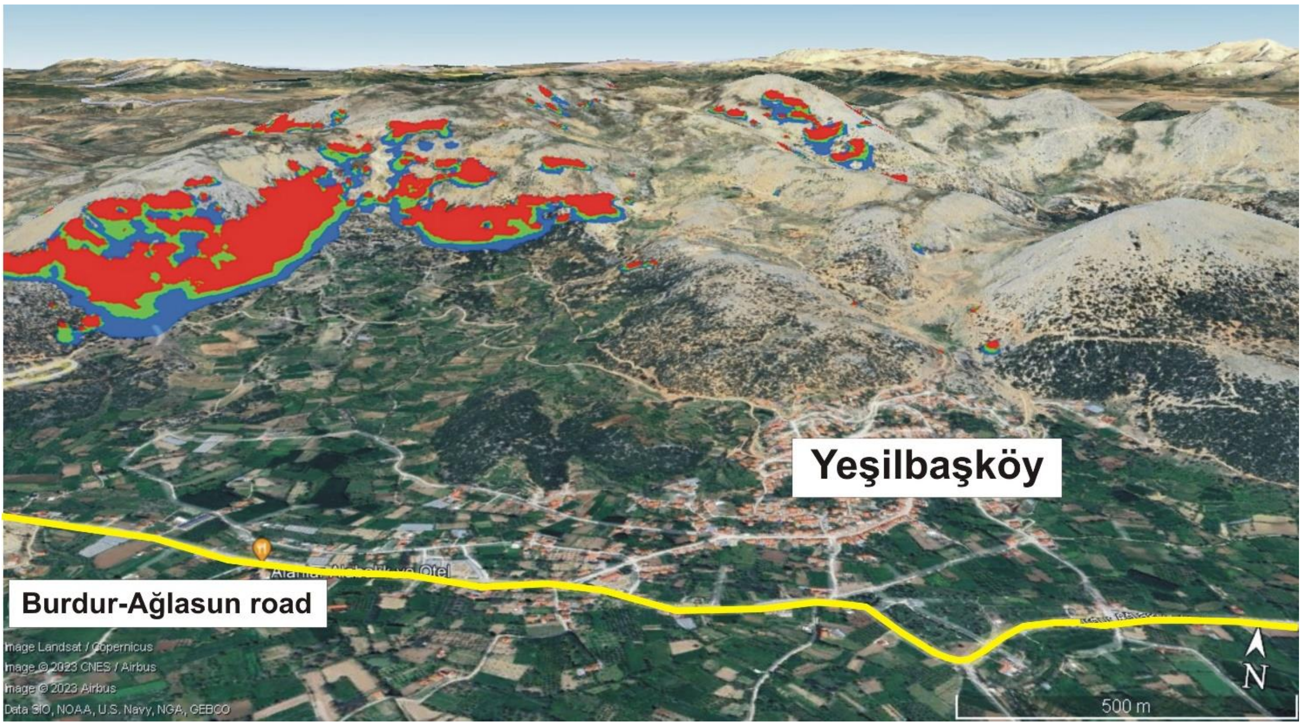

Fig. 4. Relationship between rockfall occurences and settlement areas

3. CONCLUSION

The results emphasize the importance of creating rockfall susceptibility maps using GIS. This study is significant in identifying potential rockfall risks and developing strategies to address these risks in the Yeşilbaşköy and surrounding region. GIS expedites the process of generating rockfall susceptibility maps and facilitates obtaining more precise outcomes through its advanced data analysis and visualization capabilities. By integrating spatial tools, topographic data, geological structures, and slope information, GIS aids in identifying source areas for rockfall and categorizing potential rockfall-prone areas into low, moderate, and high susceptibility levels. These maps hold great importance for local authorities and decision-makers. Accurate identification of rockfall risks is a critical step in planning mitigation measures and effectively utilizing resources. The maps enable local authorities to make informed decisions regarding urban development and settlement planning in hazardous areas. The findings of this study underscore the significance of creating rockfall susceptibility maps, providing guidance to local authorities and decision-makers in understanding and addressing rockfall risks, thus contributing to the sustainability and safety of the region. In conclusion, maps generated through the use of GIS have become a critical tool for local authorities and decision-makers. These maps contribute to the formulation of accurate planning and risk reduction strategies, ultimately enhancing community safety. Future research efforts should focus on collecting more data, refining analysis methods, and promoting widespread use of GIS to create more accurate and up-to-date maps.

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