Multicriteria decision analysis methods in landslides susceptibility assessment. The case of South Pilio, Central Greece

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3rd International Conference on Environmental Design, ICED2022

Sustainability / Pollution / Energy / Cities-Buildings / Transportation / Erosion / Climate Change / Policy / Social Acceptance / Health Impacts 22-23 October 2022, Hybrid (Athens, Greece and Virtual)

Introduction

During the last decades climate crisis has affected the precipitation patterns around the world, and since the precipitation is the most common landslides' activation factor, has relatively affected the landslide phenomenon.[1]

These changes, because of their ongoing nature, have render the landslide susceptibility assessment (LSA) a dynamic process, where the meteorological parameters used, such as the mean annual precipitation, must be regularly updated. Multicriteria decision analysis (MCDA) methods can be very useful for the LSA of an area, as they can be applied rather quickly and can be easily modified.[2]

However, the selection of the most efficient MCDA method, remains a challenge for many researchers, as each method has its own advantages and disadvantages.

Methodology

The aim of this study is to analyze the most common MCDA methods, highlighting their advantages and disadvantages.

The Analytical Hierarchy Process (AHP), the Rock Engineering System (RES), and the Expert-Based Fuzzy Weighting (EFW) methods, were selected as the most common MCDA methods.[2]

Case Study

As a case study, South Pilio region in central Greece was selected. A landslides' inventory was created from geotechnical reports of the Hellenic Survey of Geology and Mineral Exploration and field surveys. Precipitation, geology, slope's angle, slope's aspect, distance from rivers, land use and relative relief were identified by experts as the most landslides' important causal factors at the area of interest..

AHP, RES and EFW were applied in the examined area to conduct the LSA and to create the relative susceptibility maps (SM). In figure 1 the SM, which was created by using the EFW method, is illustrated. With red color are illustrated the areas where the landslide susceptibility is higher, with yellow where it is moderate and with green where it is low. Moreover, the landslides of the landslides' inventory are illustrated on the map with red dots.

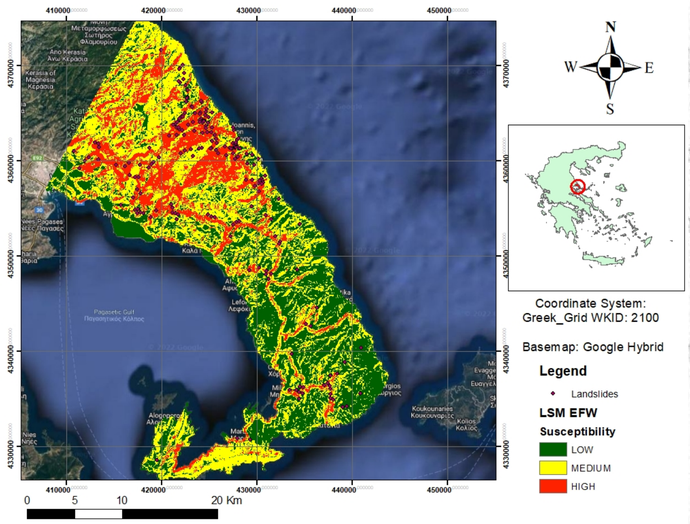

Figure 1, Landslide Susceptibility Map for EFW method at South Pilio area, Greece

Results

On the examined case of South Pilio, the Receiver Operating Characteristics curve and Area Under curve were used to evaluate the effectiveness of each method. As shown in Figure 2, EFW was the most efficient method (86% success), while the rest of the methods had a quite sufficient accuracy (RES 82% and AHP 73%).

All the examined MCDA methods can be applied rather quickly and do not require extensive data of the examined area. AHP is the simplest one, as it requires the least processing procedures.

All the examined MCDA methods are mostly based in qualitative criteria, and therefore can be relatively easily modified, regarding the replacement of the meteorological data which are used as inputs (as a causal factor). Nevertheless, their accuracy depends significantly on the expertise of the experts used for the appliance of each method.

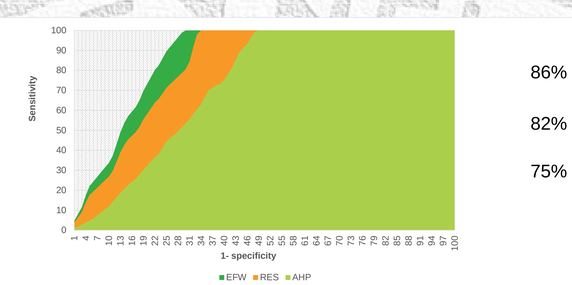

Figure 2, ROC for EFW, RES and AHP at South Pilio

Conclusions

It is concluded that MCDA methods provide nowadays a valuable and efficient tool for LSA as they can be modified to incorporate the precipitation changes, due to climate change. Thus, they can significantly contribute to the climate change adaptation measures. Moreover, as it was shown EFW, was the most efficient MCDA method for the LSA of South Pilio, Greece region.

References

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