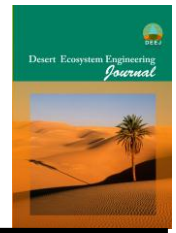




University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: <http://deej.kashanu.ac.ir>

Quantitative Assessment of the Desertification Intensity and Risk: A Case study of Sarakhs City

Mahboobeh Sarbazi¹, Majid Ownegh^{2*}, Ali Mohammadian Behbahani³, Morteza Akbari⁴

Received: 28/08/2020

Accepted: 18/12/2020

Extended Abstract

Introduction: The growing trend of desertification is one of Iran's most serious environmental, economic, and social problems, making the identification of the desertification processes and their causes and intensification an important and necessary task. Therefore, to provide a model for showing the intensity of desertification and determining the most critical factors involved in desertification and its prevention, it is necessary to select appropriate criteria and indices.

Characterized by a dry climate, low rainfall, unfavorable soil conditions, unprincipled land-use change, and increased wind erosion, Sarakhs city is facing a critical desertification crisis which has led to severe environmental problems as it is considered the center of wind erosion crisis. Thus, considering the critical environmental and human problems existing in Sarakhs and the strategic position of this city, this study sought to assess the severity of the risk via the Iranian model IMDPA and calculate and prepare a desertification risk map of the region. To this end, all the criteria required by the model were evaluated. As the desertification risk maps and the effective indicators of the region's desertification serve as a suitable and efficient tool for managing desertification crises, the

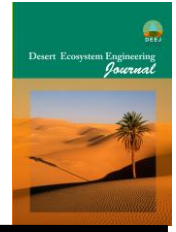
1. PhD. Student of Gorgan University of Agriculture Sciences and Natural Resources

2. Professor, Department of Range Land and Watershed Management of Gorgan University of Agriculture Sciences and Natural Resources, Gorgan, Iran. Corresponding Author, Email: ma94ownegh@yahoo.com

3. Assistant Professor, Department of Range Land and Watershed Management, Gorgan University of Agriculture Sciences and Natural Resources, Gorgan, Iran

4. Assistant Professor, Department of Desert Area Management, Faculty of Natural Resources and Environment, Ferdowsi University of Mashhad, Mashhad, Iran

DOI:10.22052/deej.2021.10.31.11



prioritization of the crisis management program and the type of programs will be determined.

Methodology: The Iranian IMDPA method, the geometric mean of nine climatic criteria, and relevant indicators in terms of geology, vegetation, agriculture, water, soil, water and wind erosion, social and economic issues, urban and industrial development were used to assess the severity of desertification. The scoring of criteria and indicators was performed in work units, which are the faces of subsistence. Risk assessment of desertification was performed by combining the risk map of desertification risk, hazardous elements, and the degree of environmental vulnerability using a global risk equation. After identifying the desertification risk classes and the natural and human elements across them via expert opinions and field facts, the vulnerability classes of the elements were determined according to the type of class of the risk severity. To calculate the quantitative value of environmental vulnerability, each element's hazard map and conditions were considered economically and ecologically. Elements at higher risk were also vulnerable. This evaluation was based on the relevant executive departments' expert opinions according to the regional conditions, which can have different values in different regions. Finally, the product of the risk classes of desertification (H) in the classes of hazardous elements (E) and the degree of vulnerability of the elements (V) in the GIS environment of the risk classes (R) was determined.

Results: Lithographic maps, physiography, land use, and satellite images were prepared and integrated with the GIS environment to achieve work units' maps. After combining the maps in the ArcGIS geographic information system environments version 10/2, work units were obtained to be reviewed and corrected. Moreover, land use maps, geology, and surface cover maps were located via Google Earth images to be further adapted to the landforms. Finally, three units, 22 brigades, and 67 geo-biophysical faces were separated in the study area. Based on the criteria's geometric mean and the characteristics of desertification in the IMDPA model, the numerical value of each of the faces was estimated to be 3, indicating the severe intensity of desertification in the region. In terms of zoning, the region was classified into low classes with an abundance rate of 0.6, medium classes with an abundance rate of 18.8, severe classes with an abundance rate of 6.9, and very intense classes with an abundance rate of 11.7. Among the factors involved in desertification, wind erosion criteria, vegetation, agricultural and socio-economic factors had the most significant impact on the intensity of desertification in the region with an average weight of 3.5. Moreover, the vulnerability and sensitivity of the phenomena showed that low-sensitivity elements covered more than 35% of the area, and sensitive middle-class elements covered more than 64% of the area. Also, the number of risks was calculated and classified into four categories ranging from low to high via global risk equation, with their frequency reported to be 11.97%, 26.53%, 46.24%, and 15.26%, respectively. In this regard, it was found that more than 60 percent of western and eastern Sarakhs were on a high and very high-risk level in terms of desertification. These areas were home to many agricultural lands.

Discussion & Conclusions: According to the study's results, it was found that more than 80% of the whole study area was classified as severe and very severe in terms of desertification. Furthermore, wind erosion, vegetation, agriculture, and socio-economic criteria had the most significant impact on the region's desertification process, with their weight value reported to be 3.5 on average. In general, using the Iranian IMDPA model, which is compatible with Iran's climatic and environmental conditions, especially with the study area, helped assess the region's desertification intensity. Also, considering the use of intensity maps and the existence of hazardous elements and environmental vulnerabilities, the application of the global risk model indicated the possibility of the development of desertification in the region. It could be argued that evaluation of hazardous elements, especially the human and economic ones, is a good practice to assess environmental vulnerabilities, a fact that this study attempted to apply appropriately. It should also be noted that a desertification intensity map alone cannot be a helpful tool for providing a desert crisis management program. While the region could be at a high risk of desertification, the desertification risk would not be significant due to the lack of endangered elements, and thus, it would not be a priority in the Desert Crisis Management Program. Therefore, in addition to the desertification intensity map, the endangered and vulnerable elements' map is also of great importance. The novelty of this applied research lies in its assessment of the desertification intensity and risk.

Keywords: Desertification Indices, Vulnerability, Risk, Wind erosion, Sarakhs.