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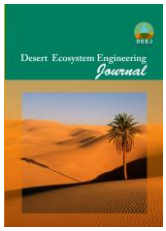

Desertification Evaluation and its Site Assesment: A Case Study of Saravan City, Sistan and Baluchistan Province, Iran

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Extended Abstract

Introduction: As a serious global environmental challenge that significantly influences arid and semi-arid regions, desertification brings about land degradation, reduced water resources, soil erosion, and a host of socio-economic problems. Therefore, this study sought to investigate the critical status of desertification in Saravan County, located in Sistan and Baluchistan Province, Iran, which is characterized by its arid climate, low precipitation, prolonged drought periods, and declining water resources. These conditions adversely affect vegetation and soil moisture, leading to intensified desertification. Taking the aridity index into consideration, the area is classified as "very severe" with an aridity value of 1.48, highlighting its high susceptibility to desertification. Moreover, unsustainable land management practices and overgrazing have contributed to the further degradation of such a fragile ecosystem. On the other hand, the lack of sufficient vegetation has exposed the land to severe erosion, exacerbating the process of desertification. Thus, recognizing the interplay of natural and human-induced factors is required for tackling the challenges facing Saravan County.

Materials and Methods: This study assessed desertification in Saravan County using the MEDALUS (Mediterranean Desertification and Land Use) model and the LESA (Land Evaluation and Site Assessment) system. The study area is located in Saravan, covering 12,821 square kilometers. The required data were collected from governmental records on land management and groundwater resources, meteorological station data on precipitation, and field surveys of soil, vegetation, and wind erosion indicators. On the other hand, the MEDALUS model was used to assess desertification vulnerability in terms of six criteria, including climate, soil, vegetation, management and policy, wind erosion, and groundwater depth. Each criterion was then assessed through specific indicators and scored based on its contribution to desertification. Then, the criteria were combined geometrically to determine the vulnerability of each land unit. As for the analysis of data, climate analysis included precipitation data (to evaluate annual precipitation rate), aridity index, drought patterns, and geographical direction. Moreover, soil analysis included assessment of texture, drainage, gravel content, and slope, all of which play a crucial role in land degradation. Also, vegetation was assessed in terms of its percentage, resistance to erosion and drought, and fire risk. Furthermore, the implementation of sustainable practices and the severity of land use, including agricultural and grazing activities were assessed in terms of

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management and policy factors. On the other hand, wind erosion was examined using the IRIFR model, where landform, wind characteristics, soil and surface cover, vegetation density, erosion marks, and land use were taken into consideration. In addition, groundwater depth fluctuations were analyzed using piezometric data collected from 22 wells in a 20-year period (1982–2002). Also, the LESA system was used to assess the suitability of land for agricultural use in terms of two components: Land Evaluation (LE) and Site Assessment (SA). Accordingly, LE focused on soil properties such as texture, salinity, drainage, topography, and erosion, and SA evaluated non-soil factors, including proximity to urban areas, access to infrastructure, and compatibility with surrounding land uses. Finally, Geographic Information Systems (GIS) was used to map the spatial distribution of desertification indicators, revealing severity levels across land units. The findings showed that vegetation and climate were the primary driving forces of desertification in Saravan County, with their values being 1.92 and 1.08, respectively. Moreover, the overall desertification severity value was found to be 1.02, indicating critical conditions in the northern and southern regions and the fragile status of the northwestern area. On the other hand, the LESA findings revealed heightened vulnerability in agricultural and residential areas, with the grasslands showing the highest suitability for sustainable land use.

This study stressed the link between land use intensity and desertification severity, particularly in agricultural and residential zones, and recommended sustainable practices such as modern irrigation techniques, optimized cropping patterns, and controlled livestock populations.

Results: According to the results of the application of the MEDALUS model, low precipitation and prolonged droughts were found as key contributing factors to the severe desertification in Saravan County. Moreover, the arid climate of the region exerts an adverse influence on vegetation and soil moisture, with the aridity index rate of 1.48 indicating very severe vulnerability. On the other hand, soil analysis revealed variations in desertification levels, according to which areas with exposed rock and poor drainage showed severe conditions. However, while agricultural lands were found to be less vulnerable, the region was found to suffer from moderate desertification based on soil texture analysis. Moreover, the study found that the region's vegetation was sparse due to overgrazing and unfavorable climatic conditions. In addition, the results indicated that while areas with no vegetation suffered from severe desertification, agricultural lands displayed lower vulnerability in this regard. Generally, the geometric mean of vegetation indicators was reported to be 1.92, classifying the region as very severe in terms of desertification status.

Furthermore, it was found that while management and policy factors played a moderate role in desertification, unsustainable practices like overgrazing made a significant contribution to desertification. On the other hand, based on IRIFR model assessments, the study found that wind erosion was moderate to very severe and that groundwater had significantly been depleted in the western region, both of which have led to exacerbated desertification. Moreover, according to the results found by the LESA system, while agricultural and residential areas showed higher vulnerability to desertification, grasslands are the most suitable areas for sustainable land use.

Considering all the above-mentioned findings, this study recommends sustainable resource management, including modern irrigation, optimized cropping patterns, and conservation efforts as crucial strategies to be adopted for mitigating desertification.

Discussion and Conclusion: The integrated use of the MEDALUS and LESA models provided comprehensive insights into desertification trends in Saravan County, confirming a critical level of vulnerability that is primarily driven by unfavorable climatic conditions, unsustainable land management, and inherent soil weaknesses. Sparse vegetation, prolonged droughts, poor soil quality, and overgrazing were found as key contributors to desertification, leading to the exacerbation of erosion, reduction of water infiltration, and diminishing of biological productivity. Moreover, the findings of the study underscored the significance of promoting sustainable land use practices to mitigate land degradation. On the other hand, wind erosion and groundwater depletion were identified as significant concerns, necessitating measures such as windbreak erection, application of conservation tillage, and adoption of sustainable groundwater management strategies. The study also highlighted the value of combining the data collected from field study, remote sensing, and spatial modeling for effective desertification assessment and mitigation planning. Furthermore, the study recommended the application of additional indicators such as soil shear strength and wind stress and emphasized the use of a multi-faceted approach involving scientific, policy, and community-driven initiatives to combat desertification and ensure the ecological integrity of Saravan County.

Keywords: MEDALUS Model, Geographical Information System, Modeling, Desertification.