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Review Article

Reviewing the evaluation methods for determining aquifer vulnerability in Iran using the Drastic method

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Abstract

Introduction
Groundwater is a critical resource, especially in arid and semi-arid regions, where it serves as the primary source of freshwater. However, the increasing contamination of groundwater due to human activities such as agriculture, industry, and urbanization has become a significant concern. Preventing groundwater pollution is essential, as remediation is often costly and complex. One effective approach to managing groundwater resources is assessing their vulnerability to contamination. This study evaluates the vulnerability of aquifers in 12 regions across Iran using the DRASTIC model, a widely used method for assessing groundwater vulnerability. The results provide valuable insights for decision-makers to implement preventive measures and manage groundwater resources sustainably.

Materials and Method
The DRASTIC model was employed to assess groundwater vulnerability in 12 selected regions of Iran. The model evaluates seven hydrogeological parameters: Depth to water table (D), Net recharge (R), Aquifer media (A), Soil media (S), Topography (T), Impact of the vadose zone (I), and Hydraulic conductivity (C). Each parameter was assigned a weight and rating based on its influence on groundwater vulnerability. Geographic Information System (GIS) tools were used to integrate and analyze spatial data, creating vulnerability maps for each region. Sensitivity analysis was conducted to determine the relative importance of each parameter, and the model was validated using nitrate concentration data from groundwater samples.

Results and Discussions
The results revealed varying levels of groundwater vulnerability across the studied regions. Areas with high vulnerability were primarily located in regions with shallow water tables, high recharge rates, and permeable aquifer media. Sensitivity analysis indicated that the depth to the water table and the impact of the vadose zone were the most influential parameters in determining vulnerability. The validation process using nitrate concentrations showed a strong correlation between high vulnerability zones and areas with elevated nitrate levels, confirming the model's accuracy. The study also highlighted the importance of land use in influencing groundwater contamination, with agricultural and industrial areas showing higher vulnerability due to the presence of pollutants such as fertilizers and industrial waste.

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Conclusion

The DRASTIC model proved to be an effective tool for assessing groundwater vulnerability in the studied regions of Iran. The results underscore the need for targeted management strategies to protect vulnerable aquifers from contamination. Preventive measures, such as regulating agricultural practices, controlling industrial discharges, and implementing land-use planning, are essential to safeguard groundwater resources. The findings also emphasize the importance of continuous monitoring and the use of advanced tools like GIS for sustainable groundwater management. Future research should focus on refining the DRASTIC model by incorporating additional parameters and validating it in diverse hydrogeological settings to enhance its applicability and accuracy.

Conflict of Interest

The author declares no conflict of interest regarding the authorship or publication of this article.

Data availability statement

The data and results used in this research will be available through correspondence with the author.