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NITRATE VULNERABILITY ASSESSMENT USING RANDOM FOREST AND CATASTROPHE THEORY IN THE GÜMÜŞHACIKÖY PLAIN

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Abstract

Lack of proper knowledge about areas vulnerable to contamination can lead to severe pollution of groundwater resources, rendering them unusable. In the Gümüşhacıköy Plain, groundwater is affected by nitrate leachate from agricultural fertilizers. Therefore, identifying vulnerable areas within this aquifer using reliable methods is crucial. This study applied a Random Forest (RF)-optimized DRASTIC method and Catastrophe theory to assess groundwater vulnerability in the Gümüşhacıköy Plain. Seven hydrogeological parameters of the DRASTIC method served as input variables, while the vulnerability index was the model output. Model validation was performed using measured nitrate concentration data and by comparing the correlation between nitrate levels and vulnerability indices. Validation metrics, including the Correlation Coefficient (CI) and Receiver Operating Characteristic (ROC) curve, showed that the RF-optimized DRASTIC method outperformed the Catastrophe theory in predicting vulnerable areas. The RF model identified water table depth and hydraulic conductivity as the most influential factors controlling nitrate contamination in the aquifer. According to the optimized vulnerability map, approximately 21% of the area is very low vulnerability, 18% low, 27% medium, 5% high, and 29% very high vulnerability. These results provide valuable insights for groundwater protection and sustainable management in the region.

Key words: contaminated groundwater, Gümüşhacıköy Plain, nitrate concentration, optimized DRASTIC, vulnerability

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