



## ASSESSMENT AND VALIDATION OF SHALLOW GROUNDWATER VULNERABILITY TO CONTAMINATION BASED ON FUZZY LOGIC AND DRASTIC METHOD FOR SUSTAINABLE GROUNDWATER MANAGEMENT, SOUTH-EAST HUNGARY.

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### ABSTRACT

An evaluation of shallow groundwater vulnerability based on an origin-path-target approach, by integrating the DRASTIC model and the fuzzy logic tool, is presented. The outcomes represent the potential risk to pollution of the natural aquifer to leaching of contaminants from the land surface to shallow groundwater in South-Eastern Hungary, a region characterised by a flat and fertile plain, largely cultivated, and growing industrial activities. Accordingly, the seven DRASTIC factors, including shallow aquifer depth, recharge rate, aquifer media, soil media, topography, vadose zone impact and hydraulic conductivity, were created to examine the spatial distribution of groundwater vulnerability. The integration of the fuzzy logic tool with the DRASTIC model were used to deal with the uncertainty arising from the sparsity of data in the intrinsic vulnerability evaluation. The results showed that the vulnerability index is classified as "low", "moderate" and "high". The Fuzzy DRASTIC model delineates 49.23% of the groundwater basin highly vulnerable to water pollution. A positive linear correlation was also found, during validation of the final vulnerability map, between the vulnerability index and the nitrate concentration ( $\text{NO}_3^-$ ) observed from 46 groundwater sampling wells, with  $\text{NO}_3^-$  concentrations ranging from 1 mg/l to 36 mg/l. The correlation coefficient  $R^2$  (0.31) shows a moderately strong positive correlation between the nitrate concentrations available in the groundwater and the different vulnerability classes established. The Fuzzy DRASTIC model has proved to be a suitable approach for assessing the vulnerability of shallow aquifer to pollution in south-east Hungary. The outcome of this study will provide useful information to help policy-makers identify the main contributors to pollution as well as adopt effective management strategies to mitigate nitrate pollution in groundwater to avoid further pressure on this invaluable resource.

*Keywords: Vulnerability assessment, Shallow groundwater, DRASTIC, Fuzzy Logic, Southeast Hungary*