

A Modified DRASTIC Model in GIS for Assessing Groundwater Vulnerability to Nitrate Contamination in Malolos City, Bulacan, Philippines

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Abstract: Assessing groundwater vulnerability is essential for the prevention and control of groundwater contamination. This can be done with the help of various tools or models like the DRASTIC model. However, this model is only useful for intrinsic vulnerability assessment of an area and is not appropriate for specific vulnerability assessments. A modified DRASTIC method was developed and implemented in a geographic information system (GIS) platform by integrating another parameter: land use, to determine which areas are most likely vulnerable specifically to the contaminant nitrate, since it is usually introduced by anthropogenic factors and is not naturally occurring in the ground. The accuracy, appropriateness, and reliability of the vulnerability map produced were analyzed using different statistical analyses including Cohen Kappa coefficient, Pearson's correlation analysis, ANOVA F-statistic, and the chi-square value. The Cohen Kappa coefficient for the nitrate concentration and nitrate vulnerability index classes have values ranging from 0.67 to 0.79 which indicates good agreement between the classes. The correlation between the vulnerability class and the actual groundwater nitrate concentrations using the modified DRASTIC model is 0.84, compared to the 0.32 obtained using the original DRASTIC model. The chi-square value for the modified DRASTIC model is 52.92, compared to the 8.72 of the original DRASTIC model, which indicates a high association between the vulnerability classes of the modified DRASTIC model and the actual groundwater nitrate concentrations, thus indicates an improvement in the efficiency of the modified model. Finally, the ANOVA F-Statistic for the modified model is 36.28, compared to the 0.75 of the original DRASTIC model. The higher value of the F-Statistic for the modified model indicates a lower overlap between the mean values of nitrate concentration in the different vulnerability classes. The groundwater vulnerability to nitrate contamination map can help officials identify places that are likely to contribute water with poor quality to the city's water supply, and places where the groundwater can be utilized to their full potential.

Keywords: Groundwater Vulnerability, Modified DRASTIC, Land Use, Nitrate Concentration, GIS