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Investigating aquifer vulnerability employing drastic model and GIS techniques in Menzel Habib shallow aquifer, South-Eastern Tunisia

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Abstract

Groundwater vulnerability assessment shows an extreme sensitivity to in situ anthropogenic pollutants. A dichotomous assessment of geological and hydrological (inter alia) characteristics makes it possible to determine the vulnerability of an aquifer system. The natural vulnerability of an aquifer can be severely compromised by human activities. The physical structure and material composition of aquifers shows resistance to contaminants transport from surface to groundwater. Currently, numerous methods have been posited evaluating aquifer's vulnerability. Similarly, the DRASTIC and DRASTIC pesticides models utilize computer algorithms and hydro-geological data within a Geographical Information System (GIS) to compute spatial aquifer vulnerability.

The DRASTIC and DRASTIC pesticides models are constructed using combined spatial datasets on Depth to groundwater (D), Aquifer Recharge (R), Aquifer media (A), Soil media (S), Topography (T), Impact of the Vadose Zone (I) and Hydraulic Conductivity (C) of the aquifer.

The degree of vulnerability of the aquifer system can be evaluated by computing sensitivity analysis of DRASTIC index using GIS, showing the contribution of each parameter to vulnerability sensitivity. The GIS was used to develop a vulnerability map for Menzel Habib aquifer area. The obtained results indicated that moderately vulnerable areas are of 5%, while areas of no risk correspond to 95% using DRASTIC index. Otherwise, DRASTIC pesticide index indicated that 15% area of low vulnerability, 84% moderately vulnerable and 1% high vulnerability. The central area of Menzel Habib aquifer showed a low vulnerability due to dense human settlement and a deeper water level. However, agricultural areas recorded high vulnerability risk.

Menzel Habib's environmental and socio-economic development is dependent on policy makers and planner's ability to use information effectively for decision making. The obtained groundwater vulnerability maps provide a basis for this aimed at protecting the aquifer from pollutants. Additionally, land use and development activities can be informed by mapping variables, showing that agriculture areas are highly vulnerable as compare to settlement areas.