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The title (العنوان):

Hybridization of DRASTIC Method to Assess Future GroundWater Vulnerability Scenarios: Case of the Tebessa-Morsott Alluvial Aquifer (Northeastern Algeria)

The paper document Shelf mark P22-10 (: paper version not available)

APA Citation (APA توثيق):

Boufekane Abdelmadjid; Belloula Moufida; Busico Gianluigi; Drias; and other (2022). *Hybridization of DRASTIC Method to Assess Future GroundWater Vulnerability Scenarios: Case of the Tebessa-Morsott Alluvial Aquifer (Northeastern Algeria)*. Applied Sciences, vol 12(n° 18), p. 9205-9205. DOI ou URL : <https://www.mdpi.com/2076-3417/12/18/9205>

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Abstract : In this study, a new approach integrating a groundwater vulnerability method and a numerical model for predicting groundwater resource sustainability under actual and future conditions of exploitation (2010–2030) is proposed in the semi-arid region of the Tebessa-Morsott alluvial aquifer (northeastern Algeria). The groundwater vulnerability method-based DRASTIC model was used to evaluate and delineate the vulnerable areas using a GIS technique. The MODFLOW code, on the other hand, was used to calculate the dynamics of groundwater level under actual and future conditions of exploitation considering two scenarios. The results of the application of the DRASTIC method to the reference year conditions (year 2010) showed that the high and average vulnerability classes covered a wide zone of the study area, about 97%. These results were validated based on the nitrate concentration values ($R^2 = 0.955$). However, the results for predicting future groundwater vulnerability showed that groundwater vulnerability variation over time (period 2010–2030) was closely related to groundwater depth variation caused by the pumping rate, since the decreases in the piezometric level produce a worsening of groundwater vulnerability. To achieve better groundwater management, an experimental site for artificial recharge supplemented by hydro-chemical monitoring of the groundwater could be an effective remediation strategy

Key words : Aquifer vulnerability; DRASTIC method; Numerical model; MODFLOW; Prediction

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