Assessment of Groundwater Vulnerability by DRASTIC-LU, Khemis Miliana Plain (Algeria)

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Abstract

In recent years, groundwater vulnerability assessment has become a very useful tool for planning and decision-making on groundwater protection. The main value of vulnerability maps is that they can be used as a preliminary and effective tool for planning, policy, and operational levels of the decision-making process for groundwater management and protection. Vulnerability maps that will be developed during this research will become valuable planning guides and can help water planners in the region make informed and environmentally responsible decisions regarding Land use and the protection of groundwater quality, which will allow planners to focus on priority areas. The objective of this study is to determine vulnerable areas of groundwater in the study area, using a recent DRASTIC-LU model.

Keywords: Groundwater quality- Vulnerability- DRASTIC-LU model- Khemis Miliana Plain

Introduction:

The assessment of groundwater vulnerability, as used in many methods, is not a feature that can be measured directly in the field. It is an idea based on the fundamental concept "that certain areas are more vulnerable to groundwater contamination than others".

Assessing the vulnerability of groundwater to pollution is an important process to understand the intrinsic fragility of a given region from a given threat if it is of natural or anthropogenic origin. Vulnerability assessments are often conducted in areas where water resources are stressed from industrial and agricultural activities. Therefore, vulnerability studies can provide valuable information for practitioners working on preventing environmental degradation.

Due to the dangers of groundwater pollution to human health, the protection of this resource through prevention has become a necessity. Since prevention is the key to helping to ensure that ground-based practices do not result in groundwater pollution, many planning and management tools have been used to help recognize where some activities may higher risk. It is in this context that a new cartographic base model (DRASTIC-Land) Use will be applied for the assessment of the vulnerability to groundwater pollution of the alluvial plain of Khemis Miliana.

Materials and methods

Geographic location:

The study area corresponds to the upper Cheliff valley, the alluvial plain of Khemis Miliana, it is located 120 km south-west of Algiers, it belongs to the Upper Cheliff watershed in the northern part of the country, Algeria. Its area is 359.5 km² and its perimeter reaches 159 km, It is ranked among the largest reserves of groundwater in the region. It is considered as an area whose dominant activity is essentially agricultural.

The DRASTIC-LU method is based on the mapping of Eight (08) vulnerability parameters and which are:

- The depth of the water (D)
- Efficient recharge (R)
- The materials of the aquifer (A)
- Type of soil (S)
- Topography or slope (T)
- The impact of the vadose zone or aerated zone (I)
- The permeability or hydraulic conductivity of the aquifer (C).
- Land use (LU)

Vulnerability assessment by the DRASTIC-LU method is carried out by calculating

Of the DRASTIC-LU Index according to equation (1).

$$I_{DRASTIC\text{-}LU} = D_r \times D_w + R_r \times R_w + A_r \times A_w + S_r \times S_w + T_r \times T_w + I_r \times I_w + C_r \times C_w + LU_r \times LU_w$$

Where D, R, A, S, T, I, C and LU are the eight parameters of the DRASTIC-LU model, r and w are respectively the scores and multiplier weights assigned to each parameter. The multiplier weight 10 corresponds to the highest degree of vulnerability.

Mapping of parameters of the DRASTIC-LU model in the alluvial plain of Khemis Miliana: The data collected in the alluvial plain of Khemis Miliana were processed using several geoinformatics platforms (ESRI ArcGISR, MapInfoR, SurferR RockWorksR .....).

These data were recorded in the database from which the information layers of parameters such as hydrogeological unit, soil map, geomorphological objects, boundaries, spatial distribution of precipitation, etc. were generated in The vector mode, while the entities (such as the Digital Terrain Model, groundwater depth, etc.).

Results and discussion

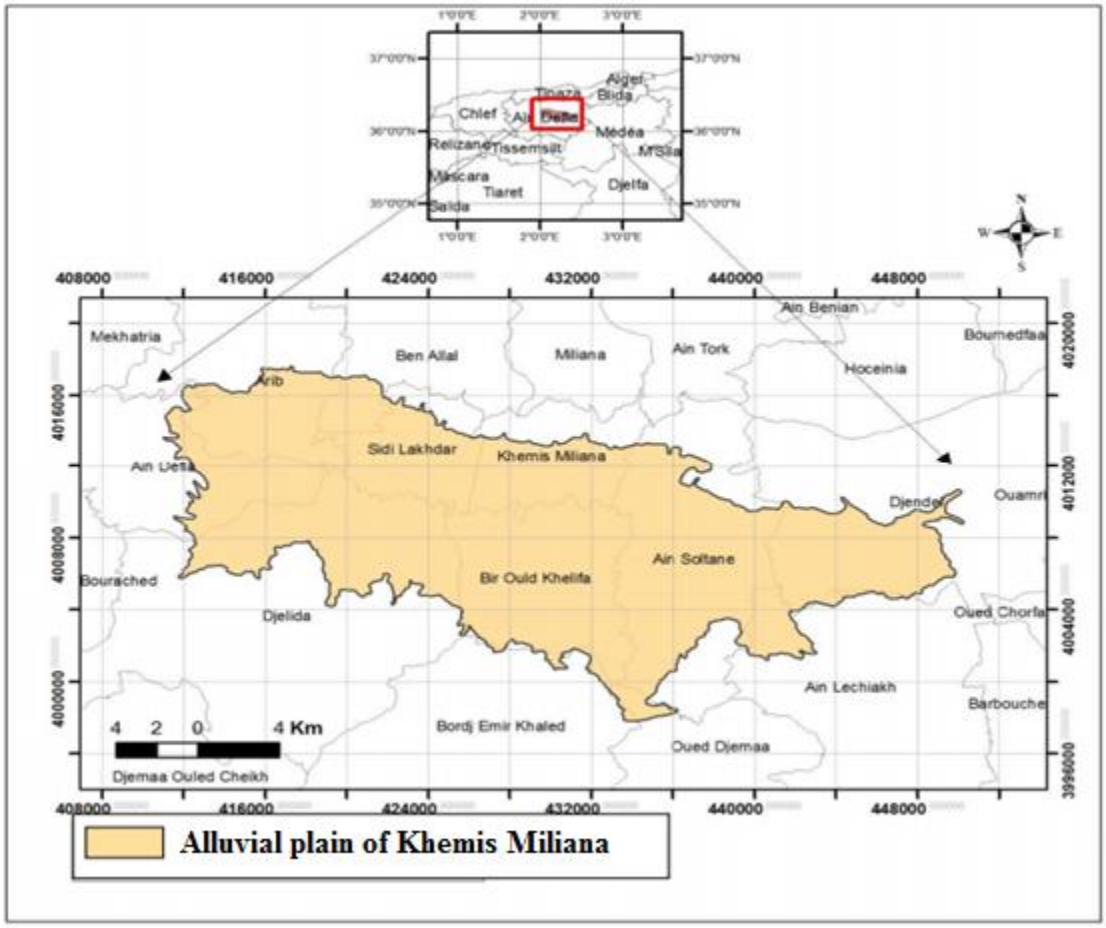

Figure 1: Location map of study area (Alluvial plain of Khemis Miliana)

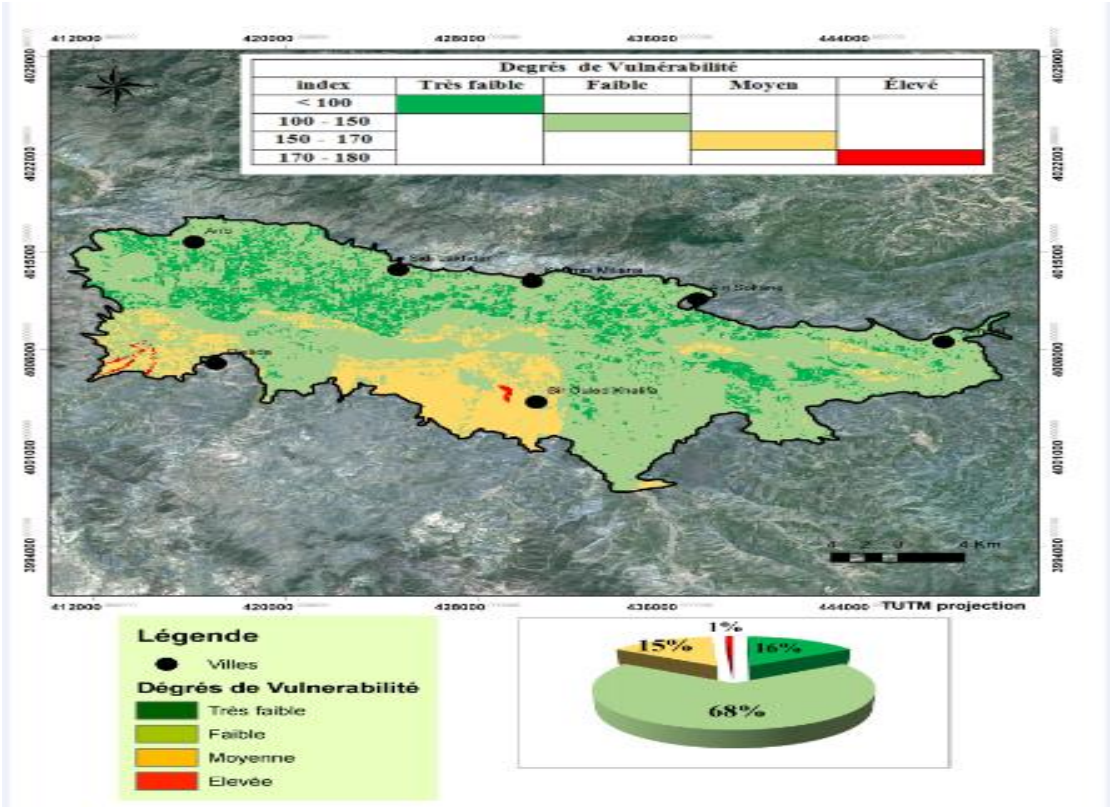

Figure 2: Final vulnerability map according to Model-DRASTIC-LU

Final vulnerability map according to Model-DRASTIC-LU

The method that was used to map the intrinsic vulnerability of groundwater to pollution is carried out by eight parameters, called model-DRASTIC-LU mapping. Several mappings were developed and then superimposed, depth of water level, impact of vadose zone, hydraulic conductivity and land use are the most effective parameters compared to net recharge, aquifer environment and type of Ground. Groundwater vulnerability, a map of the potential for contamination, was generated (**see Figure 2**). Analysis of this map shows that **68%** of the area is characterized by a low degree of vulnerability, **15%** of the total area A degree of average vulnerability, while **1%** of the area has an area of high vulnerability. The analysis of the map shows that about **16%** of the study area is in the very weak vulnerable zone. The southwestern and northern parts of the study area are characterized by a high vulnerable area.

From the result of the final vulnerability map obtained using the DRASTIC-LU method, we note that the southern part of the plain, which grows to the southern borders, as well as the southwestern part, are the zones The most vulnerable, and therefore the most exposed to the risk of groundwater contamination.

The Groundwater Vulnerability Map is used as an effective preliminary tool for the planning, policy and operational levels of the decision-making process for groundwater management and protection.

Conclusion

The mapping of vulnerability to pollution of the lowland alluvial aquifer was carried out by applying the DRASTIC-LU parametric method, which indicates a tendency of vulnerability to low pollution with a distribution of four classes as follows Low with 16% of the whole plain, low of 68%, average 15% is a high class of 1% of the total surface of the plain respectively, which allows us to say that the groundwater of this aquifer is Threatened locally and the risk of contamination is more or less manifested, this threat is marked by the influence of hydraulic conductivity, soil type and water depth as well as land use. Even if the very high vulnerability class is not included, the risk is high due to the presence of some sources of pollution in the region, the excessive activities of agricultural products generated by farmers, the vulnerability of these classes may evolve by anthropogenic effects.

RECOMMENDATION

Prevention against groundwater contamination is essential for effective and sustainable management.

References Bibliographic:

Alam.F, Rashid, Ahmed et Farooq Ahmad.D (2012) : A new model (DRASTIC-LU) for evaluating groundwater vulnerability in parts of central Ganga Plain, India.

Carreras, X., Fraile, J., Garrido, T., & Cardona, C. (2015). Groundwater Vulnerability Mapping Assessment Using Overlay and the DRASTIC Method in Catalonia. In *Experiences from Ground, Coastal and Transitional Water Quality Monitoring* (pp. 117-134). Springer International Publishing.

Chandoul, I. R., Bouaziz, S., & Dhia, H. B. (2015). Groundwater vulnerability assessment using GIS-based DRASTIC models in shallow aquifer of Gabes North (South East Tunisia). *Arabian Journal of Geosciences*, *8*(9), 7619-7629.

Djémin, J. É., Kouamé, J. K., Deh, K. S., Abinan, A. T., & Jourda, J. P. (2016). Contribution of the Sensitivity Analysis in Groundwater Vulnerability Assessing Using the DRASTIC Method: Application to Groundwater in Dabou Region (Southern of Côte d'Ivoire). *Journal of Environmental Protection*, *7*(01), 129.