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Assessment of Groundwater Vulnerability Using the DRASTIC Method in the Transboundary Coastal Aquifer between Albania and Montenegro: Focus on Lake Sasko and the Pentari Plain

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INTRODUCTION & AIM

The DRASTIC model is a standardized methodology used to assess the potential vulnerability of aquifers to contamination, based on the Delphi method, where relative weights (Fig. 1) are assigned to each hydrogeological parameter comprising the index (Aller et al., 1987). This model assumes that contamination originates at the surface and is transported vertically through infiltration to the aquifer (Muhammad Abu Sayed et al., 2023).

Fig. 1. Location of the study site in the Mediterranean basin.

The study site is a transboundary aquifer between Montenegro and Albania, with the Buna or Bujana River as country border between both countries.

METHOD

The DRASTIC index is a widely used tool for assessing groundwater vulnerability, integrating multiple hydrogeological and environmental parameters. The index provides a quantitative measure that helps identify areas more susceptible to contamination. The DRASTIC index is calculated as follows:

$$DRASTIC = (Dr \cdot Dw) + (Rr \cdot Rw) + (Ar \cdot Aw) + (Sr \cdot Sw) + (Tr \cdot Tw) + (Ir \cdot Iw) + (Cr \cdot Cw)$$

Each of the seven parameters considered in the DRASTIC index contributes differently to the overall assessment of groundwater vulnerability. To reflect their relative importance, specific weighting factors are assigned to each parameter.

Once the DRASTIC index has been calculated, the resulting values can be interpreted to assess the relative vulnerability of groundwater in different areas. This is done by categorizing the index into distinct classes, which provide a clear indication of the level of susceptibility to contamination. The classification of the DRASTIC index is presented in Table 3.

RESULTS & DISCUSSION

The assessment of the DRASTIC parameters is summarized in Table 4.

Table 4. DRASTIC parameters assesment

	Description	Values
D	Depth to water table	Dr=1 (<30 m), Dr=2 (22-30 m), Dr=5 (9-15 m), Dr=7 (4-9 m), Dr=9-10 (<4 m).
R	Net Recharge	Rr=1-2 (0-50 mm), Rr=3 (50-100 mm), Rr=6 (100-180 mm), Rr=8 (180-250 mm), Rr=9 (>250 mm).
A	Aquifer media	Ar=2-5 intergranular, Ar=6-10 karstified.
S	Soil media	Sr=3-5 clay, Sr=6-8 sandy soils, Sr=7-10 gravels or absent soil.
T	Topography	Tr=3 (12-18%), Tr=5 (6-12%), Tr=9 (2-6%), Tr=10 (<2%).
I	Impact of vadose zone	Ir=1 confining layer, Ir=3 clayey, Ir=6 limestone/conglomerate, Ir=10 sands and gravels.
C	Hydraulic conductivity	Cr=1 (<10^{-3} m/d), Cr=2 low permeability, Cr=4 permeable, Cr=6 moderately permeable, Cr=10 very permeable (>0.1 m/d).

- Very low (48-77): Areas with lowest permeability materials
- Low (77-108): Silt-clay zones with limestone inclusions.
- Moderate (108-116): Mixed grain-size materials and altered limestone.
- High (116-141): Conglomerates and gravels.
- Extreme (141-206): Karstified limestone zones.

Classsification

CONTINUATION OF RESULTS & DISCUSSION

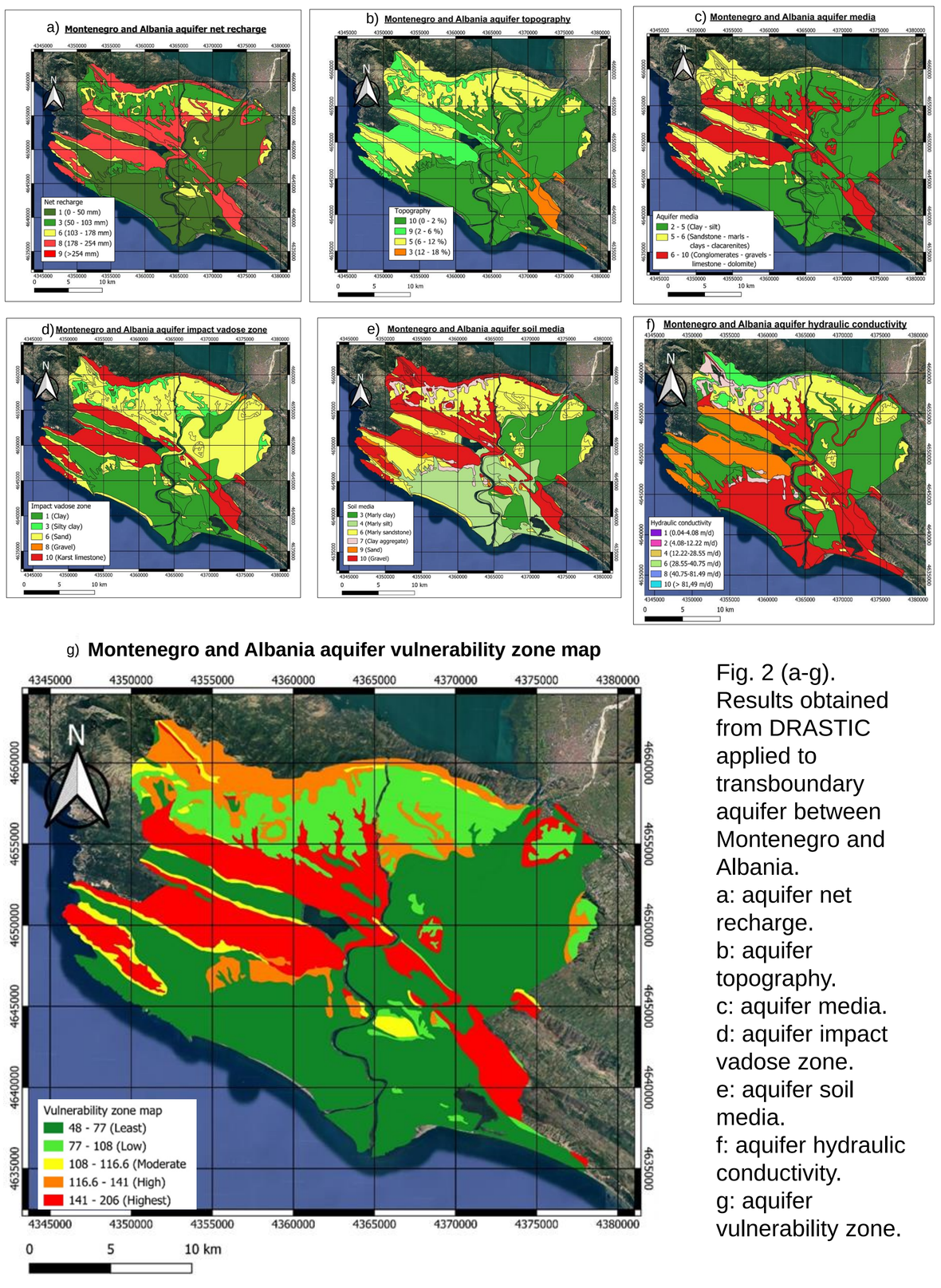

Fig. 2 (a-g). Results obtained from DRASTIC applied to transboundary aquifer between Montenegro and Albania.
a: aquifer net recharge.
b: aquifer topography.
c: aquifer media.
d: aquifer impact vadose zone.
e: aquifer soil media.
f: aquifer hydraulic conductivity.
g: aquifer vulnerability zone.

CONCLUSION

The analysis indicates that karstic and gravel-dominated areas exhibit high susceptibility to diffuse contamination, while clay-rich zones show lower vulnerability. Effective transboundary management, monitoring programs, and pollution control measures are essential to safeguard water resources in the region.

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