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ORIGINAL ARTICLE

Assessing groundwater quality using GIS

Insaf S. Babiker · Mohamed A. A. Mohamed · Tetsuya Hiyama

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Abstract Assessing the quality of groundwater is important to ensure sustainable safe use of these resources. However, describing the overall water quality condition is difficult due to the spatial variability of multiple contaminants and the wide range of indicators (chemical, physical and biological) that could be measured. This contribution proposes a GIS-based groundwater quality index (GQI) which synthesizes different available water quality data (e.g., Cl^-, Na^+, Ca^{2+}) by indexing them numerically relative to the World Health Organization (WHO) standards. Also, introduces an objective procedure to select the optimum parameters to compute the GQI, incorporates the aspect of temporal variation to address the degree of water use sustainability and tests the sensitivity of the proposed model.

The GQI indicated that the groundwater quality in the Nasuno basin, Tochigi Prefecture, Japan, is generally high (GQI >90). It has also displayed the natural (depth to groundwater table, geomorphologic structures) and/or anthropogenic (land-use and population density) controls over the spatial variability of groundwater quality in the basin. Temporally, groundwater quality is more variable in the upper and lower parts of the basin (variation, *V*, 15–30%) compared to the middle part (*V*, <15%) probably attributed to the seasonality of precipitation and irrigation of rice. In the lower southeastern part of the Nasuno basin and the vicinity of the Naka and Houki rivers the sustainable use of groundwater is constrained by the relatively low and variable groundwater quality. The model sensitivity analysis indicated that parameters which reflect relatively lower water quality (high mean rank value) and those of significant spatial variability imply larger impacts on the GQI and must be carefully and accurately mapped. Optimum index factor technique allows the selection of the best combination of parameters dictating the variability of groundwater quality and enables an objective and fair representation of the overall groundwater quality.

I. S. Babiker (✉) · T. Hiyama
Hydrospheric Atmospheric Research Center, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan
e-mail: insaf@hyarc.nagoya-u.ac.jp

M. A. A. Mohamed
Graduate School of Environmental Studies, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan