

Enhancement of groundwater contamination-vulnerability assessment using DLNN method combined with optimized original DRASTIC methods

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(a) Purpose of study or research hypothesis

The purpose of study is to enhance the assessment of groundwater contamination vulnerability using a Deep Learning Neural Networks (DLNN). Groundwater is an essential water resources for human life as well as agricultural activity. However, groundwater contamination increases continuously in the world due to the many kinds of contamination origins and inappropriate management. The reliable assessment of groundwater contamination vulnerability (GCV) is especially important for the effective management of groundwater.

(b) Key issue(s) or problem(s) addressed

Original DRASTIC model (ODM) has flaws in determining the weights of 7 DRASTIC factors and its assessment cannot guarantee the reliability of GCV. ODM uses only subjective integer weights like "Depth to water 5; net Recharge 4; Aquifer media 3; Soil media 2; Topographic slope 1; Impact to vadose zone 5; hydraulic Conductivity 3.

(c) Methodology or approach used

This study used 2 metaheuristic optimization methods of particle swarm optimization (PSO) and differential evolution (DE) to determine the objective weights of ODM and assessed GCV using ODM with the new objective weights. The ODM coupled with optimized methods are named as ODM-PSO and ODM-DE, respectively. This study also used Deep Learning Neural Networks (DLNN) to enhance the assessment of GCV and DLNN used the vulnerability indices (VI) of ODM-PSO and ODM-DE as its input data. The output data of DLNN was adjusted vulnerability indices (AVI) conditioned with nitrate concentrations.

(d) Results or conclusions derived from the project

Assessment capability of Optimized ODMs (ODM-PSO, ODM-DE) was compared to that of supervised artificial intelligence DLNN using correlation coefficients with nitrate concentrations and VI maps. DLNN showed the higher coefficient and more accurate spatial distribution map of VI than the Optimized ODMs.

(e) Implications of the project relevant to congress themes

VI maps of all methods represented the high groundwater contamination vulnerability around two rivers. An effective countermeasure for groundwater management and conservation was required for the sustainable development of groundwater in the study area. Finally, it is considered that this study can contribute to the water security of any contaminated groundwater areas as well as the study area (Miryang City of Korea).

Keywords : groundwater contamination vulnerability (GCV), Nitrate, Optimized ODMs, DLNN, Water

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