ABSTRACT

Groundwater is a valuable asset for household, farming, and commercial functions and for its ecological benefits. Notwithstanding this, this asset faces a severe threat because of increased contamination from human interference. To guarantee its dependability for current and future usage, groundwater must be managed effectively not solely in regard to availability but also quality. This can be accomplished by pinpointing places that are more susceptible to contamination and adopting countermeasures. The current study used a recently created Python programming-based objective modelling algorithm, the integrated determination of objective criteria weights-multi-attribute utility theory (IDOCIRW-MAUT) modelling algorithm, in evaluating groundwater vulnerability of the study area. The evaluation outputs were contrasted to those established using the analytical hierarchy process (AHP) model. For this evaluation, five groundwater vulnerability modelling factors (GVMFs)—bedrock topography, hydraulic conductivity, aquifer depth, drainage density, and slope from geophysical and remote sensing datasets—were weighted applying the IDOCRIW algorithm prior to the ultimate groundwater vulnerability metrics being established by incorporating the weights into the MAUT modelling algorithm. The overall groundwater vulnerability map was created in a GIS context with groundwater vulnerability indices generated by the Python-based IDOCRIW-MAUT modelling program. The groundwater vulnerability evaluation map categorized the research terrain into five kinds: very low, low, medium, medium high, and high groundwater vulnerability, with 3% (59 km²), 26% (485 km²), 33% (608 km²), 25% (473 km²), and 13% (251 km²) falling into each category, respectively. The correlation between the IDOCRIW-MAUT model and the AHP model leveraging longitudinal conductance (LC) data was determined to be 86% and 57%, respectively. The IDOCRIW-MAUT, which used an object-centred framework pattern, is more accurate and has the ability to provide applicable knowledge and potential solutions to choice-making in the field of groundwater quality in the research area and other locations of the globe with similar geologies.

Keywords: Groundwater vulnerability; IDOCRIW-MAUT; Objective MCDM algorithms; Python programming; Ranking of Alternatives; Sensitivity analysis