

Title: Hydro-chemical based assessment of groundwater vulnerability in the Holocene multi-aquifers of Ganges delta

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Abstract: Determining the degree of high groundwater arsenic (As) and fluoride (F⁻) risk is crucial for successful groundwater management and protection of public health, as elevated contamination in groundwater poses a risk to the environment and human health. It is a fact that several non-point sources of pollutants contaminate the groundwater of the multi-aquifers of the Ganges delta. This study used logistic regression (LR), random forest (RF) and artificial neural network (ANN) machine learning algorithm to evaluate groundwater vulnerability in the Holocene multi-layered aquifers of Ganges delta, which is part of the Indo-Bangladesh region. Fifteen hydro-chemical data were used for modelling purposes and sophisticated statistical tests were carried out to check the dataset regarding their dependent relationships. ANN performed best with an AUC of 0.902 in the validation dataset and prepared a groundwater vulnerability map accordingly. The spatial distribution of the vulnerability map indicates that eastern and some isolated south-eastern and central middle portions are very vulnerable in terms of As and F⁻ concentration. The overall prediction demonstrates that 29% of the areal coverage of the Ganges delta is very vulnerable to As and F⁻ contents. Finally, this study discusses major contamination categories, rising security issues, and problems related to groundwater quality globally. Henceforth, groundwater quality monitoring must be significantly improved to successfully detect and reduce hazards to groundwater from past, present, and future contamination.

Keywords: Ganges delta, Groundwater vulnerability, Holocene multi-layered aquifers, Logistic Regression (LR), Random Forest (RF), Artificial Neural Network (ANN)

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