

Simulation analysis of effect of mixing and reaction on groundwater nitrogen contamination in Kathmandu Valley, Nepal by a mathematical model

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Groundwater is a valuable water source in developing countries, where population and water demand are increasing, but groundwater is contaminated with nitrogen by industrial and domestic wastewaters and agricultural activities. In the underground environment, the form and concentration of nitrogen compounds are changed complexly by microbial reactions and mixing. Therefore, there is a limit to understand these effects on nitrogen contamination by using survey data alone. The purpose of this study was to analyze groundwater nitrogen contamination in the Kathmandu Valley, Nepal using a new mathematical simulation model.

The data used in the analysis were obtained from well water surveys at the Kathmandu Valley in August and September 2016. Two models, a reaction model and a mixing model, were prepared. The reaction model was prepared based on the previously reported model. The mixing model was prepared based on the literature values and river-groundwater mixing diagram.

As a result of the model simulation, nitrogen form was changed from nitrate ion to ammonium ion as time proceeds in river, and the decrease of nitrate ion by denitrification was observed in the groundwater. The increase in ammonium ion due to inflow of sewage was not observed. In addition, significant change in the nitrogen isotope ratio of nitrate was not observed, but the oxygen isotope ratio of nitrate significantly increased due to rainwater recharge. The mathematical model could simulate the nitrogen contamination process in groundwater.

Keywords: Kathmandu Valley, Groundwater, Nitrate ion, Ammonium ion, Nitrogen and Oxygen stable isotope ratio