Assessment of groundwater contamination using environmental tracers in a heavily cultivated coastal area

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Groundwater recharge patterns, nitrate contamination and seawater intrusion were assessed using stable isotopes of groundwater, chlorofluorocarbon (CFCs), and ^{3}H-^{3}He with hydrogeochemical data in an agricultural area, Maehwari, in the Hwaseong province of Korea. The study area is an agricultural area surrounded by low hills at the northern and eastern borders and close to ocean in the western area. The study area is mostly composed of forests and agricultural area. Agricultural activities in addition to seawater intrusion are attributable for the groundwater contamination in the study area. The concentration of NO_3-N in groundwater showed 0.1 ~ 45.6 mg/L in August 2015 (wet season), and 0.2 ~ 39.6 mg/L in March 2016 (dry season). More than half of the samples (55% and 59%) collected in the study area exceeded 10 mg/L (the maximum acceptable level) of NO_3-N in groundwater. The groundwater samples in some wells showed relatively high concentration of Cl^- (388 ~ 1,107 mg/L) with high values of electrical conductivity (1,027 ~ 2,715 μS/cm) indicating sea water intrusion in the study area. The values of $\delta^{18}O$ and δD showed that groundwater is mostly recharged from summer precipitation with some evidences of seawater intrusion and evaporation in the paddy fields. The apparent groundwater ages using ^{3}H-^{3}He and CFCs ranged from 0.5 to 17 years in the upgradient mountainous area and from 26.1 to 67.5 years in the downgradient coastal area. The NO_3-N concentration in recently recharged groundwater showed 3~45.6 mg/L while the NO_3-N concentration in 60 years old groundwater showed less than 3 mg/L. The inverse relationship between groundwater age and the NO_3-N concentration indicated that NO_3-N was recharged in recent years. Groundwater flow and NO_3-N transport model combined with seawater intrusion will be constructed to investigate the contaminant source in the study area.