

Natural Attenuation of Nitrate and Site Characterization of Major Factors Affecting the Quality of Shallow Groundwater near Livestock Area

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ABSTRACT

The main purpose of this study was to examine the hydrogeochemical factors leading to nitrate contamination of shallow groundwater near livestock area and to characterize the distribution and fate of pollutants emanating from point sources such as livestock. For this study, we chose a mountainous area, affected by agricultural activities, and located around Wonju, in mid-eastern part of the Korean peninsular. Most domestic wells in the area were developed for drinking water and irrigation. Groundwaters are primarily extracted from individually owned wells drilled in and around cultivated and residential areas. Most wells are only drilled to within 30 m below the surface because of high development costs. The general direction of groundwater flow is affected by the topography of the study area because of the narrowness of the alluvial aquifer.

Multivariate statistical analysis results that the groundwater in the study area is classified into three types. These results indicate that groundwater composition is mainly affected by three factors; fresh groundwater, fertilizers and animal excreta. In the recharge area, chemical concentrations were not very high. However, concentrations in groundwaters affected by agricultural activities were high. In particular, wells affected by agricultural activities (cultivation and livestock) could be identified from their high values for nitrate concentrations. It was thought that nitrate was increased by a nitrification process acting on NH_4^+ from components of fertilizer and animal excrement. Also, some concentrations of nitrate were decreased in the

environment in zones of low dissolved oxygen near livestock. This result indicates that denitrification is naturally attenuating nitrate. Above all, the concentrations of organic matter (BOD and COD) and the number of microbes (total coliforms) in groundwaters affected by livestock were higher than in any other groundwater types. The values for the ratio COD/BOD, organic matter concentrations and microbial concentration (total coliforms), show that the ratio of COD/BOD increases along an anticipated groundwater flow, even though COD, BOD and total coliforms decrease. It was inferred that this was due to the faster loss of easily biodegradable organic matter compared with non-biodegradable organic matter proceeding away from a discharge.

Key words: nitrate, groundwater, livestock, statistical analysis, denitrification