

Nitrate pollution and dynamics of groundwater flow at Tsukuba tableland to bottomland

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Groundwater contamination by nitrate results from over-fertilizing and/or inadequate disposal of livestock excreta has been large-scale problem in agricultural area. Because nitrate is primarily transported to streams via ground water flow, explaining actual condition of groundwater is needed to propose an effective measure for the conservation and restoration of sound nitrogen cycle in agricultural river catchments. The purpose of this study was to clarify an actual condition of nitrate pollution and flow system of groundwater, at the experimental field.

The field is located on a slope from Tsukuba tableland to the bottomland, which is a part of the Nishi-Yata River watershed in Ibaraki Prefecture, Japan. The site area is about 0.0675 square kilometers and the altitude varies from 24 m to 19 m. Land use of the tableland, the bottomland and the intermediate between them are forestland, paddy field and cropland, respectively. The groundwater quality and level were monitored for the year 2004.

The results from soil core survey, the soil layers were Joso Clay and sand classified into Joso Formation and loamy layer of the Kanto Plain with alluviums in alluvial lowland and surface soil. This site was characterized by blue-gray clay deposited around boundary between cropland and paddy field and riparian zone. There is a possibility of distribution of blue-gray clay layer under paddy field widely.

During the study period, nitrate concentration of groundwater did not change dramatically. Relative high concentration of nitrate was observed in the forestland (74 - 179 mg/l) and the cropland (3 - 43 mg/l). Based on the results of measured stable isotope ratios of nitrate-nitrogen, it was presumed that nitrate of groundwater in the forestland was mainly chemical fertilizer origin and in the cropland was mainly inadequate disposal of livestock excreta origin. It was also assumed that there was a denitrification zone in the paddy field and the area around its 2-4m consisted of blue-gray clay with reductive environment, where the nitrate concentration of groundwater was relatively low (0-2.46 mg/l).

The pressure head was converted into hydraulics head, and the groundwater flow were calculated. According to the results, it seems that groundwater flow from the tableland to the riverbed through the bottomland. It is presumed that groundwater cultivated in cropland pass through the denitrification zone. On the other hand, it is assumed that groundwater in the forestland does not pass through the depth of this purification zone. Based on the results, the nitrate originated from chemical fertilizer may not cause serious problem with nitrate pollution of river water.

We estimate nitrogen budget in the catchment and the amount of nitrogen circulating in agricultural area by fertilizer application, crop absorption and denitrification are a lot. We also be going to explain the nitrate pollution and dynamics of groundwater flow of catchment scale at our presentation.