# Estimation of nutrients sources for surface and ground water in an abandoned meadow adjacent to mire area

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Recently, abandoned meadows have been becoming evident due to their poor drainage and wet condition in the margins of the Kushiro Mire, eastern Hokkaido. Increase of abandoned meadows brings various negative impacts on the management of dairy farm and the rural landscape. Therefore, effective utilization of abandoned meadows is an important issue. Focusing on the water quality improvement function in wetlands, we are considering about the role of abandoned meadows as buffer zone between agricultural and mire areas. Objectives of the study are to examine (1) the present status of water quality in surface and ground water and (2) the nutrient sources from the spatial variations of water level and quality, and the nitrogen stable isotope ratio of groundwater, aiming the quantitative assessment for nutrient cycling function of abandoned meadows.

We set a plot of approximately 100 m×175 m surrounded by open drainage ditches at an abandoned meadow in Tsurui Village. The ground surface gently down from the north to the south and slightly down along the east and west drainage ditches. We comparted the plot into 28 cells of each 25 m×25 m. A well and three piezometers (30, 80, and 130 cm depths) were installed at the center of each cell. Surface and ground water at each piezometer, surface flowing water at the drainage ditches and adjacent rivers, and rain water were sampled in August and October of 2015 and about once a month from May to November of 2016. Water quality including EC, pH, DO, ORP, nitrogen and phosphorous concentrations was measured. Additionally, the concentrations of the stable isotope $\delta^{15}N$ were analyzed for the 30 cm depth groundwater at four point in the plot and two point in the riparian wetland of the adjacent river in November 2016. Water level was automatically recorded at a continuously waterlogged point in the plot and drainage ditches on the north and south sides of the plot.

Water level was higher at the point in which ground elevation was slightly lower than the maximum point. Lower area on the east and southwest of the plot along drainage ditches was continuously waterlogged. Water level measurement showed about 90 cm variation during investigation period. In the extreme flooding event of August 2016 by the continuous typhoons, backward flows were observed in the drainage ditches and the whole study plot was inundated.

The highest concentration of dissolved total nitrogen (DTN) was appeared at 30 cm depth groundwater in the center of the plot. Dissolved organic nitrogen (DON) and $NH_4$-N represented large portions of the DTN. The highest concentration of dissolved total phosphorous (DTP) was appeared at 30 cm depth groundwater in the continuously waterlogged points along drainage ditches. Dissolved organic phosphorous (DOP) represented a large portion of the DTP. The concentrations of DTN and DTP of surface and ground water in the study plot were higher than those of drainage ditches and rivers.

For the extreme flooding event of August 2016, the concentrations of DTN and DTP at surface water in the plot were higher than those for normal hydrological period. Dissolved inorganic nitrogen (DIN), mainly consist of $NO_3$-N, represented about 60% of the DTN. $PO_4$-P represented about 70% of the DTP. Every water quality variables were similar between surface water in the plot and the drainage ditches. Thus, the ditches' water likely flowed into the study plot, affecting directly the water quality of the surface water in the plot.

Groundwater near the drainage ditches, which represented higher DTP concentration, showed relatively higher $\delta^{15}N$ values of 15-30‰. This suggests animal waste might to be a nutrients source. In contrast,

 

groundwater at the center of the plot, which represented higher DTN concentration, showed relatively lower $\delta^{15}$N values of 5-8‰. This suggests a different nutrients source exists at the center of the plot, becoming the major nitrogen source in the groundwater.

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