Risk evaluation of the groundwater pollution by nitrate-nitrogen leached from farmlands in a middle-sized agricultural watershed

DIP below 16:1, especially in the agricultural catchments. During winter, NO_3-N tended to increase while PO_4-P decreased, resulting the increase of DIN:DIP above 16:1. The lower DIN:DIP during summer indicated a high rate of denitrification and a release of PO_4-P from paddy soils or sediments in an anoxic condition. Chl.a concentrations in the lake water were higher in the southeast area (max 1190 mg L^{-1}) where the DIN:DIP were relatively low. Therefore, P limiting for algal bloom would be removed in the southeast area, and the lower DIN:DIP water from rivers during summer may trigger harmful algal bloom in the Lake Hachiro. This study suggested we should focus on the balance of N and P cycles in the watershed, and the input nutrients especially P should be managed carefully in the Lake Hachiro watershed.

References

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The relationship between Nitrogen load and river water quality in several catchments in different area sizes

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In comparative research on water quality in watersheds, the issue of size of watershed area is often discussed. In this research, several catchments in different area size were set up and relationship between properties of catchment and potential nitrogen load in whole watershed and/or catchments was explored.

In the study, potential nitrogen load concentration (PNC) in the catchments were calculated and each catchments were categorized using land use types that were set based on ratio of urban, ratio of forest, ratio of cultivated land, ratio of paddy field in cultivated land and ratio of livestock load. In case of Upper Naka river watershed, there were 134 catchments and they were categorized into 7 land use types. Less than 20 % of catchments were same land use type as whole watershed. As a result, similarity of land use type in whole watershed and small catchments is one of the important factors. It is considered that the small catchment that has similar land use type of watershed represents property of river water quality of watershed.

Risk evaluation of the groundwater pollution by nitrate-nitrogen leached from farmlands in a middle-sized agricultural watershed

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Groundwater pollution by nitrate-nitrogen (NO_3-N) is widespread in Japan. Nitrogen (N) in chemical fertilizer and manure can be a source of the pollution but site vulnerability to the pollution cannot be determined in a wide area due to difficulties in understanding water and N movements in the soil-groundwater system. We developed a

PC system for evaluating groundwater pollution by agricultural activities in a wide area by a combination of statistical and GIS data, modified existing numerical model (LEACHM, Leaching Estimation And Chemistry Model, Hutson, 2003; Asada et al., 2011) and a newly developed GIS model (MacT, Mixing areal chemical Transport, Itahashi et al., 2011).

The application of the system to an agricultural watershed where standard cultivation methods were supposed to be adopted for each crop types revealed almost 100 % risk to groundwater pollution below farmlands. Two alternative treatments were suggested to reduce such groundwater pollution effectively while maintaining desired crop production; that is introduction of cleaning crops after harvest of the major crops to recover excess N still remaining in the soil, and reduction of total N inputs by both chemical fertilizer and manure with a careful look at carbon and nitrogen dynamics in soil-plant systems using LEACHM.

Although the groundwater pollution by NO_3-N is one of the persistent environmental problems in Japan, this system will help constructing more environmental friendly fertilization systems, and moreover conserving healthy water environment.

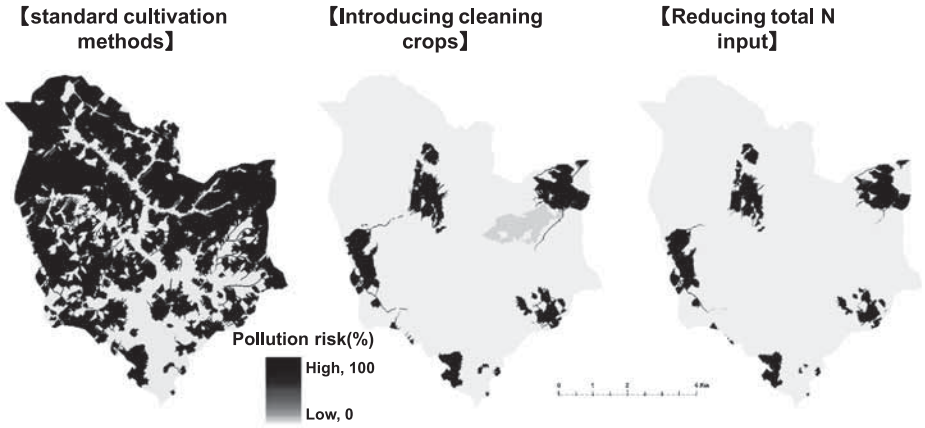

Fig. Risk evaluation maps to groundwater pollution by agriculture in an agricultural watershed.

Effects of silicate fertilizer application on growth and yield of organically managed rice

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Organic rice farming without chemical fertilizer and agrochemicals is expected to have merits of ecosystem conservation and reduction of environment pollution, but the yield level is low. It has a number of technically problems, for example, unestablishment of weed control technique and low yield by low nitrogen nutrient. In previous studies, it was shown that silicon (Si) can enhance photosynthetic ability and increase growth and yield of rice with conventional farming. In this study, we examine effects of silicate fertilizer application on growth and yield of organically managed rice.

Material and Methods: The field experiment was conducted in 2010 in the paddy field of the Field Science Center, Graduate School of Agricultural Science, Tohoku University, Miyagi prefecture, Japan. We use three silicate fertilizers; calcium silicate (CS), silica gel (SG), Poly-Silicate Iron sludge (PSI). PSI sludge includes large amount of silicon and iron derived from the flocculant. Main treatment was organic farming and four treatments were composed by no silicate fertilizer (control, CON), CS, SG, and PSI application. Application rate of each