Spatio-temporal variation of riverine N and P concentration in the Lake Hachiro watershed

Comparison of Nitrogen Budgets in Agricultural Watersheds

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To analyze the effect of agricultural activity on nitrogen (N) budget at watershed scale, a watershed-scale analysis was conducted at two Japanese and one Chinese watersheds. The study sites are the Shibetsu River watershed (SRW) and Upper-Naka River watershed (UNRW) in Japan, and the Jurong Reservoir watershed (JRW) in China. The total area and the proportion of agricultural area (in brackets) of the watershed was 685 km^2 (51%), 1299 km^2 (21%) and 46 km^2 (55%) for SRW, UNRW and JRW, respectively. The main agricultural land use in SRW was forage grass, while paddy rice fields occupied the highest proportion in UNRW and JRW with values of 11% and 31% of total land area, respectively. The farmland surplus N was 61, 48 and 205 kg N ha-1 yr-1 for SRW, UNRW and JRW, respectively. The total input and output for the whole watershed was 89 and 76, 83 and 61, and 353 and 176 kg N ha^{-1} yr^{-1} for SRW, UNRW and JRW, respectively. The proportion of discharged N to net anthropogenic N inputs was 31%, 37% and 1.7% for SRW, UNRW and JRW, respectively. The two watersheds in Japan showed similar relation to the previous reports, while the JRW showed a totally different characteristic compared to the proceeding studies. The high proportion of paddy rice fields and the water bodies in the landscape was an underestimated N sink in this area.

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Water quality in the Lake Hachiro is degraded as a result of nutrient pollution such as N and P, which can cause harmful algal bloom during summer. The relative availability of N and P in an lake water determines which nutrient is more limiting: P tends to be limiting for algal bloom when the N:P is over the Redfield ratio of 16:1 (moler). The balance of N and P delivering from rivers to the lake, therefore, can control algal bloom. This study evaluated a spatio-temporal variation of riverine N and P concentration in the Lake Hachiro watershed. River water sampling was conducted at 28 points in the BBM river catchment and at 20 points in the MTN river catchment once a month in 2008. Lake water sampling was also conducted once at 45 points in August 2010 (Hayakawa et al., 2011). The temporal variation of riverine DIN and DIP concentrations showed a reverse trend. During summer, NO_3-N concentration decreased while PO_4-P concentration increased, resulting the decrease of DIN:

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