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Hydrologic cycle of upland-lowland system in Shimosa Upland, Chiba Prefecture and spatio-temporal distribution NO3-N in

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1. INTRODUCTION

NO3-N in the environmental water has been increasing in many places in the world because of human activity, especially by agriculture. Upland regions in Chiba prefecture is extensive crop area and much amount of NO3-N is expected to add in hydrologic cycle.

This paper deals with the NO3-N contamination in the upland-lowland hydrologic cycle. Surface waters and groundwaters are sampled and analyzed for NO3-N. With the concept of groundwater flow system, holistic understandings of NO3-N distribution are attempted.

2. Study area and the methodology

Takasaki-gawa is the tributary of Kashima-gawa which flows into Inbanuma Lake, one of the source of domestic water in urban area of Chiba Prefecture. Takasaki-gawa dissects the flat upland called Shimosa Upland, prominent crop land in Japan. Valley bottom is mostly used for paddy field. Along the dissected valleys, there are two types of land use chains, crop land to paddy field and urban area to paddy field.

Waters are sampled routinely after 2008 to measure inorganic nitrogen, and seasonal variation and spatial distribution of inorganic nitrogen are made clear. Groundwater are also sampled and analyzed for NO3-N. The flow of rivers are measured seasonally and nitrogen load is calculated.

3. Results

There are many points that shows high NO3-N concentration in upper reach of Takasaki-gawa watershed. There is seasonal change in NO3-N. Low concentration is observed in May or June. Most observation points except urban area on the upland show the same seasonal change. There may be some signal concerning hydrologic cycle and material cycle in the upland-lowland system.

The paddy fields on May and June are in flooding condition. The source of irrigation water is deep groundwater and its NO3-N concentration is revealed to be low. Low NO3-N water is added to paddy field during irrigation period. At the same time, denitrification under the paddy is possible in deoxidization condition.

There are characteristic changes in NO3-N concentration along the tributaries of the Takasakigawa-river.

Channels A (Takasaki-gawa main course) and C starts from shallow dissected valley on the upland, gradually deepening the valley and transit to boat-shaped dissected valley. There is a knick point between shallow valley and boat-shaped valley. Uppermost area is urban area, or cropland in shallow valley, and paddy fields in the bottom of boat-shaped dissected valley. NO3-N concentration increased downstream and reach its maximum. After the maximum, NO3-N concentration gradually decreased downward.

Channel B starts from valley head with clear valley walls, so-called horse's hoof shape. NO3-N concentration is high from the beginning, and gradually decrease downward or keeps high level. There is extensive flat cropland behind the valley head. NO3-N concentration at the spring in valley head is high, and exceed environmental standard. Manuring on the upland should be the source of NO3-N.

The chain of land use and topography have primary influence of NO3-N concentration in river water. In channels A and C, there is a chain like upland (residential)– upland (cropland)– lowland (paddy). In channel B, the chain is upland (cropland) – valley head – lowland (paddy)

Along Takasaki-gawa main channel, the flow steadily increases downward. NO3-N concentration has its maximum and decrease downward, however, nitrogen load gradually increase downward. Total nitrogen load in the middle reach of Takasaki-gawa watershed is estimated to be 100 to 200 t/year.

Preliminary survey on groundwater reveals that the "NO3-N pool" in the upland reaches to the depth of about 50m. Below this depth the concentration of NO3-N is still low. The evaluation of local groundwater system correspond to uppermost dissected valley is important as drainage system of high NO3-N groundwater.

Keywords: nitrate-nitrogen, Shimosa upland, Chiba Prefecture, The chain of land use and topography, groundwater flow system, public water area