Influences of land and water use on the water quality of Shinotsu Canal

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1. Introduction

Shinotsu district is one of the important agricultural sectors in Hokkaido. Shinotsu Canal basin is covered by paddy field, upland, forest and others where agriculture is the main land use activity. Water quality of streams is highly related to the land use in the catchments that can affect the quantity and quality of runoff during and after precipitation. Tachibana et al. (2001) reported that non-point pollution greatly influence the water quality of the Ishikari River. Reuse of drainage water is one of the important factors for water quality in Shinotsu Canal, which contain high load of pollutants. Pollutants load from Shinotsu Canal influence on the water quality and agriculture of lower reaches of the Ishikari River, which consequently affects the aquatic biota of the Japan Sea. Therefore, the objective of this study is - to asses the influences of land use and water reuse activities on the water quality of Shinotsu Canal.

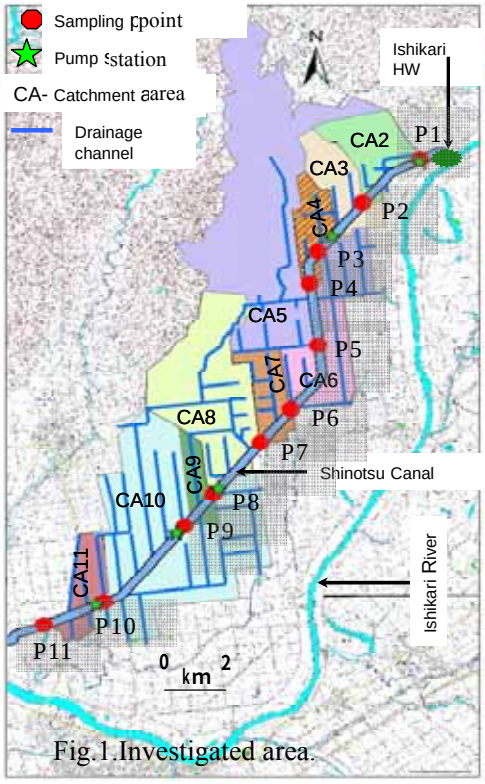

Fig.1.Investigated area.

2. Materials and methods

The investigation was carried out on the Shinotsu district of southern part of the Ishikari River basin of Hokkaido. Water samples were collected manually from May 2006 to October 2007, upstream to down stream along Shinotsu Canal at 11 points (P1~P11) in Fig.1, where P1, P6 and P11 are upstream, middle and down stream point, respectively. Conc. of SS was analyzed by suction filtration method and conc. of T-N, NO_3-N, NH_4-N and T-P were determined by UV spectrophotometric and ion-chromatographic methods, respectively. Catchments area divided into 10 sub-areas i.e. CA2~CA11 (Fig.1). GIS Arc-View software was used for scaling the catchments area and land use categorized by supervised classification method (Satillite data SPOT 4th June and ALOS 28th July & 9th Aug, 2006).

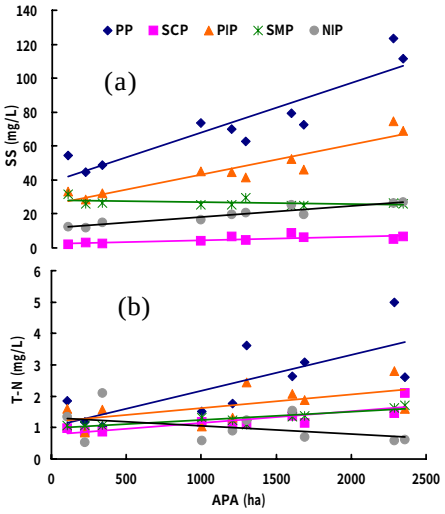

Fig.2. Relationship between APA and SS & T-N at each period

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Keyword- SS, T-N, T-P, land use, water quality

3. Results and discussion

3.1. Relationship between APA and water quality

The relationship between water quality (SS, T-N & T-P) and accumulated paddy field area (APA) in the catchment area are shown in puddling period (PP), normal irrigation period (NIP), post irrigation period (PIP), snow covered period (SCP) and snow melting period (SMP), respectively. APA was calculated by $APA_i = \sum_2^i PA_i$, where i=2~11. The relationship between APA and conc. SS are strongly correlation in PP and PIP due to intensive agricultural activities exist and no relationship in NIP, SCP and SMP (Fig. 2a). T-P indicates similar trend as SS. Conc. of T-N showed the relationship in SMP (Fig. 2b) in spite of no relationship to SS in this period. It is estimated that melting water of SMP percolated into the soil and discharge high conc. of NO_3-N.

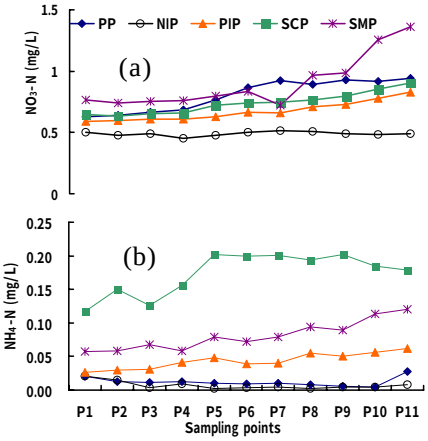

Fig.3. Periodic variation of NO_3-N and NH_4-N

3.2. Periodic effect on stream nutrients

Conc. of NO_3-N showed the highest value of 1.36 mg/L at point 11 in SMP (Fig. 3a).Large quantities of snow melting discharges through the under drain in SMP. So, NO_3-N flows out from the soil with melting water. Conc. of NH_4-N showed the highest value of 0.202 mg/L in SCP (Fig. 3b). It indicates that one of the high concentrations depends on a little discharge in SCP. In addition, it's regards as percolating water with NH_4-N through under drain of ground water in SCP.

3.3. Comparison of upstream and downstream water quality

Conc. of SS and nutrients shows the higher values at downstream and the lower values at upstream in every period (4a) except T-N. Conc. of T-N showed lowest value at downstream than upstream in normal irrigation period (NIP), because in that period paddy plants are growing stage and expend higher amount nutrients than others period (Fig. 4b).

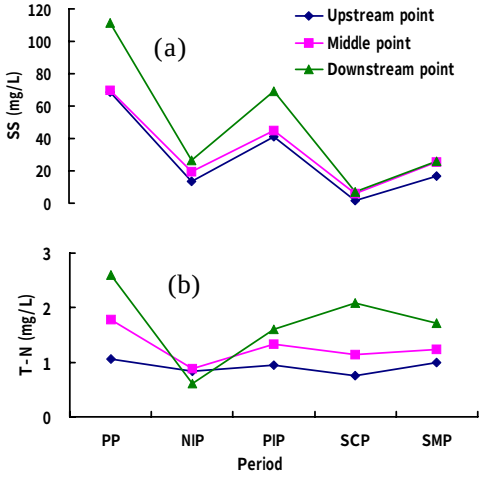

Fig.4. Upstream and down streams SS and T-N at each periods

4. Conclusion

APA is significantly correlated to SS in PP and PIP conversely, T-N has a correlation in SMP. The conc. of NO_3-N and NH_4-N shows the highest in SMP and SCP, respectively. Downstream found higher values of SS, T-N, NO_3-N, NH_4-N and T-P than upstream in every period except T-N in NIP. It is focused that strong influences of land use activities on the water quality. Since, downstream point shows the higher values in almost every period the impact of land use and water reuse of catchment areas on drainage water which affects on the water quality of Shinotsu Canal and finally affect to the lower reaches and the neighboring sea.

References

Tachibana, H., Yamamoto, K., and Magara, Y. 2001. Non –point pollution of Ishikari river, Hokkaido, Japan, Water Science and Technology, 44: 1-8.