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Preparation of the river water quality map and analysis of the organic pollution in the region of small precipitation

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Introduction

In the northern part of Shikoku Island, where there is small precipitation, particulate organic substance concentration in the river water is high, because the water is stored in a basin for efficient water use, leading to organic pollution of the river water. In a previous study, it was demonstrated that majority of the particulate organic substances in the Shin river, a major river in the Kagawa Prefecture, were from the basin (Yamada et al. 2010). The other hand, the basins in the Kagawa Prefecture is supplied with the water from the Yoshino river (Kagawa channel water, from central Shikoku Island) during the irrigation period. Since the organic substance concentration of the Yoshino river water is low, it may have dilution effect on the polluted river water in Kagawa Prefecture. In the Kagawa Prefecture, mechanism of ensuring river water quality becomes complicated because of efficient water use. In this study, the relationship between water pollution and water utilization were analyzed under the preparation of the water quality map.

Material and method

The investigation was conducted in the Shin river basin, one of main rivers in the Kagawa Prefecture. The total length of the Shin river is approximately 19 km, and the pond density (over an area of 1 ha) is 0.05 km^2/ km^2 in the middle and lower river basin. To analyze water and the source of organic substances in the Shin river, investigations of temporal variation (in the Shin river) and distribution (in its basin) for organic substances were conducted. Particulate organic carbon (POC), delta^{18}O, and phytoplankton composition in the sample were measured.

Result and discussion

The delta^{18}O of the Shin river decreased in the irrigation period, during which the supply of water from the Kagawa canal was increased (before supply, approximately ?5par-mil; after supply, approximately 7par-mil). The delta^{18}O of water from the Kagawa canal was low, at ?8.5par-mil. Supplying the Kagawa canal water for the irrigation seems to lower the delta^{18}O value of the river water. During the non-irrigation period, it was considered that the irrigation pond was the source of much of the water in the middle and downstream because delta^{18}O values of river and the irrigation pond were similar. The POC of the river water was low, at 2 mg/L, after the supply of Kagawa canal water, whereas it was 8 mg/L before the supply. Because the POC was low for the Kagawa canal water, the inflow of this water could cause the reduction in the POC of the river.

In spatial distribution, the POC and delta^{18}O increased from the upper stream to the middle stream in June and October. This rise was consistent with the rise in pond density in the basin. The proportion of the rise in October was higher than that in June. In October, the POC concentration rose from approximately 0.0?2.0 mg/L to 2.8?6.4 mg/L after the inflow of the largest irrigation pond in the basin. At the same time, delta^{18}O also increased from approximately ?8.2??6.1par-mil to ?4.4??5.1par-mil. It was indicated that POC in the river water rose because of the inflow of water from the irrigation pond. The fact that the POC of the river in June is low, when the water in the irrigation pond is predominantly discharged, was because low POC water, such as Kagawa canal water, flowed into the river during the irrigation period.

The phytoplankton species (*Microcystis aeruginosa* and *Cyclotella meneghiniana*) in both river and irrigation pond were similar, and the composition ratio was also similar.

From these results, it is thus proved that water from the irrigation pond was the source of organic substances in the middle and downstream river. However, during the irrigation period, when considerable water is discharged from the irrigation pond, the river POC was reduced because of dilution of organic substances due to inflow of low POC water from Kagawa canal.

Keywords: Organic pollution, Oxygen isotope ratio, River, Irrigation pond, Water quality map, Irrigation water