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Quantitative Analysis of Nutrient Inflow from River and Groundwater to Imazu Bay in Fukuoka, Japan

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Abstract : Imazu Bay plays an important role for endangered species such as horseshoe crabs and black-faced spoonbills that stay in the bay for spawning or the passing of winter. However, this bay is semi-enclosed with slow water exchange, which could lead to eutrophication under the condition of excess nutrient inflow to the bay. Therefore, quantification of nutrient inflow is of great importance. Generally, analysis of nutrient inflow to the bays takes into consideration nutrient inflow from only the river, but that from groundwater should not be ignored for more accurate results. The main objective of this study is to estimate the amounts of nutrient inflow from river and groundwater to Imazu Bay by analyzing water budget in Zuibaiji River Basin and loads of T-N, T-P, NO3-N and NH4-N. The water budget computation in the basin is performed using groundwater recharge model and quasi three-dimensional two-phase groundwater flow model, and the multiplication of the measured amount of nutrient inflow with the computed discharge gives the total amount of nutrient inflow to the bay. In addition, in order to evaluate nutrient inflow to the bay, the result is compared with nutrient inflow from geologically similar river basins. The result shows that the discharge is 3.50×107 m3/year from the river and 1.04×107 m3/year from groundwater. The submarine groundwater discharge accounts for approximately 23 % of the total discharge, which is large compared to the other river basins. It is also revealed that the total nutrient inflow is not particularly large. The sum of NO3-N and NH4-N loadings from groundwater is less than 10 % of that from the river because of denitrification in groundwater. The Shin Seibu Sewage Treatment Plant located below the observation points discharges treated water of 15,400 m3/day and plans to increase it. However, the loads of T-N and T-P from the treatment plant are 3.9 mg/L and 0.19 mg/L, so that it does not contribute a lot to eutrophication.

Keywords : Eutrophication, groundwater recharge model, nutrient inflow, quasi three-dimensional two-phase groundwater flow model, submarine groundwater discharge
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