Analysis of nitrogen and phosphorus loading in Saijo Plain using trace elements as tracer

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1. Introduction
River water sources in the Saijo Plain, Ehime Prefecture, are diverse irrigation water directly conducted from the Kamo River, shallow groundwater recharged from the Kamo River, and deep groundwater supplied from the hinterland of the Saijo Plain. Although it is difficult to grasp the water source quantitatively, Tokumasu et al. (2018) proposed a method of quantitatively analyzing the origin of river water using antimony as an index. In this study, using this method, we analyzed the origin of river water and clarified the effects of nitrogen and phosphorus loads from each water source and the effects of artificial loads from plains.

2. Materials and methods
On April 19 and 20, 2019, surface water was sampled at 43 small and medium rivers and waterways in the Saijo Plain on the right bank of the Kamo River, and each flows was measured by an electromagnetic velocimeter. The collected water was analyzed by ICP-MS for multi-elements, and the analysis of total nitrogen and total phosphorus was analyzed by the spectrophotometric method.

3. Results and Discussion
Using the antimony concentration of each water source (irrigation water, shallow groundwater, deep groundwater), the ratio of the water source at each point was calculated, and by multiplying the nitrogen and phosphorus concentration of each water source, the concentrations of natural resources without any human influence was obtained. The natural load was determined by multiplying the concentration of natural resources at each point by the flow rate. The lowest points are Stn. 11, 22, 23, 32, 33, 34, 36, 38 and 39.
Total nitrogen concentration was about 1 mg / L for irrigation water from Kamo River, and about 0.5 mg / L for shallow and deep groundwater. The concentration of natural resources estimated from the resource rate of water at the lowest point was 579 μg / L on average, and the load was 104 kg / day. On the other hand, the measured average concentration was 532 μg / L and the load was 95 kg / day, slightly lower than the natural load, and there was no increase in the balance due to the artificial load. This indicates that the artificial increase is within the range of natural purification such as trapping of particles in the riverbed, absorption by aquatic plants, and denitrification.
The total phosphorus concentration was about 10 μg / L for irrigation water from Kamo River, and about 10-30 μg / L for shallow and deep groundwater. Similarly to nitrogen, the natural concentration estimated from the resource ratio of the most downstream water was 21 μg / L, and the load was 3.7 kg / day. On the other hand, the measured average concentration was 36 μg / L, and the load was 6.4 kg / day and was 1.7 times the natural load. As for phosphorus, the balance shows that 0.7 times the natural load of phosphorus is present in the river water, indicating that there is an artificial load that exceeds natural purification.
Nitrogen has a mechanism of removal from water, such as denitrification. The nitrogen / phosphorus ratio of chemical fertilizers used for agriculture is approximately 1: 1 by weight, which is higher than the nitrogen / phosphorus ratio of biological substances. These are thought to be the causes of phosphorus

remaining in river water more easily than nitrogen due to artificial load.

Keywords: environmental tracer, antimony, artificial load

