

## Long-term Changes of Nutrients in River Water Flowing into the Osaka Bay, Japan

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The amounts of loadings of nutrients that flow into the Seto Inland Sea have been calculated by using unit loads for point and nonpoint sources by the Ministry of Environment, Japan. As unit loads on pollutant sources are values gained by limited researches, there is large difference between unit and actual load. Therefore, the pollutant loadings calculated by using a unit load procedure will include a large error as a necessary consequence. In addition, any changes of chemical forms are not able to evaluate by this method. To confirm the changes of loadings and forms of nutrient based on actual measurement, we studied the concentrations and forms of nitrogen and phosphorus in river water flowing into the Osaka bay, Japan, where is the most polluted enclosed sea in the Seto Inland Sea.

The data of continuous monitoring plan conducted by Hyogo and Osaka Prefecture since 1970's were collected and arranged as a set of nitrogen and phosphorus. The thirty three rivers, which consist of the first and the second class rivers, were selected in descending order of discharge and annual average concentration of nutrients were calculated.

The concentrations of nitrogen and phosphorus in most rivers indicated a decreasing trend as a whole. Some non-polluted rivers have maintained lower concentrations of nutrients for a long term. The decreasing trend of nutrients in most rivers fitted together changes of loadings reported by the Ministry of Environment every five years. The average concentrations of nitrogen and phosphorus for five years between 2004 and 2009 reduced 30 to 50 % than those in the 1970's, and the concentration of phosphorus were cut down more than that of nitrogen. Ammonium nitrogen remarkably decreased. Meanwhile, the ratio of nitrate nitrogen increased and occupied the largest part of inorganic nitrogen. Nitrite nitrogen was not detected. The change of inorganic nitrogen reflected a development of sewage system in each river watershed, that is, the percentages of treatment on domestic effluent is more than 90 % in Osaka and Hyogo Prefecture. Precipitation in Osaka and Kobe city faced to the Osaka Bay does not any trend during the period between 1970 and 2009. This suggests that the loads of nutrients from rivers in the watershed of the Osaka Bay would decrease according to the change of concentration.

These results showed that the loadings of nitrogen and phosphorus from watershed surrounding the Osaka Bay have been successfully cut by a total amount control based on the extraordinary measures law for environment conservation of the Seto Inland Sea.

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