

## An Analysis of Covariance to Determine the Effect of TPLMS in Masan Bay, Korea

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This study aims to evaluate the effects of Total Pollution Loads Management System (TPLMS) in Masan Bay, implemented to solve the pollution issues of coastal water of the Bay in 2007. The Bay had been famous for both a traditional fishery market selling flounder, sea string and other endemic fish, and a beautiful beach where local people used to enjoy sea-bathing annually until early 1970s.

The Bay experienced the rapid urbanization and economic development after early 1970s. Total population size of the watershed of 0.2 million in mid 1970s increased to one million in 2004. The development of the bay resulted in the dramatic degradation of water quality, outbreaks of fish-kill, a permanent beach-closing, the public notice of the prohibition of shellfish-gathering, and the first appearance of large scale red-tide in Korean history. Currently the bay is an exemplary area of the most deteriorating coast in Korea.

The Bay is a small and semi-enclosed bay with 17 small rivers and two sewage treatment plants in the watershed; total area amounts to about 70 square kilometers; an average depth is about 15 meters; the average tidal speed of tide in the innermost part of the Bay is only about 2~5 cm/sec; therefore, it is believed that pollutants in the Bay cannot be easily washed out.

Local and national governments invested additional 108 million USD for TPLMS projects such as river management projects, the enhancement of capacity of sewage treatment plants (STPs), and other best management practices to restore the Bay's environment since 2007.

To test the effect of TPLMS implementation, the samples of 17 rivers and 11 stations of the Bay were collected since 2005. The concentration and discharges of Chemical Oxygen Demand (COD), Total Nitrogen (TN), and Total Phosphorus (TP) of rivers and bay water were measured. The multivariate analysis of covariance (ANCOVA) using the data of measurements of both 2005-2006 (before TPLMS) and 2009-2010 (after TPLMS) samples was used to determine the impacts of TPLMS. Results of ANCOVA indicate that the implementation of TPLMS is likely to lower the concentration of COD by 2.35 mg/L. On the other hand, it is not clearly estimated that those of TP, and TN drop statistically even though those seems to be lowered.

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