

Spatial and temporal pollutant budget analyses toward the total maximum daily loads management for the Yeongsan watershed in Korea

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Abstract This paper delivers two issues: water quality in the Yeongsan (YS) watershed which is one of the major watersheds in Korea and new watershed management plans with respect to the total maximum daily loads (TMDL) management. Field studies were conducted to estimate the pollutant loads according to the spatial and temporal distribution based on the biochemical oxygen demand (BOD) concentration and the volumetric flow rate (VFR) data from YS watershed. The results of both spatial and temporal analyses show the main pollutant source was originated from the city of Gwangju and the pollutant load from the city to YS watershed was the most out of five cities during this study period. Concerning YS reservoir located downstream of YS watershed, it also shows the worst water quality in the entire watershed during the study period. These results collectively demonstrate that the city of Gwangju is a main region which generates numerous point and non-point pollutant sources and eventually the pollutants are accumulated in YS reservoir. Based on the results, we suggest two different management plans for YS watershed. One is the flow-control approach that is to increase the amount of dam discharge in order to guarantee the river management flow for the midstream region. The other is the mass-control approach that is to dredge the contaminated sediments in YS reservoir for removing pollutants chronically accumulated in the sediment. Simulations for the former and the latter provide the pollution mitigation rate in the watershed up to 6 and 8% for BOD₅, respectively. The methodology proposed here for TMDL management can be applied to a wide range of watersheds in Korea.

Keywords Pollutant budget analysis; spatial and temporal analysis; total maximum daily loads (TMDL); watershed management

Introduction

As one of the four largest watersheds in Korea, the Yeongsan (YS) watershed located in the southwest part of Korea, Jeollanamdo province, goes through the city of Gwangju and finally flows into the Yellow Sea. It is encompassed by a vast agricultural area (1000 km²) with 13 tributaries merging with the mainstream. In the watershed, there are also several artificial structures for agricultural purposes such as four dams upstream and one artificial lake with an embankment downstream. Although it features a relatively short mainstream length (130 km) and slow urbanisation (EMC, 2004), it shows the worst water quality out of the four largest watersheds. To this end, many studies and plans have been undertaken and suggested to improve the water quality in YS watershed. However, these plans have not been as successful as desired; rather, the water quality in the region has been getting worse. One reason for this is that a scientific and systematic approach for the watershed management has not been successfully carried out. The other reason is that fundamental planning through these approaches has not been effectively established yet. Therefore, in this study we investigate the water quality of YS watershed from historical data, as well as