

Interpretation of seasonal water quality variation in the Yeongsan Reservoir, Korea using multivariate statistical analyses

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ABSTRACT

The Yeongsan (YS) Reservoir is an estuarine reservoir which provides surrounding areas with public goods, such as water supply for agricultural and industrial areas and flood control. Beneficial uses of the YS Reservoir, however, are recently threatened by enriched non-point and point source inputs. A series of multivariate statistical approaches including principal component analysis (PCA) were applied to extract significant characteristics contained in a large suite of water quality data (18 variables monthly recorded for 5 years); thereby to provide the important phenomenal information for establishing effective water resource management plans for the YS Reservoir. The PCA results identified the most important five principal components (PCs), explaining 71% of total variance of the original data set. The five PCs were interpreted as hydro-meteorological effect, nitrogen loading, phosphorus loading, primary production of phytoplankton, and fecal indicator bacteria (FIB) loading. Furthermore, hydro-meteorological effect and nitrogen loading could be characterized by a yearly periodicity whereas FIB loading showed an increasing trend with respect to time. The study results presented here might be useful to establish preliminary strategies for abating water quality degradation in the YS Reservoir.

Key words | autocovariance, estuarine reservoir, principal component analysis, seasonal Kendall test, water quality

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INTRODUCTION

The Yeongsan (YS) reservoir is an estuarine reservoir located in the southwestern region of Korea. Since its construction in the late 1980s, it has been an important part of agriculture and flood control in Yeongsan (YS) Watershed in Jollanamdo province of Korea. The YS Watershed is encompassed by large agricultural (1,161 km²) and urban/industrial areas (304 km²), which rely on the YS Reservoir for water; hence, the YS Reservoir is an important water resource for the YS Watershed. In addition, because the community in YS watershed suffered from severe flooding in monsoon season, the YS Reservoir is a useful tool for controlling water level of estuarine system.

Water quality in the YS Reservoir, however, has been drawing the public interest in recent years because of the deteriorated aqua-ecological state caused by stagnant waterbody of the reservoir and continuous pollutant loadings from the YS watershed. As the estuarine dam built at the outlet of the YS River has prohibited natural water circulation and caused poor water quality as a result of the anoxic and hypoxic conditions in the bottom layer of water. Furthermore, there are numerous point- and non-point sources discharging into the YS Reservoir from the YS watershed (Ki *et al.* 2007), causing eutrophication. Although scientific and reliable assessment on water quality