# Characterization of Korean Reservoirs Based on Algal Biomass and Morpho-physical Parameters

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**Abstract:** Classifying analysis of small-and medium-sized agricultural reservoirs in Korea was conducted, and subsequently, water quality characteristics of classified reservoirs were evaluated. The collected data of 486 reservoirs were classified as 4 types, with the chlorophyll-*a* (25μgL$^{-1}$) and water storage/surface area ratio (mean depth: 7.5m). Reservoirs designated as Type II were evaluated to be a major concern in the management perspective. Type II reservoirs generally showed high Chl-*a*, relatively old age, small ratio of drainage area/lake area, and high generation loading of pollutants, compared to other types.

## Introduction

Water quality and ecological consequences in reservoirs are specifically influenced by various parameters including local meteorology, source and distribution of pollutants within the watershed, geography, and morphometric characteristics. In spite of specific reservoirs being surrounded by many different parameters, their responses can be occurred in a similar manner, which could be generalized in both scientific and management perspectives. This study tried to generalize responses of reservoirs in terms of eutrophication, and evaluated important factors engaged in representative types of the reservoir.

## Database and analyses

Database was generated from Korean agricultural water quality monitoring network (KARICO, 2001), which included 486 reservoirs. In order to first characterize the trophic state the Chl-*a* concentration of 25μgL$^{-1}$, a numerical criteria of eutrophic state proposed by OECD. For the further classification, various parameters potentially related with reservoir water quality were analyzed, and among them, one additional parameter was selected. Pearson's correlation analysis was conducted to compare the relationships between reservoir water quality and other parameters. The difference among classified reservoir types was tested by Student's t-test. Statistical significance was tested at $p < 0.05$ level.

## Results and discussion

Reservoirs were first classified into two types based on the OECD chlorophyll-a criteria of eutrophic status: Type I with < 25μg Chl-*a* L$^{-1}$ and Type II with > 25μg Chl-*a* L$^{-1}$. Among various parameters analyzed, mean depth of reservoir showed most significant correlation ($r = 0.47$, $p<0.001$) with Chl-a concentration, and specifically mean depth of 7.5m was the one most evident to differentiate reservoirs. Thus, these two criteria were attributed to the 4 types of classification of the studied reservoirs (Figure 1).

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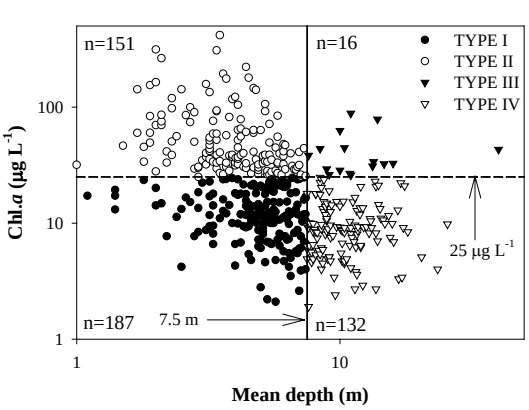
Chl-*a* concentration was high with reservoir age regardless of mean depth, while the effect of drainage area/lake area (DA/LA) ratio on the water quality was considerable. Type I reservoirs showed higher DA/LA ratio, shorter hydraulic residence time (HRT), and younger-aged relative to Type II reservoirs. Chl-*a* concentration became higher with both age and DA/LA ratio among Type III and IV reservoirs(Figure 2).

The higher proportion of both paddy and upland field within the drainage area resulted in the higher Chl-*a* concentration. This result was most evident in Type III reservoirs with the smallest DA/LA ratio among classified types of reservoirs. Relative intensity of generation load of pollutants (BOD, TN, TP) attributed to high Chl-a concentration in reservoirs, and it was highest in Type II reservoirs with differential effects by point (BOD) and nonpoint (TN) sources. Increase of Chl-*a* concentration was proportionally high with values of water quality parameters (BOD, COD, SS, TP) ($r > 0.70$, $p < 0.001$). The differentiation among types was relatively clearer with TP than TN, and lower TN/TP ratio caused higher Chl-*a* concentration (Figure 2, Table 1).



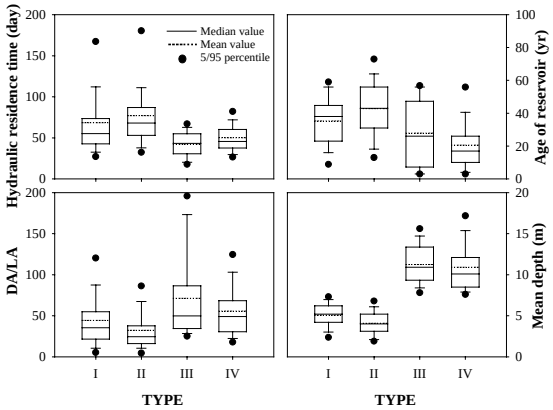




Figure 1 (Left). Classification of reservoirs based on OECD criteria of Chl. *a* concentration (25 μg $L^{-1}$) and mean depth (7.5 m). Figure 2 (Right). Morphometric and hydraulic characteristics in classified four types by OECD criteria of Chl.a concentration and mean depth of 7.5m. DA and LA denotes drainage area, reservoir surface area, respectively.

Table 1. Summary of relationship among trophic state, morphometric characteristics, type of land use, pollutant loading and water quality in classified four types of reservoirs.

| Characteristics | Parameters | Type I | Type II | Type III | Type IV |
|---|---|---|---|---|---|
| Trophic state | | | High | | Low |
| Morphometric factors | LA | Large | | Small | |
| | DA | Large | | Small | |
| | Age | Shallow | Old | | Young |
| | ž | | | Deep | |
| | DA/LA | | Small | Large | |
| | HRT | | Short | | Long |
| Type of land use in watershed | PFA/DA | | Large | | Small |
| | UFA/DA | | Large | | Small |
| | FOA/DA | | Small | | Large |
| Contribution on generation loads per watershed area | P | | High | | Low |
| | NP | | High | | Low |
| | P+NP | | High | | Low |
| Water Quality | Chl.*a* | | High | | Low |
| | TP/TN | | Low | | High |