

Water quality analysis in Chikugo River

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Introduction

For water resources management in Chikugo basin, it is necessary to study about the characteristics of the discharged pollutants especially how much of them are being discharged within a certain period. The objectives of this study are 1) to develop tank model for water quality analysis and 2) to evaluate the annual loading rate of Chikugo River. The flow rate and water quality parameters obtained from tank model are not only the predicted results but they also implicitly give some important information about characteristics of the pollutant loading. The application of simulated water quantity and water quality in the evaluation of pollutant loading of Chikugo River is described below.

In order to determine the amount of pollutant discharged into Chikugo River, the study about the characteristics of pollutant loading from each pollutant source in Chikugo basin is necessary.

Chikugo basin

As shown in Figure 1, the study area is the middle reaches of Chikugo River, located between Arase and Senoshita. The study area is 852 km², which is about 30% of Chikugo basin area. Almost 50% of total population in Chikugo basin lives in this area.

The existing major hydraulic structures are four reservoirs and three weirs, namely, Gosho reservoir, Egawa reservoir, Terauchi reservoir, Yamagami reservoir, Oishi weir, Yamada weir and Eri weir. Chikugo weir, which plays an important role in flood control and irrigation supply, locates near Senoshita.

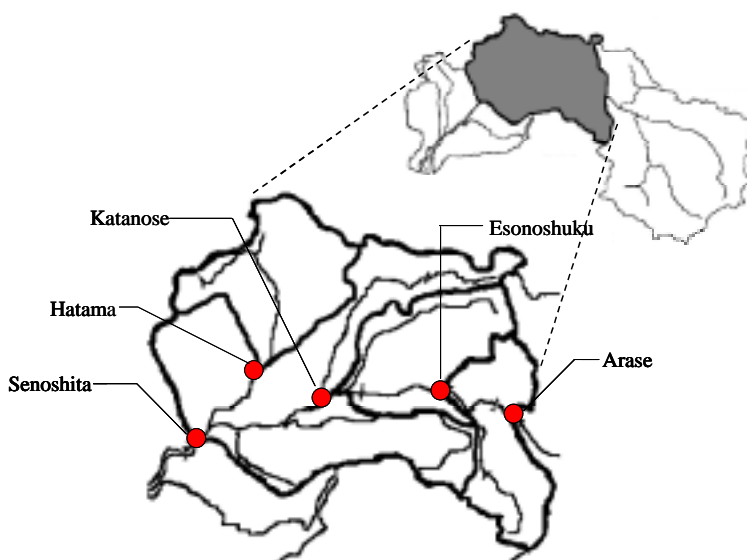


Figure 1 The study area - the middle part of Chikugo basin.

Tank model- simple but effective simulation model

Though most of tank models are developed for water quantity simulation, tank model is developed for both water quantity and water quality simulation in this study. The developed tank model is a series of three tanks. The lateral orifice represents surface or sub-surface runoff from each tank while the orifice at the bottom of the tank represents the infiltration.

Based on the water balance within the watershed, tank model was, at first, developed to simulate discharge from catchment area and flow rate of Chikugo River. Simulated flow rate of Chikugo River has good agreement with observed data¹. Then, the pollutants discharged from catchment area and the results from water quantity simulation are utilized as input data for water quality simulation. Pollutant loading from catchment area is discharged from three sources, nature (forest and mountain), human's activities (urban and rural area) and agriculture (paddy field).

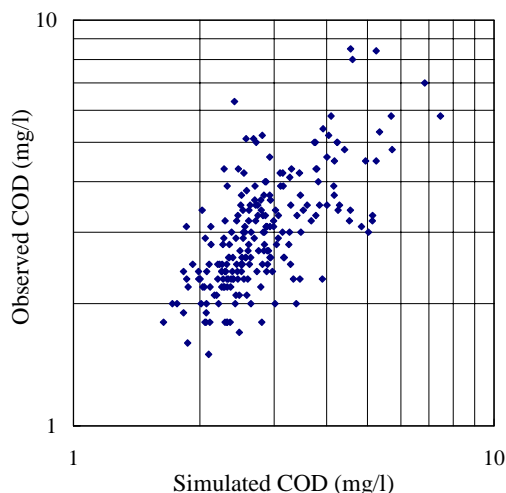


Figure 2 COD concentration simulated by tank model and observed COD concentration at Senoshita.

Chikugo River, tank model, water quality analysis, annual loading rate

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Water quality simulation and annual loading evaluation

To examine the performance of the developed tank model, water quality simulation in Chikugo River is carried out at Katanose and Senoshita from 1983 to 2001. The comparison between the obtained result and the observed data indicates that the developed tank model can effectively simulate water quality in Chikugo River². Simulated COD concentration and observed one at Senoshita are demonstrated in Figure 2.

After verifying the developed model, total amount of pollutant discharged from Chikugo River per year, calculated from the resulting flow rate and water quality concentrations, is employed in pollutant loading analysis. Figure 3 shows COD, BOD, T-N, T-P and SS loading at Senoshita compared with its observed data from 1991 to 2001.

On the other hand, averaged pollutant loading of one river also can be estimated from its empirical relationship between loading, L , and flow rate, Q . Annual loading rate of Chikugo River obtained from tank model and the L - Q relationship at Senoshita are presented in Table 1. Except suspended solid loading, the annual pollutant loading estimated by tank model and loading-flow rate relationship is not much different.

Table 1 Averaged annual loading rate of Chikugo River obtained from tank model and its relationship between loading and flow rate (1983-2001).

Loading (t/year)	Tank model	L-Q equation
COD	10904	11302
BOD	7099	6212
T-N	5372	5471
T-P	360	495
SS	37561	81284

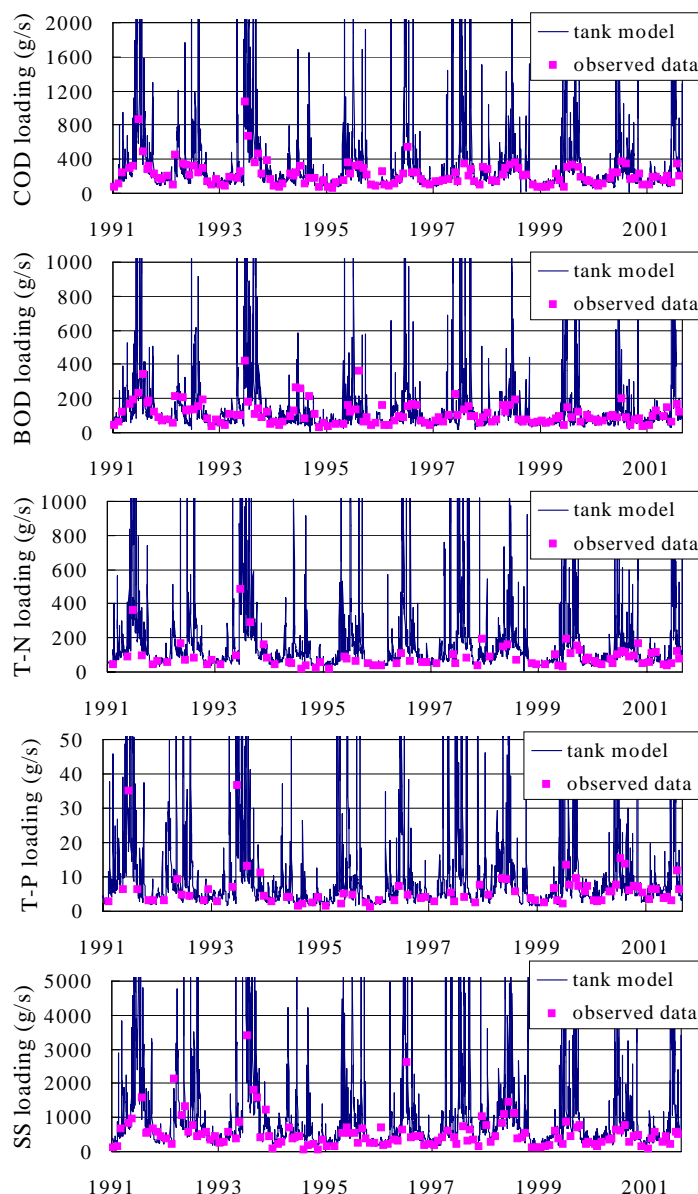


Figure 3 Pollutant loading discharged from Chikugo River.

Conclusions

From the comparison of pollutant loading and annual pollutant loading rate, the developed tank model sufficiently simulates both water quality and pollutant loading of Chikugo River.

Annual pollutant loading discharged from Chikugo River into the Ariake Sea, which can be obtained from the developed tank model, is important information for pollution control in the Ariake Sea as well as in Chikugo River itself. Through the application of tank model, the influence of Chikugo River's loading on water quality and ecosystem in the Ariake Sea can be pointed out.

In the future, besides the effects on its water quantity and quality, it is also possible to evaluate the effect of hydraulic structures on pollutant loading of Chikugo River with the application of tank model as well.

[Reference]

- 1) Vongthanasunthorn, N., K. Koga, H. Araki, Y. Mikuriya, K. Moriyama, N. Ohwa. 2000. Water Quantity Analysis in Chikugo River. *JSCE Annual Meeting*.
- 2) 真崎亜希子, Narumol V., 古賀憲一, 荒木宏之, 大和則夫: 「筑後川水系の水質解析に関する基礎的研究」平成 13 年度土木学会西部支部研究発表会