

Annual Variation in Sediment Yield and Nutrient Load in Chugoku Region, Western Japan

*Fandy Tri Admajaya¹, Yuta Shimizu², Shin-ichi Onodera¹, Mitsuyo Saito³

1. Graduate School of Integrated Arts and Sciences, Hiroshima University, 2. National Agriculture and Food Research Organization, Western Region Agricultural Research Center, 3. Graduate School of Environmental and Life Science, Okayama University

Introduction

There are many of enclosed bays have faced environmental issues of eutrophication, pollution, and oligotrophication. In addition, the threat of a shortage of water resources and serious flood on a watershed scale has been found in the world under a climate change. Thus, a relevant concern to clarify this issue is emphasized. Rivers has a great impact on biological production in coastal zones as a nutrient source, as well as human activities as water resources or flood disaster. To conserve environments of enclosed bays and their catchments, it is important to confirm production processes and long-term variations of streamflow quantity and quality. To understand and clarify hydrological and biogeochemical processes and variations in the complicated systems as catchments with various natural and human environments, the hydrological and biogeochemical were examined model to the Japanese enclosed bay catchments. The Soil and Water Assessment Tool (SWAT) was chosen for water, sediment, and nutrient discharge modeling to apply in the Ota river basin and the Gonokawa river basin. The objectives of this study are: (1) to estimate hydrological element rates on a steep and forested catchment (2) to estimate the water balance of the Ota River and the Gonokawa River. (3) to confirm the sensitive parameters on a monthly and daily basis (4) to estimate the suspended sediment, and nutrient load (total nitrogen) in the Ota river catchment by considering the extreme storms and flood events.

Methods

The SWAT-CUP SUFI2 was used for model calibration and validation which confirmed by sensitivity analysis. The model calibration was performed for the period (2006-2010), with three years of warm-up period (2003-2005), then the model was validated for four years (2011-2014). Evapotranspiration was estimated by the Penman-Monteith method. To evaluate the competence of the model, six objective functions are observed: p-factor, r-factor, R^2 , NSE, RSR, and PBIAS.

Results and Discussion

The results show very strong correlation and agreement of simulated and the observed data during calibration and validation periods on the monthly and daily basis. The SWAT model had shown significant results to estimate hydrological element rates on a steep and forested Japanese catchment. So, the model is probably applicable to a steep and forested Japanese catchment. In future, the SWAT model application can be extended to another place in Japan Based on the simulated model, the evapotranspiration rate ranges from 39.7% to 41.7%, discharge ranges from 45.7% to 51.9%, and groundwater recharge ranges from 5.6% to 9.1%. The difference was caused by the precipitation variation, and it is spatial distribution. There are three sensitive parameters that be found in the simulated model: CH_K2, CN2, HRU_SLP. Based on these results, the surface runoff/overland flow parameter and the topographic aspect is potentially considered to be relevant in these catchments. For example, HRU_SLP is a sensitive parameter to adjust the lateral flow rate. When the parameter was in default values, the lateral flow reaches 48.9% of the total water budget. In these case, controlling lateral flow was required. After modified this parameter, the amount of lateral flow was decreases up to 5.7%. The assessment of water quality estimated to be 119.5 tons/year of total nitrogen and 4,769.6 tons/year of sediment in 2014, especially calculated to be 8,4 tons and 394.7 tons in August in 2014 with serious disaster. The average annual value of nutrient and

sediment are 115.7 tons 4,290.6 tons, respectively. In addition, the average monthly value of nutrient is 8.8 tons and sediment is 285.6 tons. However, it is important to validate by the other methods in the future studies. More reliable observed data with daily resolution and improvement of the model were needed to get the acceptable value of water quality estimation to understand the natural-environmental processes and relationships.

Keywords: SWAT Model, Sediment yield, Nutrient Load, Water balance estimation, Gonokawa River, Ota River