

Water resources potential assessment of ungauged catchments in Lake Tana Basin, Ethiopia.

Getachew Tegegne Damtew*, Young-Oh Kim**

Abstract

The objective of this study was mainly to evaluate the water resources potential of Lake Tana Basin (LTB) by using Soil and Water Assessment Tool (SWAT). From SWAT simulation of LTB, about 5236 km² area of LTB is gauged watershed and the remaining 9878 km² area is ungauged watershed. For calibration of model parameters, four gauged stations were considered namely: Gilgel Abay, Gummera, Rib, and Megech. The SWAT-CUP built-in techniques, particle swarm optimization (PSO) and generalized likelihood uncertainty estimation (GLUE) method was used for calibration of model parameters and PSO method were selected for the study based on its performance results in four gauging stations. However the level of sensitivity of flow parameters differ from catchment to catchment, the curve number (CN2) has been found the most sensitive parameters in all gauged catchments. To facilitate the transfer of data from gauged catchments to ungauged catchments, clustering of hydrologic response units (HRUs) were done based on physical similarity measured between gauged and ungauged catchment attributes. From SWAT land use/ soil use/slope reclassification of LTB, a total of 142 HRUs were identified and these HRUs are clustered in to 39 similar hydrologic groups. In order to transfer the optimized model parameters from gauged to ungauged catchments based on these clustered hydrologic groups, this study evaluates three parameter transfer schemes: parameters transfer based on homogeneous regions (PT-I), parameter transfer based on global averaging (PT-II), and parameter transfer by considering Gilgel Abay catchment as a representative catchment (PT-III) since its model performance values are better than the other three gauged catchments. The performance of these parameter transfer approach was evaluated based on values of Nash-Sutcliffe efficiency (NSE) and coefficient of determination (R²). The computed NSE values was found to be 0.71, 0.58, and 0.31 for PT-I, PT-II and PT-III respectively and the computed R² values was found to be 0.93, 0.82, and 0.95 for PT-I, PT-II, and PT-III respectively. Based on the performance evaluation criteria, PT-I were selected for modelling ungauged catchments by transferring optimized model parameters from gauged catchment. From the model result, yearly average stream flow for all homogeneous regions was found 29.54 m³/s, 112.92 m³/s, and 130.10 m³/s for time period (1989 - 2005) for region-I, region-II, and region-III respectively.

Keywords: Ungauged Basin, SWAT, Parameter Transfer, GLUE, Lake Tana Basin

* Member · PhD student, Dept. of Civil and Environmental Engineering, Seoul National Univ. · E-mail: getfix@rocketmail.com

** Professor, Dept. of Civil and Environmental Engineering, Seoul National University · E-mail: yokim05@snu.ac.kr