SWAT モデルを利用したカンボジア・ポーサット川流域の河川流量評価
Assessment of Stream Flow Variability in Pursat River Basin of Cambodia using SWAT Model

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I. Introduction

Cambodia is one of the more disaster-prone countries in Southeast Asia, effected by variability of water resources due to excessive water in the rainy season and limited water in the dry season. In Pursat River Basin (PRB), while water demand is increasingly under competition, water resources have become severely variable recently according to Pursat Provincial Department of Water Resources and Meteorology. Water resource in PRB is significantly important for agriculture, mainly rice production, which is estimated to double in term of planting area by 2030 (JICA, 2016). For future water resource development and planning, understanding the historical change in stream flow is crucial. Therefore, the objective of this study is to assess stream flow of the river basin from the past three decades in order to evaluate the flow variability and predict the future trend.

II. Materials and Methods

This study was conducted on Pursat River Basin, one of the Tonle Sap sub-basins, which drains an area of 5,965 km^2 (JICA, 2011) (Fig. 1). To achieve the objective, Soil and Water Assessment Tool (SWAT) model was used to simulate the stream flow from 1982 until 2015, including the warm-up period of the first 4 years. SWAT is a physically based model and it requires extensive data including topography, landuse, soil properties, weather, and management practices which were obtained from various sources. For model calibration and validation, SWAT-CUP with SUFI-2 algorithm was selected to proceed within the period of 2000-2007 and 2008-2015, respectively using

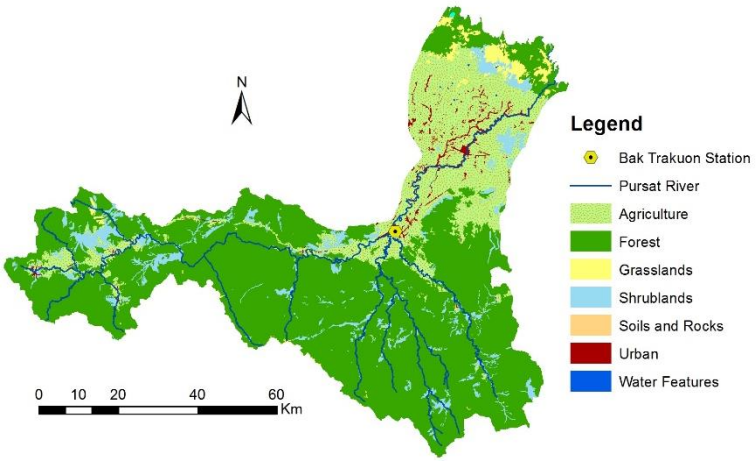

Fig. 1. Pursat River Basin and its landuse in 2010 (CNMC, n.d.).

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Keywords: Water resource variability, SWAT model, Pursat river basin

the daily observed stream flow at Bak Trakuon station. The model performance was then evaluated using the coefficient of determination (R^2), the Nash-Sutcliffe Efficiency (NSE), the percent bias (PBIAS).

III. Primary Results

The results shown in this section are the primary simulation results from the model. Both calibration and validation results were simulated using the default parameters and values in the SWAT-CUP. Hence, the model performance fell into dissatisfaction. The model calibration result is shown in Fig. 2a by plotting hydrograph of daily observed versus simulated stream flow from 2000 to 2007. It indicated that the model overestimated the discharge particularly during the peak from the year 2000 till 2004 with a low R^2 of 0.30, and NSE of 0.11, and a high negative PBIAS of -31.6%. For the primary result of the validation between 2008 and 2015 (Fig. 2b), the model perform worse than the calibration result, giving a low R^2 of 0.16 and negative NSE of -0.08, and a high negative PBIAS of -23.8%. It is overestimated for the peak flows in the year 2008, 2009, and 2011, while it is underestimated for the peak flows in the year 2012, 2013, and 2015.

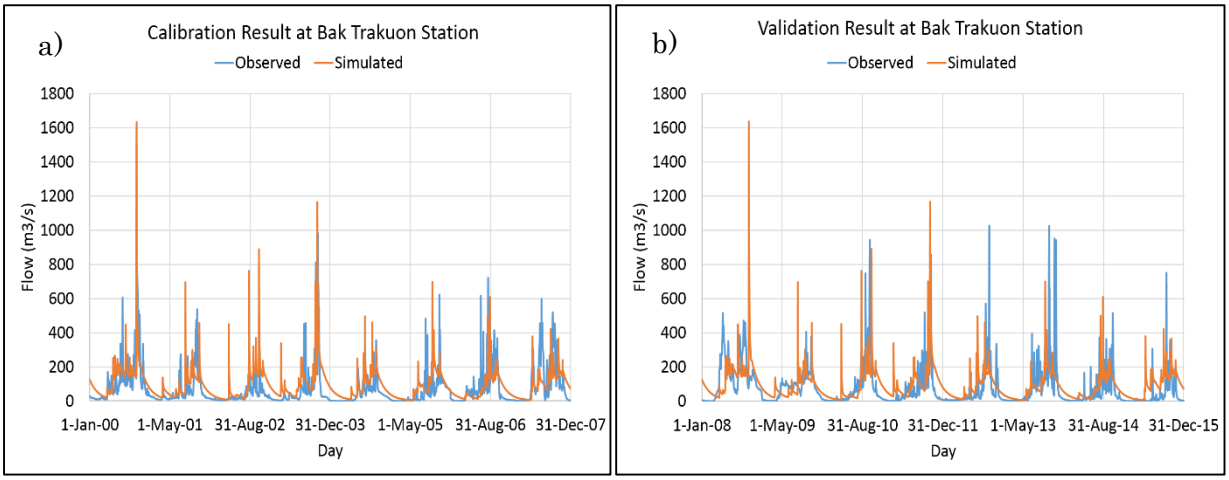

Fig. 2. Results of calibration (a) and validation (b) at Bak Trakuon station.

IV. Next Plan and Expected Outcomes

For the next plan, sensitivity analysis will be conducted to estimate the rate of change in model outputs in relation to change in the model inputs, which helps in determining important parameters for improving the accuracy of the results. After that, the model calibration and validation will be performed repeatedly using the modification of those sensitive parameters until a proper result is obtained.

From this study, it is expected that the stream flow from the past 30 years can be estimated and the variability trend can also be captured to see how it is likely to be in the future so that the water resources in this river basin would be able to be managed in a sustainable way.