Assessment of Water Resources and Hydrological Conditions by Using the SWAT Model in the Stung Sen River Basin, Cambodia
カンボジア国ストゥンセン川流域における SWAT モデルによる評価

○Sreyleak KORN*　Tasuku KATO*
コーン スレイレア*　加藤亮*

I. Introduction

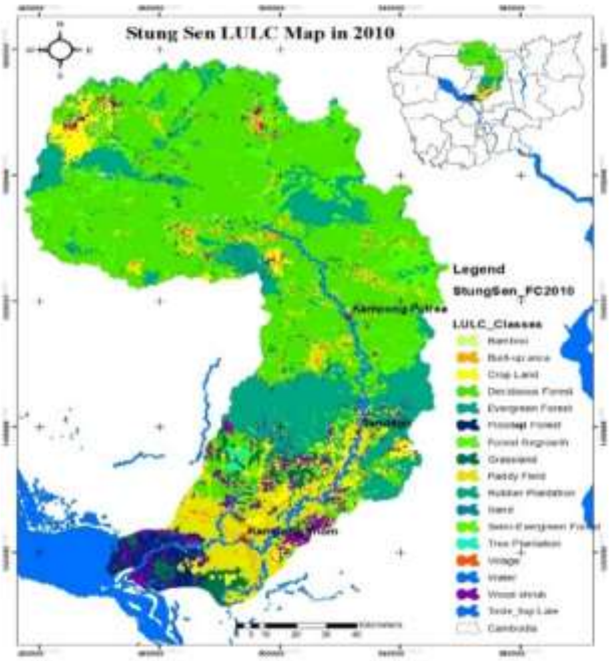

Fig.1 Study location & its land-use

Changes in land use caused by urbanization, deforestation, and changing agricultural practices have impacted the hydrological processes by shifting interception, infiltration rates, evapotranspiration, surface runoff, and groundwater depletion (Samal & Gedam, 2021). Tonle Sap Lake (TSL) is an essential source in Cambodia for the country's core social-environmental development. As Tonle Sap Lake watershed scale, the contribution of the flow from tributaries is very seasonal (Sok et al., 2022). The previous study found that changing runoff results due to land use change that significantly impacts the some sub-basins (Sok et al., 2022). This study aims to assess the impact of land use change on streamflow in a watershed of the TSL sub-basins.

II. Material and Method

The Stung Sen sub-watershed was chosen for this research because it is the largest tributary and primary contributor to Tonle Sap Lake, with an area of 16,341 km^2. As research methods, The Soil and Water Assessment Tool (SWAT) model was applied for hydrological analysis, water balance, and discharge processes with land use management over a long period. Model parameter sensitivity analysis, calibration, and validation were performed with the SWAT-CUP tools by the sequential uncertainty-fitting algorithm (SUFI-2). The performance of the SWAT model can be evaluated by using the Nash–Sutcliffe efficiency (NSE).

所属　*東京農工大，*Tokyo University of Agriculture and Technology, Keywords: Hydrological model, SWAT, Water Resources, Stung Sen River Basin

III. Results

Calibration and validation results with statistical performance and the model evolution of the daily streamflow indicated that the SWAT model was well calibrated and validated in a very good range. Figure 2 graphically summarizes the annual results of the simulation discharge process from 2007-2021. The simulated discharges corresponded well with observed flows; however, several years of streamflow were fluctuated. This means the basin flow has changed due to changing agricultural practices such as irrigation development.

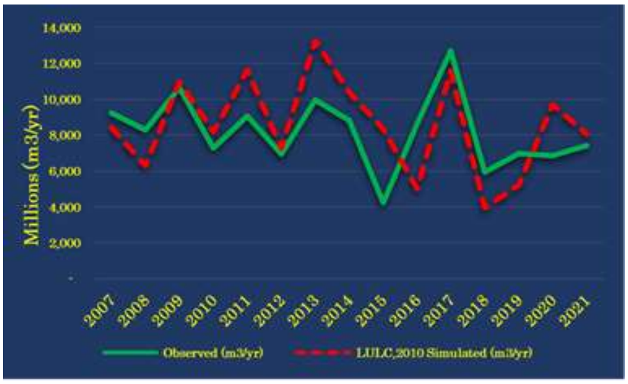

Fig. 2 observation and simulation streamflow

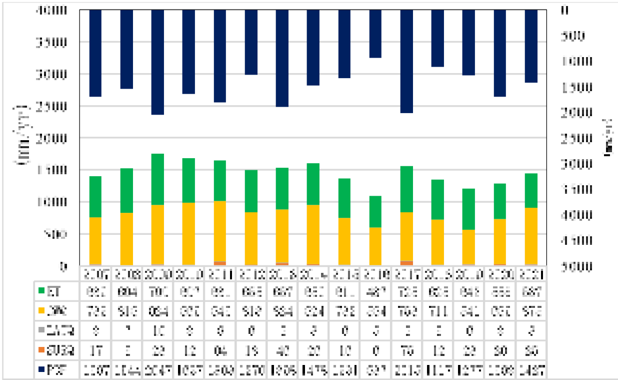

Fig. 3 Annually Water Balance Components

Figure 3 shows annual water balance components, including precipitation, evapotranspiration, lateral flow, surface runoff, and groundwater, from 2007–2021. The years with the highest annual contribution of water balance components was 2009, 2011, 2013, 2017, 2020, and 2021, while the years with the lowest contributions were 2016 and 2018. This shows seasonal fluctuation and reflects flood and drought periods.

IV. Discussion

The study determined the possible effects of land use on hydrological conditions using the SWAT model. The annual contribution of water balance components indicated a hydrologic alteration under the component of the hydrological condition that related to the local ecosystem leading to seasonal fluctuations during flood and drought periods. Streamflow of the basin has flatulated under irrigation development periods.

V. Conclusion

SWAT was applicable for daily streamflow calibration and validation processes. The model produced the streamflow in an acceptable range from the beginning to the end of the seasonal streamflow. Between 2015 and 2021, the annual distribution pattern of streamflow changed when compared to the pattern of basin flow and simulation results due to changing agricultural practices such as irrigation development. This is ideal for assessing and quantifying various hydrological components in the study area to address watershed management issues.