Impact of Land Use Changes on Stream Discharge by SWAT Model
A Case Study in Bago River Basin, Myanmar

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1. Background and Purposes of This Study

Myanmar has numerous flood plains where monsoon flooding is an annual concern. Bago River Basin was often hard-hit, with a frequent loss of life and damage to households, properties, and physical facilities (Zin, et al., 2015). An impact of climate change has been visible in this watershed with a dawn of twenty-first century. Increasing surface runoff, land cover changes, and deforestation are major impacts in Bago River Basin. Quantitative and qualitative flow changes due to changes of precipitation on the river watershed is determined by Soil and Water Assessment Tool called SWAT model. The purpose of this study is to evaluate the impact of land-use changes on stream discharge in Bago River Basin, Myanmar.

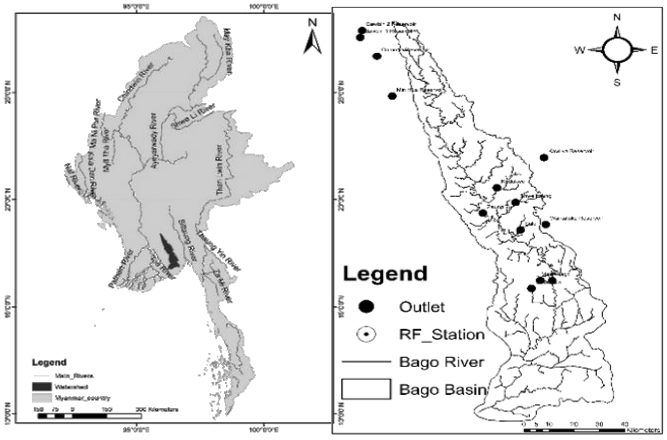

Figure 1. Location of Bago River Basin in Myanmar.

2. Research Methodology

Figure 1 illustrates the location of the Bago River Basin in Myanmar. In this study, input data processing such as creation of DEM data, land use maps and soil maps were prepared in ArcGIS environment. The land-use maps for the year 2000, 2010 and 2017 from the source of SERVIR MEKONG Land Cover Portal were used for estimating the effect of land-use changes by using SWAT model.

3. Results and Discussion

A comparison of the land uses of 2000, 2010 and 2017 in the Bago River Basin has notified some conspicuous changes in that area. **Figure 2** depicts the Bago river basin land use map in 2000, 2010 and 2017.

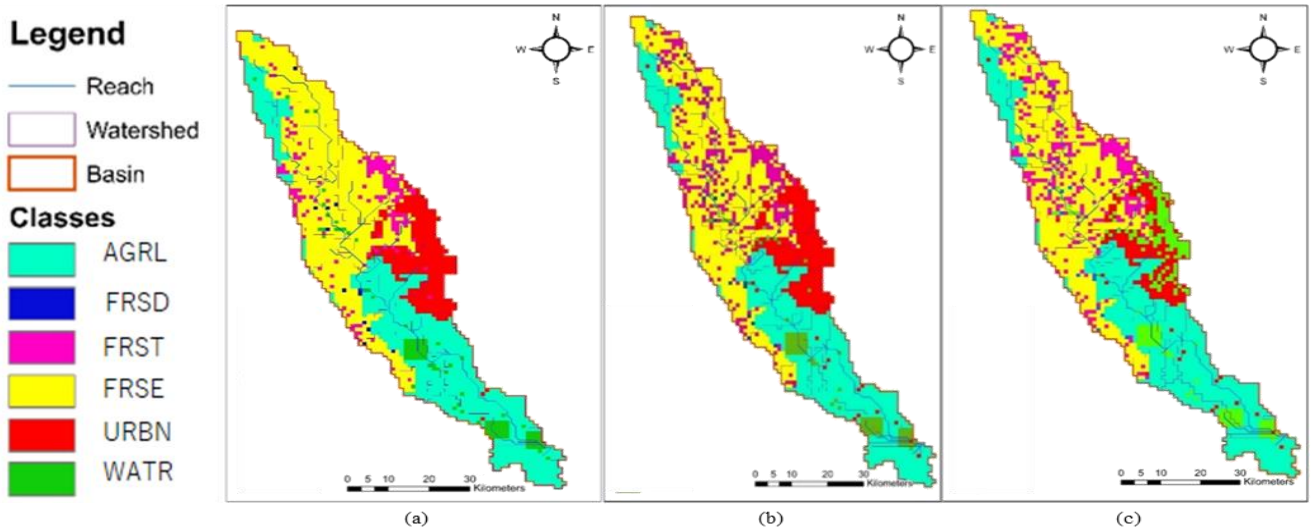

Figure 2. Bago River Basin land use map in (a) 2000, (b) 2010 and (c) 2017.

The results show a significant increase in the forest mixed area, which is also known as forest shifting with cultivation prescribed by the Forest Department of Myanmar, to 28% from the period of 2000 to 2010 and 32% from 2000 to 2017. The effect of the land-use change was evaluated by effectively applying the calibrated models for the period from January 2010 to December 2013. In the prediction of an annual hydrological response, this result also indicated that a gradual increase of the surface runoff and a continuous decline in groundwater flow when compared to the land use in 2000. To be more specific, the surface runoff increased 8% in 2010 and 10% in 2017, whereas, the groundwater flow decreased 6%

in 2010 and 10% in 2017 respectively. These changes occur due to an increase in forest mixed areas in Bago River Basin, having some influences on the hydrologic cycle. **Figure 3** shows the comparison of land uses in 2000, 2010 and 2017. Forest deciduous changed rapidly to forest mixed as shown in **Figure 3**.

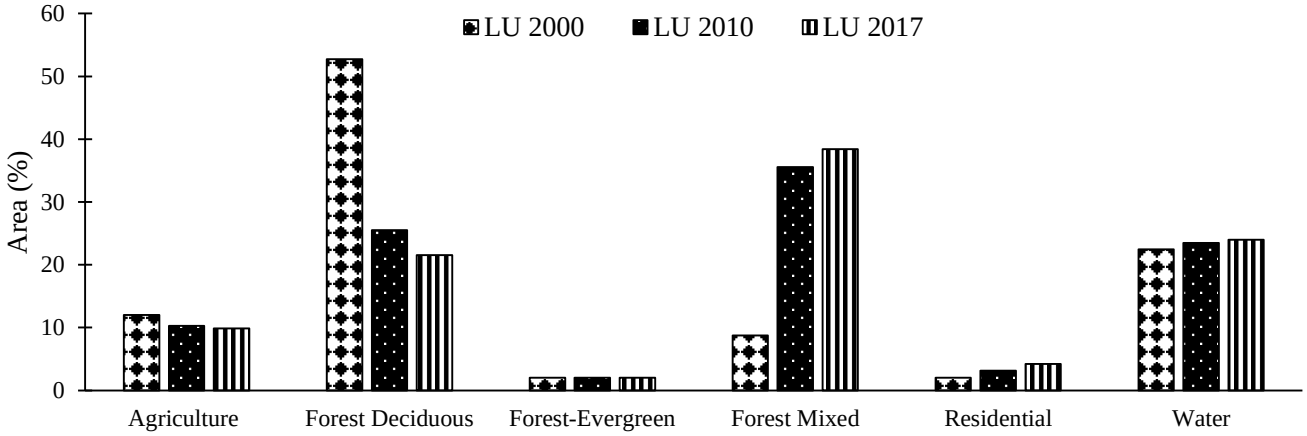

Figure 3. Comparison of land uses in 2000, 2010 and 2017.

A calibration process in SWAT model was performed by mainly using land-use changes for three different years, 2000, 2010 and 2017. Nash-Sutcliff efficiencies (NSE) and Root Mean Square (R^2) provided by the SWAT model are observed to check the performance of this model. As a result, the model generates for NSE 0.69, 0.75, 0.76 and also produces 0.75, 0.83, 0.85 for R^2 respectively. These aforementioned results confirm that this model can be beneficially use for evaluating the runoff mechanism in advance. **Figure 4** shows the observed and simulated discharge in calibration period at Bago Station.

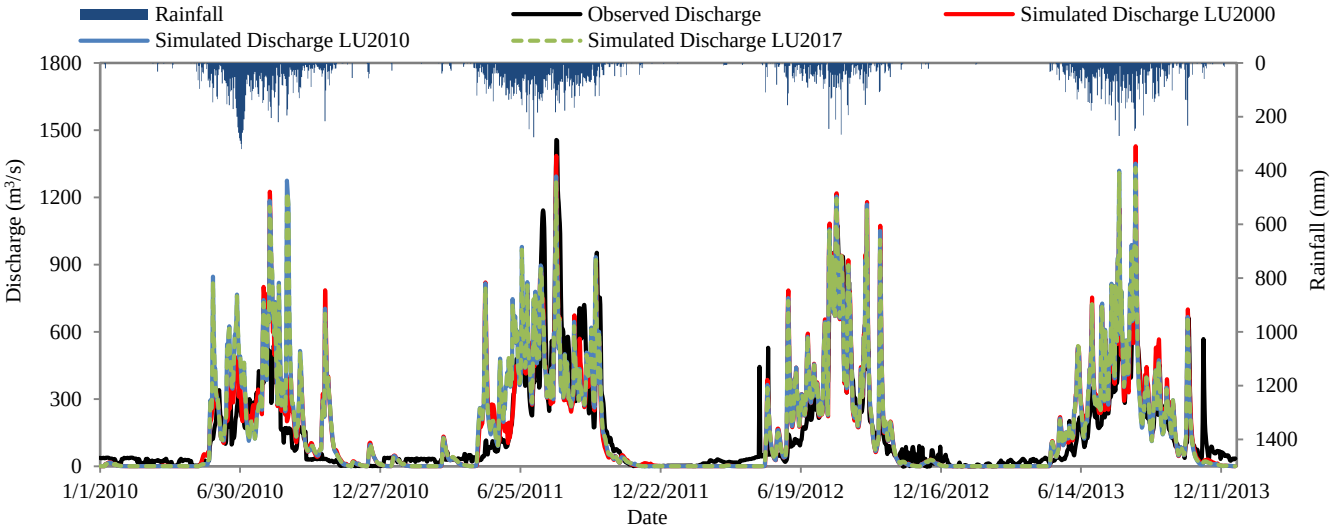

Figure 4. Observed and simulated discharge in calibration period at Bago Station

4. Conclusion

1) By using SWAT model, the calibration process in Bago River Basin was achieved in terms of NSE and R2 analysis, especially executing a comparison between the observed and simulated discharge data in the period of (2010-2013) which provides the best fit in the hydrological process and the reliable statistical performance for Bago River Basin.
2) According to the analysis of land-use change, it can be investigated that forest mixed areas in Bago river basin obviously escalated in 2010 and 2017 as compared to 2000. Due to the impact of the land-use change, the simulated runoff in 2010 and 2017 is slightly affected by the increases of mixed forest as compared with 2000 of Bago river basin.

5. References

Tufa, D., Abbulu, Y., & Srinivasarao, G. (2014). Watershed Hydrological Response to Changes in Land Use/Land Covers Patterns of River Basin. International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development, 157-170.

Zin, W. W., Kawasaki, A., & Win, S. (2015). River Flood Inundation Mapping in the Bago River Basin, Myanmar. Journal of Hydrology, 9 (4), 97-102.