

Evaluation of the Effect of Land Use Change on Runoff Using the Markov Chain in Shiraz Nahre Azam Basin

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(Received: May 22-2023 ; Accepted: October 7-2023)

Abstract

Land use changes are one of the main factors in the amount of surface runoff changes in watersheds. Therefore, it is necessary to investigate it to reduce the damages (human and financial) caused by floods and to modify watershed management. Hence, the accurate estimation of the current and future runoff of the watershed is of particular importance for water and soil management, vegetation cover, and the reduction of human and financial losses (facilities and constructions). The watershed of Nahra Azam is located in the north of Shiraz city and a lot of loss of life and money to the residents of Shiraz due to floods has occurred in previous years. The present research was conducted to investigate the relationship between land use change and runoff in the Nahre Azam watershed in Shiraz using the SWAT model in the period of 2004-2020. The model was calibrated using data from 2004 to 2014 and validated for 2015 to 2020. These images were classified into 6 main land uses using the supervised classification method after performing necessary pre-processing, and a land use map was prepared for 2040 using the Markov chain method. Then, the effect of the land use change in 2003 and 2040 on the amount of simulated runoff was evaluated with the recalibrated model. The calibration results of Nahre Azam watershed for the values of statistical parameters in the calibration step for the coefficient of determination, P-Factor and R-Factor are 0.77, 0.72, and 2.43, respectively, and for the validation step we obtained 0.69, 0.65, and 2.3 respectively. The analysis of the land use map showed that the main land use change in the region related to the conversion of pastures to agricultural land and urban land, which caused a decrease in pastures. Also, the results of the model simulation using the land use maps of 2003 and 2040 indicated that the amount of runoff decreased. The results revealed that if all the uncertainties are minimized, the calibrated SWAT model can produce acceptable hydrological simulation results for the user, which is useful for water resource and environmental managers and politicians as well as city managers of Shiraz.

Keywords: Runoff, Land use, Climate change, Markov chain, SWAT model, Calibration, Validation

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