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Impact of Climate Change on Runoff of Silakhor-Rahimabad Basin in Lorestan

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1- Introduction

Due to the importance of climate change and the effects it can have on runoff, developing a suitable model for simulating the present and future conditions of the catchment areas is of great importance (Rajabi et al, 2012). Nowadays, the LARS-WG and SDSM models are used to downscale environmental parameters in climate change studies nowadays. Studies show that the SDSM model has less uncertainty and a more complex simulation process, and the LARS-WG model with simpler process and faster performance is more efficient (Aghashahi et al., 2012). Considering that many of Iran's watersheds lack hydrometric stations, it is of great importance to use those methods that can estimate the amount of runoff obtained from the rainfall. Therefore, the present study aimed to investigate the role of climate change in estimating runoff from the Silakhor-Rahimabad basin of Lorestan using a rainfall-runoff model (SIMHYD).

2- Methodology

Silakhor-Rahimabad basin is in the catchment area of Dez Dam in Borujerd, Lorestan Province, which is located between N 33º 45′ and 34º 7′ and E 48º 29′ and 48º 57′. First, the baseline data including observation data of minimum temperature, maximum temperature, precipitation and sunshine during the period 1990-2014, and rainfall-runoff data including evaporation, rainfall and flow data, which were available, were received from the General Department of Aerology and Regional Water Authority of Lorestan Province, respectively. In this study, the daily data from Borujerd metrological synoptic station were used as the basis because they were complete and the elevation of the station was equal to the average of other stations' elevations. For the evapotranspiration variable, the mean daily data from Rahimabad, Borujerd, and Silakhor stations were used, the mean daily data from the six rain-sensing stations for the rainfall variable. Moreover,

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Rahimabad hydrometric station at the outlet was used as the base station to observe the runoff variation in the basin.

3- Results and Discussion

The results of the evaluation of criteria show that the LARS-WG model has a good ability to simulate rainfall parameters, minimum temperature, and maximum station. The simulated precipitation is in good agreement with the observed values (Table 1 and 2). After assuring the ability of the LARS-WG model to produce the rainfall data, minimum and maximum temperatures of Silakhor-Rahimabad Basin, the output of the HADCM3 model was downscaled under the scenarios A2 and B1, the parameters were predicted and compared with their values in the period 1990-2014 (Figures 2, 3 and 4). The results of the LARS-WG model indicate a decreasing trend of precipitation and temperature rise under both scenarios A2 and B1 for the period 2046-2065. The average amounts of annual rainfall predicted under the scenarios A2 and B1 are 451.445 and 4.420 mm, respectively. If the annual rainfall is 453.8 mm in the base period, the study area will observe a decrease in precipitation from 51.0 to 20.7 percent. The results obtained in the SDSM model under the two climate scenarios A2 and B2 for the future period indicate that the average air temperature is increasing and in the period 2050, the monthly average temperature, compared to the 1990-2014 period, increases in most months of the year. Also, rainfall has a decreasing trend in this period (Figure 5). Investigations show that the model efficiency has a direct correlation with the recharge coefficient, infiltration coefficient and soil moisture storage capacity. The effects of climate change on runoff are presented in Figures 9-16. In the period 2046-2065, the amount of runoff in the studied basin will decrease compared to the 1990-2014 period. This decrease in runoff rate can be attributed to the increase in temperature, followed by an increase in evaporation and a decrease in rainfall. Regarding the study of temperature and rainfall for the future period and monthly runoff, it is observed that the amount of runoff will decrease in the future period.

4- Conclusion

In recent decades, the increase in greenhouse gases and thereby, the rise in temperature, have made Earth's climate system imbalanced and caused massive climate change in most parts of the planet. Therefore, it seems necessary to apply climate predictions in national macro plans, especially in relation to natural disasters. The results indicate the decrease in precipitation and temperature rise in both SDSM and LARS-WG models. Also, in the present study, the SDSM model showed more variations than the LARS-WG model. Finally, the results obtained in both statistical downscaling models indicate the decreased amount of runoff in the studied basin is in the future period. In the study of the effect of climate change on runoff in the studied area, according to the values of Nash-Sutcliff

coefficient and the coefficient of determination obtained at the calibration step (0.63 and 0.779, respectively) and the verification step (0.61 and 0.61, respectively), it is observed that the SIMHYD model has acceptable performance in the studied basin. These results are consistent with the findings of Aghashahi et al. (2012), Rajabi et al. (2013), Zolgharnein et al. (2013), Zhang et al. (2014).

Keywords: Rainfall-runoff Simulation, SIMHYDLARS-WG, SDSM, HADCM3, Silakhor-Rahimabad of Lorestan

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