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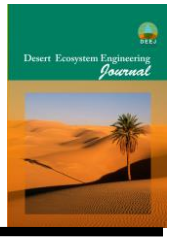

Analyzing the Floods' Frequency and Severity under Climate Change Scenarios: A Case Study of Emameh Watershed

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Extended Abstract

Introduction: As an undeniable environmental phenomenon, climate change can be defined as a reversible change or variability in the average climate and its relevant variables, including the temperature, precipitation, humidity, climate patterns, wind, radiation, etc., which lasts for a long period of time. Located in a special geographical location that suffers from insufficient precipitation, Iran faces inappropriate distribution of rainfall temporally and spatially. On the other hand, the world seems to be facing new challenges in terms of water resources. Moreover, the most important consequence of the change in the hydrological cycle is the tendency toward extreme events such as torrential rains, widespread droughts, and in some cases, regional wetlands. In this regard, it can be said that the frequency and severity of floods are among the terrible or deadly natural disasters brought about by climate change. Therefore, it is necessary to determine the best probability for the distribution of flood discharges, measure the best probability distribution for management and planning in cases where climate change occurs, and finally assess the frequency and severity of floods in Iran.

Materials and methods: To analyze the floods' frequency and severity under different climate change scenarios, the minimum and maximum values of precipitation and temperature were measured using the CanESM2 general circulation model under RCP2.6 and RCP8.5 climate change scenarios and the SDSM4.2.9 linear multiple regression downscaling model. Then, the collected precipitation data was processed and analyzed and the flood pattern was simulated for future periods via NetSTORM software (separating the rainfall from the hourly data). Moreover, the HEC-HMS model was used to simulate floods in basic and future periods. Accordingly, the SCS method, the Clark unit hydrograph method, and the Muskingum method were calibrated and evaluated to calculate the infiltration, convert the rainfall to runoff, and rout the river, respectively. Finally, to analyze the floods' frequency and severity, the probabilistic distribution function was fitted for the future periods' baseline data and propagation scenarios using the SMADA software for different statistical distributions (normal, two- and three-parameter log-normal, Pearson type III, Log-Pearson Type III and Gumbel), followed by the selection of the best-fit distribution model based on the RMSE and MSE tests.

Results: The results of the climatic model showed that under the RCP2.6 and RCP8.5 scenarios, the maximum temperature rate would increase in 2011-2055-and 2056-2100 by 3.02˚C, 3.27˚C, and 3.2˚C, and 5.47˚C, respectively. Furthermore, the minimum temperature rate would increase in the same periods by 0.62, 0.87, and 1.1 and 2.82 degrees Celsius, respectively. However, the monthly precipitation data did not reveal any specific

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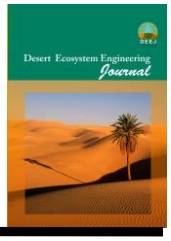

trend throughout the future periods.

The Emamah watershed's data concerning the flood discharge and maximum daily precipitation rate during the study period (1999-2019) were used to select flood and pervasive events. The predicted data were then analyzed under RCP2.6 and RCP8.5 scenarios at five separate periods. Finally, the selected events' data were imported to the HEC-HMS model and simulated. After selecting the flood events with the highest magnitude compared to other events, they were decomposed into one-hour or fewer rainfall events using the NETSTORM model. Then the flood discharge values were calculated for the base and future periods and their probabilistic distribution function was obtained through the SMADA software. Finally, the Pearson type III distribution, the best distribution among normal, two-and three-parameter lognormal, Pearson type 3, Log-Pearson Type 3, and Gamble distributions were selected for each base and future time series using the goodness-of-fit test.
According to the results of the best frequency distribution, flood values were estimated with return periods of 2, 10, 25, 50, 100, and 200 years. Moreover, one third of the floods with a 2-year return period witnessed an increase in discharge rate compared to the base period. However, the discharge rate decreased or remained unchanged in floods with other return periods. On the other hand, floods estimated with 10 and 25-year return periods were increased in two-thirds of the periods, the highest increase of which occurred in the second period under the RCP8.5 scenarios by 12.68 and 25.76 percent, respectively. It should also be noted that the highest chances of increase in flood occurrence with a return period of 200 years belonged to the second period by 56.12% increase rate and 10.07 m^2 discharge rate under the RCP8.5 scenarios.

Discussion and Conclusion: throughout the next hundred years, climate change would experience significant changes in precipitation patterns, leading to the risks of severe floods and droughts. Moreover, the results of the analysis and study of climate change indicated that the temperature increasing trend in the periods under the studied scenarios and that the biggest increase belonged to the RCP8.5 scenarios. It was also found that the temperature rate would increase more in the period 2056-2100 compared to the 2011-2055 period. However, the results of precipitation simulation under the scenarios did not show a definite trend for the future periods, with the precipitation increasing and decreasing in different months of the year. On the other hand, the simulation of basin floods for the future periods and the comparison of peak discharge values within the future and the observation periods indicated a change in the regime of river flood discharges. Accordingly, the maximum discharge rate increased in the constant returns period. Furthermore, the discharge rates significantly increased in the maximum constant flow period with an increase in the return period.

Keywords: Rainfall- Runoff Modeling, SDSM, Flood Frequency Analysis, Emameh Watershed, HEC-HMS.