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Modelling the Effect of Variability of Temperature and Rainfall on Water Resources of Asa River Catchment, Nigeria

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Abstract

The study of the effects of variability of temperature and rainfall on the quantity and quality of water resources has attracted a great deal of attention in recent years, particularly at a regional and global scale. Therefore, this research tends to evaluate the impacts of variability of climate change on the water resources of Asa river catchment in Kwara State, Nigeria. Soil and Water Assessment Tool (SWAT) embedded in Geographical Information System (GIS) environment was adopted to predict the streamflow and runoff of Asa River for a period of 30 years (1986-2015). The predicted streamflow and runoff were subjected to three different statistical analyses which include the Mann-Kendall, Regression trend and Reduction analysis. The statistical analyses were carried out to determine the measures of central tendencies, measures of dispersion, skewness and the nature of the trend in the studied parameters. The results showed that streamflow and precipitation (rainfall) were observed to have exhibited negative trends, though none of the two parameters showed a significant trend. This implies that the trend of the rainfall and stream-flow are slightly decreasing. Likewise, both maximum and minimum temperature exhibited a significant positive trend which is an indication that the temperature of the region may increase in the near future. These observations imply that climate change has started taken its toll on the water resources of Asa river catchment in Kwara state, Nigeria.

Keywords:

Asa River, Climate Change, Nigeria, Rainfall, SWAT, Streamflow, Temperature

Introduction

Impacts of climate change on water resources are potentially large and could result from increases in temperature and from changes in mean precipitation variability. However, ability to predict climate change impacts on water resources and plan for adaptation and amelioration is hindered by the lack of good prediction of future climate change at regional and watershed levels.

Methodology

The methods adopted in this study consist of three steps. First step involved the collection of various spatial and weather data of Asa watershed for the simulation of streamflow into the river. This is followed by the simulation and prediction of streamflow of the river using SWAT software. SWAT was adopted in this study because of its accuracy in predicting streamflow and other hydrological phenomenon (Adeogun *et al.*, 2015). Finally, predicted streamflow data were subjected to statistical analysis (non-parametric Mann-Kendall test, regression analysis test and flow reduction test) as described in Salami, et.al.(2014) in order to assess the trend in the river streamflow over a period of time.

Results and Conclusions

The results of the Mann-Kendall analysis presented revealed that the Kendall's S value for the streamflow is negative. This demonstrates the existence of negative trend. The value of Z_s for streamflow is 2.3907 (greater than $Z_{0.025}$ of 1.96) this makes it statistically significant. Therefore the streamflow has high tendency of reducing in future that is the impact of climate change has affected the volume of water in the river.

Also, the value of S for rainfall is negative this implies negative trend in rainfall. The value of Z_s is 2.5334 (greater than $Z_{0.025}$ of 1.96) this makes rainfall to be statistically significant at the basin. It can be inferred from the streamflow and rainfall Mann-Kendall statistical analysis that the effect of climate on rainfall directly affects the streamflow into the river. Maximum and minimum temperatures have positive S values which demonstrate the presence of positive trend in the temperatures

Conclusions

It can be concluded that Asa river catchment has been greatly affected by climate change. The flow of the river is decreasing and will still decrease in the near future due to high evaporation resulting from temperature increase and decrease in precipitation pattern of the region.

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