STI07-WEG-009

Assessment of stream flow Variability in Response to the Changes in Climate, Rainfall and Water Demands

[1]Abel M. Omanga*, [1] Arthur W. Sichangi, [2]Godfrey O. Makokha.
[1] Institute of Geomatics, GIS & Remote Sensing (IGGReS),
Dedan Kimathi University of Technology, Nyeri-Kenya
[2]School of Science and Informatics, Taita Taveta University, Voi
Correspondence author: omatech.geodimension@gmail.com

Abstract

Water availability is facing intricate climate change and anthropogenic risks that have worsened the deteriorating water resource quality and quantity. Long term streamflow and groundwater monitoring in various catchments has shown seasonal and long-term variation in water levels. This occurrence can be attributed to several events among them: recession of water sources, increasing water demand, erratic changes in land use, changing precipitation patterns and frequencies. The study assessed the current (2020) and future (2050) spatial-temporal water variability within Thiba sub basin. The historical trends in climate, rainfall and water demands were characterised and their influence on water availability assessed using the Water Evaluation and Planning (WEAP) model. Stream flow variability was evaluated in response to changes in climate, rainfall, and water demands. Water Evaluation and Planning system with monthly timesteps calculations was used to compute water situation, and Parameter Estimation Tool used in calibration of the model. Model was calibrated sing; Nash-Sutcliffe efficiency, coefficient of determination and Percent Bias, attaining values of 0.86, 0.85 and 6.64 while the validation coefficients were 0.90, 0.88 and 1.08 respectively. Climate evaluation scenarios under Representative Concentration Pathway 4.5 and 8.5 predict mean rainfall to be 1420.1 mm and 1332.2mm and mean temperatures of 18.8ºC and 19.1ºC respectively at the end of 2050. The results show a non-significant increase in rainfall and significant increase in temperatures. Both pathways predict greatly variable decreasing mean discharge by the end of 2050. This variability is attributed to the increase in water demand and temperatures in the face of decreasing rainfall. The best-case and worst-case scenario predicts total water demands to increase to 201,903 and 204,302 billion cubic meters per year respectively. Water consumption will increase from 77.0 m^3 per capita per day in 2021, to 85.2 m^3 per capita per day, and a 30% increase in unmet demands in all sectors. Results indicate climate change will significantly impact water resources under the rising water demands, change of land uses and varying discharge. Mitigation efforts will result in better flows compared to no intervention. Detailed study linking groundwater to surface water will help understand better the problem. The study recommends the development of groundwater resources

to take care of the expected rise in water demand in the face of dwindling surface water resources.