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Investigation of surface water availability dynamics by using coupled SWAT and WEAP models: case of upstream of Pangani river basin, Tanzania

Joel Norbert, Peter Kishiwa, Victor Kongo, and Prekesdis Ndomba
Department of Water Engineering – University of Dar es Salaam, Tanzania

Surface water as the major source for water related activities in the Upstream of Pangani River Basin (UPRB) has been reported in different studies that it is decreasing therefore alarming for its sustainability. This research was therefore designed to study the dynamics of current and future surface water availability to different water use sectors in UPRB under climate change. Multi-tier modeling technique was used for the study by coupling the Soil and Water Assessment Tool (SWAT) and Water Evaluation And Planning (WEAP) models to simulate streamflows under climate change and assess scenarios of future water availability to different socio-economic activities by year 2060. Six common GCMs from WCRP-CMIP3 with SRES emission scenario A2 were selected. These are HadCM3, HadGEM1, ECHAM5, MIROC3.2MED, GFDLCM2.1 and CSIROMK3. They were downscaled by using LARS-WG to station scale. The SWAT was therefore calibrated with observed data and utilized the LARS-WG outputs to generate streamflows which finally used in WEAP to assess the water availability to different socio-economic activities. GCMs results show rainfall increase in UPRB between 16-18% in 2050s relative to 1980-1999 periods. Temperature also will increase by average of 20C in 2050s relative to this baseline period. A reduction by 5.3% of the annual flows due to climate change impacts is expected by this period. This decrease of streamflows and annual demand increase (72.88% increase by 2060) results to rise of annual unmet demand from 614.29Mm3 in 2011 to 1,783.60Mm3 in 2060 (190.35% increase). The magnitude of the impact will be severe on Irrigation which will be 71.12% unmet, followed by HEP (27.47%), livestock 1.41% and domestic (0%). It can therefore be foreseen that, the plausible climate change and future demand expansion may raise pressure on the demand side due to increased unmet demands. However future studies have to customize much more the SWAT database and disaggregate the mixed crops to improve the model performance. Also the use of more available observed climate data and parameters may provide better calibration results of the models. Furthermore, projections of Land Cover and soil properties can significantly alter these predictions.