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Using SWAT to Evaluate Climate Change Impact on the Water Resources in the White Volta River Basin, West Africa

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Abstract

In West Africa, availability of and access to freshwater has a strong impact on patterns of development in both rural and urban areas. Due to extreme temporal and spatial variability in rainfall, global climate change, land degradation and population growth among others, there is a serious threat to the sustenance of freshwater and subsequently the livelihood of the many rural poor in West Africa. Therefore, wise and effective management of freshwater sources in a river basin is necessary.

The GIS based, semi-distributed Soil and Water Assessment Tool (SWAT) model was applied to the White Volta River Basin to quantify the basin's water yield and to evaluate the impact of climate change on water availability. The White Volta basin is a major sub catchment of the Volta River Basin located in West Africa. The major riparian countries are Burkina Faso and Ghana. The main channel of the river has a total length of 1,140 km and drains a total land area of about 106,000 km^2. The model was successfully setup, calibrated and validated using daily observed streamflow time serie data for the period 1980–1999 with the first 6 years (1980-1985) used as warm-up period. The results showed that SWAT was very well able to mimic the hydrology of the White Volta basin. The streamflow, surface runoff and base flow were all well reproduced by SWAT.

To evaluate the impact of climate change on water resources in the White Volta basin, the calibrated SWAT model was used to simulate the future water resources based on the future climat series of the regional climate model MM5.This model has been adapted to station-specific climate data using the weather generator LARS-WG. Compared to the simulated present (1990-2000), the results of the simulated future water resources (2030-2039) show important increases in the annual streamflow, surface runoff and the baseflow.

Keywords: Base flow, climate change, modelling, streamflow, surface runoff, SWAT, White Volta river basin

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