ABSTRACT

Climate and land use are the two most significant factors that influence watershed hydrology globally. The impact of climate variability on streamflow arises from changes in precipitation and temperature, leading to the adjustment of the physical and biological processes of ecosystems. Land use change impact on streamflow however varies across different regions and environments to warrant a universal theory, making it subject of scientific interest to hydrologists. The aim of this study therefore was to analyse and predict the impact of land use change and climate variability on streamflow in Lake Chilwa basin for the period of existing hydrological records from 1970 to 1999. Four watersheds of Domasi, Likangala, Mulunguzi and Thondwe within the basin were investigated. Land use changes were estimated after processing Landsat images representative of the period under investigation using Remote Sensing (RS) and Geographical Information System (GIS) techniques. Student's t-test was performed to compare the stationarity difference of rainfall and streamflow for the periods; 1970 to 1984 (before land use change) and 1985 to 1999 (post land use change). The probability of exceedance for the two periods were also compared using rainfall duration curves and flow duration curves (FDCs). Furthermore, hydroclimatological trends were tested using Mann-Kendall trend test. Finally, the Soil and Water Assessment Tool (SWAT) model was calibrated and validated to estimate the impact of land use change and climate variability on runoff. Modelling was done only for Thondwe watershed because it had sufficient data required for the exercise. Results from the t-test showed that there was no significant change in rainfall amount for the pre- and post-land use change periods; nonetheless, FDCs revealed that higher runoff characteristics were exhibited in the post-land use change period for watersheds that experienced deforestation and increased agricultural farmlands. The opposite was however the case for the pristine watershed (Mulunguzi) that did not experience severe land use changes. Baseflow trend test results showed a significant decline for the degraded watersheds while for the preserved Mulunguzi watershed, the baseflows were on a significant increase. Modelled results showed that climate variability within Thondwe led to a decline in streamflow by up to 13% while land use change effects increased streamflow by only 3%. From this study, it is concluded that continued degradation is likely to intensify floods and cause extreme low river flows in the basin during rainfall and dry seasons, respectively.