Hydrological evaluation of two contrasting watersheds of the Lake Tanganyika catchment

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Abstract

This study was conducted to delineate the impact of human activities on stream flow and water chemistry as well as other factors that influence the chemical character of both surface and groundwater in two contrasting watersheds of the Lake Tanganyika catchment. The study sites the Mwamgongo and Mitumba streams along the northern Tanzanian coastline of the lake are representative of disturbed and undisturbed watersheds, respectively, but are quite similar in other characteristics of slope, bedrock geology and size. Separation of stream flow components was undertaken using classical hydrograph analysis along with chemical methods using both Cl and ^{18}O data. All the data show that groundwater accounts for the predominant source of total stream flow in both the Mwamgongo and Mitumba watersheds (65 and 70% respectively). The streams have an average $\delta^{18}O$ of about -3.0% and less than 10 mg/l for Cl. The basin recession constants of 9.4×10^{-3}-d^{-1} and 9.6×10^{-3}-d^{-1} for Mwamgongo and Mitumba, respectively, indicate existence of both fissured and fractured aquifer systems. The chemical data exhibit low values of all determined ions. This supported the hypothesis that natural processes influence the water chemical character of the study area. An Mg–HCO_3 type of water dominates in the two watersheds. Despite their similar size and bedrock character the Mwamgongo watershed has an order of magnitude in sediment transport than the Mitumba one. The data show that the disturbed watershed discharges less groundwater and more sediments, and has a poorer water quality than the forested Mitumba watershed, which lies within the Gombe National Park. The data show that soil erosion processes are more active at Mwamgongo, and that both the surface runoff component of the total stream flow and increased dissolved salt load is greater in the deforested Mwamgongo watershed than in the Mitumba watershed. The chloride and $\delta^{18}O$ data complemented each other in delineating the amounts of groundwater in the total stream flow as the results using both data differed insignificantly. It may be concluded that the undisturbed watershed has a higher retention of good quality water and traps more sediments than the disturbed one. In addition, the groundwater component plays a dominant role in the total annual stream flow at each watershed.

Keywords

BaseflowHydrographStable isotopesSurface runoffTypes of waterWatersheds