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A SWAT Decision Support Tool for the Assessment of Land Use Impacts on Basin Hydrology

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Water resources of the world are currently under increasing threat due to climate change, environmental degradation and misappropriation of the available limited resources. The stresses that have developed are explicitly the aftermath of anthropogenic activities that occur within basins. Of significant impact are the changes observed in land use and land cover (LULC) over the past century. The alterations in LULC have occurred with corresponding modifications of underlying soils. The resultant effect of the interplay between LULC and soils is the environmental degradation of basin water resources which has culminated into the depletion of the resource quantity and quality. A sound understanding of basin processes are therefore required to ensure the implementation of appropriate remediation measures targeted at sustainable water resources management. In this study a decision support tool was developed to assess the water resources of a semi-arid basin by investigating the hydrological dynamics as a resultant factor of LULCCs. Hydro-meteorological datasets were obtained from the Department of Water and Sanitation and the South Africa Weather Services. Digital land use data were extracted using Landsat 7 ETM+ images to include five level I classes employing the maximum likelihood classifier in a supervised land use classification. Hydrological responses were related to LULCCs through a multi-regression analysis using SPSS 20. Results indicate annual declining rates of base flow and groundwater recharge respectively at 0.55% and 3.52%. Water resources availability within the basin was found to be extremely dependant on evapotranspiration as 78-82% of precipitation received within the basin is channelled into evapotranspiration consumptive activities. The increases in evapotranspiration were linked with the continual expansion in agricultural and urban land uses. The results further indicates urban and agricultural land uses to be the most influential environmental factors influencing surface runoff and water yield.

Keywords: Decision Support Tool, SWAT, GIS, Land Use/Land Cover, Basin