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Modelling the impact of agroforestry on hydrology of Mara River basin in East Africa using a distributed model

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Land use change is one of the main drivers of change of watershed hydrology. The effect of forestry related land use changes (e.g., afforestation, deforestation, agroforestry) on watershed hydrology depends on climate, watershed characteristics and watershed scale. The Soil and Water Assessment Tool (SWAT) model was calibrated, validated and used to simulate the impact of agroforestry on the water balance in Mara River Basin (MRB) in East Africa. Model performance was assessed by Nash-Sutcliffe Efficiency (NSE) and Kling-Gupta Efficiency (KGE). The NSE (and KGE) values for calibration and validation were 0.77 (0.88) and 0.74 (0.85) for the Nyangores sub-watershed and 0.78 (0.89) and 0.79 (0.63) for the entire MRB. It was found that agroforestry in the catchment would generally reduce surface runoff, mainly due to enhanced infiltration. However, it would also increase evapotranspiration and consequently reduce the baseflow and the overall water yield, which was attributed to increased water use by trees. Spatial scale was found to have a significant effect on water balance; the impact of agroforestry was higher at the smaller headwater catchment (Nyangores) than for the larger watershed (entire MRB). However, the rate of change in water yield with increase in area under agroforestry was different for the two and could be attributed to the spatial variability of climate within MRB. Our results suggest that direct extrapolation of the findings from a small sub-catchment to a larger watershed may not always be accurate. These findings could guide watershed managers on the level of trade-offs to make between reduced water yields and other benefits (e.g., soil erosion control, improved soil productivity) offered by agroforestry.