

IMPACTS OF LAND USE AND COVER CHANGES ON THE HYDROLOGY OF GUMARA CATCHMENT, ETHIOPIA

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Land use and cover changes (LUCC) are continuous phenomena often driven by natural or anthropogenic factors. In Ethiopia, a conversion of forest and grass lands into cultivated and urbanized lands has been reported. While such changes are known to have multidirectional impact on river flows, erosion and sedimentation, environment and socio-economic situation within a catchment, there is a lack of assessment on the scale and rate of these changes, and consequent impacts. This study quantifies the rate of LUCC in the Gumara River catchment (1413 km²), an important tributary to Lake Tana in northwest Ethiopia. The Landsat images of three years (1986, 2001 and 2015) were processed, and a supervised classification method was used for the LULC classification. An extensive field survey generated over 150 ground truth points, used in the classification and accuracy assessment process. Then, a conceptual rainfall-runoff model (HBV) was applied to assess the impact on water balance components - evapotranspiration, soil moisture and groundwater recharge, and runoff. A reasonably reliable LULC classification was achieved, with overall efficiency of 90%. In 1986, the area under forest and grass land was about 11% and 18%, respectively, which reduced to 5% and 10%, respectively, in 2015. In contrast, cultivated land increased from 70% in 1986 to 72% in 2015. The successfully calibrated and validated HBV model, against observed streamflow, indicated only a slight change in the water balance components ($\pm 5\%$). In general, the observed LULC changes seemingly caused an increase in soil moisture and recharge, and a decrease in evapotranspiration. Consequently, streamflow showed a slight increase, though not as significant as expected in the light of LULC changes. The uncertainties involved in the LULC impact modelling process are also discussed in this paper. This application also highlighted the limitations of conceptual models, like HBV, that represent LULC in a much simplified manner, in adequately simulating the hydrological response under LULC change scenarios.

Keywords: Land use and cover changes, LULC change impact, Hydrology, Gumara catchment, Conceptual hydrological model, uncertainties

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