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PII: S2095-6339(16)30153-8
DOI: <http://dx.doi.org/10.1016/j.iswcr.2017.03.002>
Reference: ISWCR86

To appear in: *International Soil and Water Conservation Research*

Received date: 22 November 2016
Accepted date: 9 March 2017

Cite this article as: Kidane Welde and Bogale Gebremariam, Effect of Land Use Land Cover Dynamics on Hydrological Response of watershed: Case Study of Tekeze Dam Watershed, Northern Ethiopia, *International Soil and Water Conservation Research*, <http://dx.doi.org/10.1016/j.iswcr.2017.03.002>

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Effect of Land Use Land Cover Dynamics on Hydrological Response of watershed: Case Study of Tekeze Dam Watershed, Northern Ethiopia

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Abstract

Land use change is a very important issue considering global dynamics and their response to hydrologic characteristics and soil & water management of a catchment. A significant land use change has been observed in the Tekeze dam catchment. The main objective of this study was to estimate the potential impacts of the land use land cover (LULC) dynamics on hydrological response (stream flow and sediment yield). This was done by integrating SWAT model with GIS. The simulation and sensitivity analysis for each land use was done by dividing the catchment in to 47 sub-catchments and assigning HRUs based on multiple HRU definition. After a sensitivity analysis, calibration and validation of SWAT model, the impact of LULC dynamics on hydrological response were evaluated using three scenarios (climate of 2000s & 2008 LULC, climate of 2000s & 1986 LULC and climate of 1980s & 1986 LULC). In the Tekeze dam watershed, land cover change had a beneficial impact on modeled watershed response due to the transition from grass and shrub land to agricultural land. Simulation results for the Tekeze dam watershed indicates that increasing bare land and agricultural areas resulted in increased annual and seasonal stream flow and sediment yield volumes. The mean annual stream flow was increased by 6.02% (129.20 to 137.74 m³/s) and the impact on sediment yield amounts to an increase of 17.39% (12.54 to 15.18 ton/ha/yr) due to LULC dynamics. The hydrological response was more sensitive to LULC dynamics for the months of August to October. These results demonstrate the usefulness of integrating remote sensing and distributed hydrologic models through the use of GIS for assessing watershed conditions and the relative impacts of land cover transitions on hydrologic response in a continuous manner.

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