INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Currently, watersheds are the focus of environmental conservation for sustainable development. Watershed-scale hydrology and soil erosion are the main environmental components that are greatly affected by climate and environmental perturbations. The aim of this study is to assess the impacts of Land Use and Land Cover (LULC) and climate changes on hydrology and sediment at the watershed-scale and to understand the relationships between hydrologic components and sediment yield with climate and land-use scenarios. An approach of modelling was used to examine the impacts of LULC and climate change scenarios on hydrology and sediment. The empirical LULC change model, Dynamic Conversion of Land Use and its Effects (Dyna-CLUE), and a hydrologic model, Soil and Water Assessment Tool (SWAT) were employed to assess the impacts of LULC and climate changes on soil erosion and sedimentation in the Rib and Gumara watersheds, North-western Highlands of Ethiopia. The Dyna-CLUE model was calibrated with 1984 LULC map and validated with the simulated and reality LULC maps of 2016 to predict the LULC until 2049. The regional climate model (RCM) REMO and RACMO22T model outputs were analysed to assess climate changes. The REMO is from the driving model of ECHAM5 based on the IPCC SRES-AR4 A1B emission scenario. The RACMO22T model is from the driving model of the Hadley Global Environment Model 2-Earth System (HadGEM2-ES) in CORDEX-Africa under emission scenarios of RCP2.6, RCP4.5, and RCP8.5. These climate models were bias-corrected and the future climate of 2025-

2099 with three-time slices (2030s, 2060s, and 2090s) was predicted. After flow and sediment calibration and validation, sub-watershed level sediment yield host spots were identified and four sediment management scenarios were simulated and compared with the baseline scenario. It is found that implementing filter strip and stone/soil bund management scenarios have a significant impact on reducing erosion and sediment yield. Analysis of the LULC change indicated that there has been a high increase in cultivated land at the expense of mixed forest and shrublands and a low and gradual increase in plantation and urban lands between 1984 and 2049.

The climate change prediction result indicated that generally, there will be a decrease in precipitation in all SRES A1B, RCP 2.6, 4.5, and 8.5 scenarios except in the Bega (dry) season and an increase in minimum and maximum temperatures in all of the scenarios. The increase in temperature will be highest in the Belg season (intermediate season). The analysis of LULC and climate change prediction indicated that there will be an increase in runoff and a decrease in groundwater flow in Rib watershed. On the other hand, in Gumara watershed the general trend shows that there will be a decrease in runoff and groundwater flow. The consistent increase in temperature in the climate scenarios will have an increasing impact on the projected ET in both watersheds. The increase in cultivated land and a decrease in forest and shrubland give rise to an increase of sediment in most scenario periods.

This study also examines the soil loss and sediment yield of Anjeb watershed, in the North-western Highlands of Ethiopia, employing RUSLE integrated with GIS and Remote sensing techniques. The average annual soil loss was 17.3 t ha^{-1} yr^{-1}. From a total of 20125.5 tons of soil, 2254.5 tons of sediment was delivered to the stream channels annually in the watershed.

Because of the continual increase in the population, there has been a frequent LULC change mainly the expansion of croplands. The climate prediction shows that the climate of the area is changing due to the impact of the global increase of atmospheric greenhouse gasses and the changing LULCs. All these phenomena give rise to the increase of soil erosion and changes in surface and groundwater flow in the study watersheds. High erosion and land degradation have been reducing crop yield which is the main source of livelihood of the area. Therefore, short and long-term watershed-scale resource management activities have to be designed and implemented to curb soil erosion facing at present and in the long-run. Soil and water conservation work effective and adaptable to the slopes have to be planned and implemented to minimize erosion through reducing surface flow, sheet erosion, and slope length**s** which increase infiltration and groundwater recharge. Among the various conservation measures filter strips and stone/soil bunds with appropriate spacing could be implemented since they significantly reduce soil erosion. In the long-run vegetation covers mainly forestation programs have to be implemented along steeper slopes where crop cultivation is prohibited because they have a function to reduce erosion and moderating the local climate.
