Abstract

Himalayas are the youngest and tallest mountains of the world, which are ecologically very fragile. They are significantly impacted by climate change in general; heavy precipitation followed by landslides, sporadic cloud bursts, excessive soil erosion/ sediment deposition and occasional earthquakes. Moreover, data related to Watersheds in the Sub-Himalayan regions is also very scarce. So, the watersheds in the Sub-Himalayan Region need to be properly studied using appropriate technological tools such as Remote Sensing, Geographical Information System (GIS), distributed hydrological models etc. so as to better understand their behavior and to arrive at meaningful inferences. With this broad objective, Rongni Chu Watershed, a part of Teesta River Basin, was chosen as the study area. Morphometric analysis for the 25 Micro-Watersheds constituting the Study Area was carried out and Universal Soil Loss Equation (USLE) was used for sediment yield estimation. Spatio-temporal land use/ land cover (LU/LC) change analysis was performed using Markov Chain (MC) Model, Cellular Automata (CA) Model and the LU/LC scenario for the year 2030 was predicted. For hydrological modeling for streamflow and sediment yield, Soil and Water Assessment Tool (SWAT) Model was used, assuming appropriate base data wherever essential over and above the hydro-meteorological data obtained by India Meteorological Department (IMD). Using the LU/LC change results, sensitivity analysis was performed on parameters which significantly impact the streamflow and sediment yield. There is a good agreement between the measured and simulated flows and sediment yields with higher values of Coefficients of determination, Nash Sutcliffe efficiency and Percent Bias. Within the study area, Taksom Chu Sub-Watershed consisting of three Micro-Watersheds was considered for the impact assessment of existing Best Management Practices (BMPs). Later on a village was selected in this Sub-Watershed and the problems affecting the village and its neighboring areas were identified based on intensive field survey conducted in 2011-2012. Using the field survey results, feasible solutions were proposed to the identified problems which are impacting the field survey village. The novelty of the research work is that, it has tried to integrate the terrain analysis, landscape analysis and hydrologic modeling to predict the hydrological behaviours of the Rongni Chu or Ranikhola Watershed. The calibrated model can be used for further analysis of the effect of climate and land use change as well as other different management scenarios on stream flows and soil erosion. The study also suggested some best Management Practices (BMPs) for the impending Rongni Chu Hydro-Electric Project area, especially for the most affected villages. To conclude, it is expected that the output of this research work will substantiate our current understanding on the effect on erosion and sediment yield and spatial pattern of LU/LC on catchment response. The result of the study could help different stakeholders to plan and implement appropriate soil and water conservation strategies. It will also enable the decision makers to formulate Best Management Practices (BMPs) in the region so that the environmental sustainability of the catchment can be maintained.

Keywords: LU/ LC Change, USLE, GIS, SWAT, Streamflow, Markov Chain, Cellular Automata, Sediment Yield, and BMP