MSc Thesis

IMPACTS OF LANDUSE CHANGES ON RUNOFF GENERATION OF SIMLY DAM WATERSHED

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ABSTRACT

Land use change has been one of factors responsible for altering the hydrologic response of watersheds leading to impacting river flows. Knowledge of the internal renewable water resources of a country is strategic information which is needed for long-term planning of a nation's water and food security, among many other needs. New modeling tools allow this quantification with high spatial and temporal resolution. In this study, Soil and Water Assessment Tool (SWAT) was used to calibrate and validate hydrologic components in Simly Dam watershed. The main objective of this study was to assess the impact of landuse changes on the flow of the Simly watershed which is located 30 kilometers (19 mi) east of Islamabad and Rawalpindi, Punjab, Pakistan. In particular, the study analyses the landuse changes between the 1992, 2000 and 2010, and the effect these changes have had on flows in the catchment. Land use maps of 1992, 2000 and 2010 were derived from Landsat images. The landuse changes within the catchment were examined through classification of satellite images with integrated use of image and spatial analysis. The Soil and Water Assessment Tool (SWAT) model was used to investigate the impact of land cover change on stream flow. The model was calibrated and validated using historical flow data. Land cover change analysis has shown an increment in the barren land from 12.2% to 18.09%, rangeland land 8.1% to 12.1%, built-up areas 2.2% to 5.14%, and water body from 2.84 to 3.12% while a decrement in the forest area from 55.15% to 46%, and vegetation land from 20 to 16% decreased between 1992 and 2010. Sensitivity analysis has shown that the curve number is the most sensitive parameter that affects the hydrology of the watershed. The model was calibrated for the year using flow data from 1991-1992, 2000-2001 and 2009-2010 and validated

from 2011 to 2012. Model predicted surface runoff with Nash Sutcliffe Efficiency (NSE) ranges from 0.81 to 0.83 and 0.75 for calibration and validation, respectively. The evaluation of the SWAT indicates that the monthly flow for wet season for 2010 landuse was increased by 409.88 m3/s than 1992 landuse which was 546.41m3/s and decreased by 173m3/s for dry season. Similarly the 2000 landuse month flow increased by 241.52 m3/s than the 1992 landuse flow for wet season and decreased by 471.07m3/s for the dry season. This indicates that landuse changes had serious impacts on wet season flow. The response of various hydrological parameters was also studied using probable changes in different landuse in the watershed in future. Landuse changes within 1992-2010 period formed the basis for developing these scenarios. The results of the scenarios revealed that expansion of urban areas from 5% to 10% indicated 1.2% and 0.2% increase in the surface runoff and water yield respectively, expansion of forests areas from 46% to 66% indicated 9.3% and 2.5% decrease in the surface runoff and water yield respectively and deforestation of the catchment from 46% to 36% indicated 6.7% and 2.2% increase in the surface runoff and water yield respectively. The study has presented that forest class is most sensitive for the Simly watershed and Soil and Water Assessment Tool (SWAT) model can be a suitable tool for evaluating the impacts of landuse changes in Simly watershed.

Key words: Land Use Change, SWAT Modeling, SWAT-CUP, Remote Sensing, Simly Watershed Catchment.