THE EFFECTS OF LAND USE CHANGES ON WATER AND SOIL EROSION IN DONGHE BASIN OF CHINA BASED ON SWAT MODEL

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Abstract: The Donghe basin is one of the typical regions with serious water and soil erosion in Kaixian county of China. In this study the spatial distribution variation of soil erosion in Donghe basin is analyzed based on a comprehensive method that integrates SWAT model with a Geographic Information System and remote sensing technologies and the effects of land use changes on soil erosion is also analyzed. SWAT is a basin-scale, continuous-time model that operates on a daily time step and is designed to predict the impact of management on water, sediment, and agricultural chemical yields in ungauged watersheds. The model is physically based, computationally efficient, and capable of continuous simulation over long time periods. Major model components include weather, hydrology, soil temperature and properties, plant growth, nutrients, pesticides, bacteria and pathogens, and land management. SWAT model calculates soil erosion caused by rainfall-runoff process using the Modified Universal Soil Loss Equation (MUSLE) presented by Williams. The model is a modified form of the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith.

With the Donghe basin as a study area, the basic data of soil, weather, hydrology, topography, vegetation and crop management, land use and remote sensing images was collected. Based on the 1:50,000 DEM data and the actual drainage network map of Donghe basin, the digital drainage network and the basin boundary are firstly extracted, then the sub-catchments are delineated. There are 33 sub-catchments to be determined in Donghe basin, and every sub-catchment is regarded as a hydrological response units.During the distributed hydrological and sediment model of SWAT are developed, the input files of model in every hydrological response units need to be generated, and in this process, the duration of simulation and some simulation methods in the model such as runoff simulation, rainfall simulation, potential evapotranspiration simulation and river channel evolution simulation, are required to determined. The SWAT model is calibrated and validated against observed runoff and

sediment data from 2003 to 2004, and the validated result shows a deterministic coefficient of 0.93 and the runoff and soil erosion simulation results obtained in the study are credible and effective.

Keeping the other model input files invariant, the spatial distribution of the water and soil erosion of Donghe and the effects of land use changes from 2000 to 2015 on water and soil erosion are analyzed. The results show that the mean sediment production of Donghe basin is 30.7 t/ha•a, the maximum sediment production of its sub-watersheds is 212.7 t/ha•a, and the minimum is 0.3 t/ha•a. There is an obviously clustering feature of sub-watersheds distribution with different sediment production level. The area of the high erosion, strong erosion and violent erosion account for 30% of the whole basin area, the other soil erosion area occupy 70%. By comparison of water and soil erosion amount, we can see that the total runoff and soil erosion amount decreased by 28mm and 1.11t/ha respectively from 2000 to 2015. The factor for the decrease of the total runoff and soil erosion amounts is mainly the area increasement of woody lands, croplands, water body and resident area, and the decreasement of grasslands.

Keywords：SWAT Model, Water and Soil Erosion, land use changes