GIS-Based Soil Erosion Modeling and Sediment Yield of the N'djili River Basin, Democratic Republic of Congo

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Abstract. In the Democratic Republic of Congo, the N'djili River and its tributaries are the most important potable water resource of the capital, Kinshasa, satisfying almost 60% of its demand. Due to increasing watershed degradation from agricultural practices, informal settlements and vegetation clearance, the suspended sediment load in the N'djili River has largely increased in the last three decades. With an area of 2,097 km^2, the N'djili River basin delivers high levels of suspended sediment that cause considerable economic losses, particularly by disrupting the operation of water utilities in the N'djili and Lukaya water treatment plants, and increasing dramatically the chemical cost of water treatment. This study aims to: (1) predict the annual average soil loss rate at the basin scale; (2) map the soil erosion rates on the entire basin for different land cover and land use scenarios; and (3) estimate the sediment delivery ratio and the sediment yield at the water intake of the N'djili water treatment plant. The Revised Universal Soil Loss Equation (RUSLE) model was implemented in a Geographic Information System (GIS) to estimate the spatially distributed soil lost rates in the N'djili basin under different land uses. RUSLE model parameters were derived from digital elevation model (DEM), average annual precipitation, soil type map and land cover map obtained from Landsat image classification using an unsupervised method. The annual average soil loss rate of the N'djili River Basin was estimated to be 7 tons/acre/year in 1995, 8.74 tons/acre/year in 2005 and 16.3 tons/acre/year in 2013. In 2013, bare land, burned areas and rainfed crops became the first contributor to the annual soil loss, producing about 60% of the soil loss. The analysis of the relationship between probability and annual average soil loss rates indicated that up to 82, 79, and 73% of the basin area are in the range of tolerable soil erosion (0 – 5 tons/acre /year) in 1995, 2005 and 2013 respectively. Based on gross erosion and sediment yield observed in 2005 and 2013, sediment delivery ratio of 4.6% and 4.1% were predicted in 2005 and 2013, suggesting that important amount of soil eroded from upland areas of the basin is trapped on flood plains covered by grass, shrubs and trees.

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