Effects of land use/cover changes on erosion and sediment yield for 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. For example, at the N'djili water intake, the average daily turbidity level which was less than 30 NTU in 1970's now typically varies between 100 and 400 NTU with peak values as high as 1000 and 6000 NTU during rainstorms.
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; (3) estimate the sediment delivery ratio and the sediment yield at the water intake of the N'djili water treatment plant; and (4) suggest Best Management Practices for the land use to reduce the total suspended solid rate to acceptable level in the N'djili river basin. 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. A total of 10 rainfall stations within and around the basin were selected to compute the rainfall-runoff erosivity factor using the Renard and Freimund approximation and the Ordinary Kriging method to interpolate those values on the entire basin. The soil erodibility factor of the N'djili basin was found to range from 0.12 to 0.36. The slope length – slope steepness factor of the RUSLE model was computed in ArcGIS software using the Moore and Burch (1985) approach from the 30 m-resolution Digital Elevation Model (DEM) of the basin. Digital image analysis was performed in ENVI and ArcGIS to obtain land cover maps of the years 1987, 2001, 2005 and 2012 from Landsat images and the associated cover management factors were used to predict the soil loss rate for those years and the sediment yield and the sediment delivery ratio for the years 2005 and 2012 at the N'djili water intake. From 1987 to 2012, this image interpretation showed that the grassland and shrub areas decreased significantly from 55 % of the basin total area to 22% with a 3% of water body loss. To reduce the sediment yield at the N'djili water abstraction point, different scenarios implying the land cover and the support practice management changes were assessed.

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