

Estimation of Water Yield and Soil Erosion in Samanalawewa Watershed in Sri Lanka using GIS-based InVEST Model

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Abstract

Ecosystem services (ES) are a group of tasks performed by the earth's ecosystems that are required to support life and offer benefits to humanity. Thus, this study explores two of the water-related ecosystem services, water yield, and soil retention that were distributed in the Samanalawewa Watershed (SW) and its eight sub-watersheds in Sri Lanka, over 20 years (2000-2020) with five-year time intervals. Soil and water conservation and water yield play an important role in ecosystem management. Hydrological balance is a crucial component of the hydrological ecosystem services. Assessing water yield and soil erosion are pivotal for watershed management. Thus, this study estimated and mapped the water yield and soil erosion, using the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST 3.9.2) Annual Water Yield (AWY) and Sediment Delivery Ratio (SDR) model respectively. According to the obtained results, in 2000, 2005, 2010, 2015 and 2020, the estimated mean annual water yield was 2.62×10^5 , 2.6×10^5 , 3.5×10^5 , 3.58×10^5 and 2.75×10^5 m³ ha⁻¹ year⁻¹, respectively. Furthermore, the estimated mean annual soil erosion rates for the above-mentioned years were 53.2, 52.9, 69.7, 87.7 and 70.2 t ha⁻¹ year⁻¹. The estimated soil loss values of the SW are 10 to 18 times greater than the soil erosion tolerance (5 t ha⁻¹ year⁻¹) in Sri Lanka. The results show that the years 2015 and 2005 have the highest and the lowest water yield and total soil loss values, respectively. The upper part of the watershed has relatively moderate water yield and soil loss values than the lower part. These findings would be beneficial in developing watershed management strategies and in the implementation of suitable soil and water conservation techniques within the watershed.

Keywords: Ecosystem services, InVEST, Samanalawewa watershed, Soil erosion, Water yield