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Hydrological impacts of sustainable land management in the Olifants sub-basin

Mthethwa, Neliswa Pretty

2021
https://hdl.handle.net/10539/32992

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ABSTRACT

Sustainable Land Management (SLM) is the most effective tool in addressing different forms of land degradation. Despite this, the adoption of SLM practices and technologies remains low. Particularly due to the lack of an enabling environment, reliable and regulated impact monitoring systems/studies and incentives measures to encourage SLM adoption in different land-use activities. This study supports water resources managers, policymakers and land users to adopt SLM practices and technologies. As for water resources management, it is vital to adopt a system that integrates water and land resources, since any land use practice is, effectively, a decision with significant implications for water resources. Furthermore, it is essential to understand the impacts of management practices on water resources before implementation. To increase the potential success rate and help water resources managers make informed decisions, hydrological models, such as the Soil and Water Assessment Tool (SWAT), allow for quantitative assessment of these impacts.

The SWAT model is an essential tool that has been used worldwide to address water questions and help water practitioners make informed decisions. With the aid of the SWAT model, the study assessed the impacts of SLM practices and technologies on streamflow and sediment yield of the Olifants sub-basin. Running the SWAT model requires a substantial number of datasets from climatic data to spatial information of soil and land use. The necessary climatic, physiographic and hydrological datasets were collected from various sources and collated accordingly. Average monthly streamflow and sediment data were then used to calibrate and validate the model. The impacts of the selected practices and technologies were simulated by optimizing appropriate model parameters.

The SWAT model was able to simulate streamflow and sediment yield satisfactorily. The coefficient of determination (r2) and Nash-Sutcliffe (NS) had values greater than 0.5. Root mean square error (RSR) values were all less than 0.7 and per cent bias (PBIAS) had values below 25 per cent, indicating satisfactory model performance. All the SLM practices used in this study reduced surface runoff and sediment yield. Filter strips had no impacts on the streamflow but decreased sediment yield. The introduction of agroforestry resulted in a decrease in sediment yield and total water yield. The decrease in net water yield is attributed to increased actual evapotranspiration due to increased tree cover. Contour farming is

accountable for a 34% and 46% decrease in streamflow and sediment yield respectively. Sediment yield and streamflow were reduced by 87% and 20% respectively, as a result of parallel terraces simulation. Adopting these practices in the sub-basins will prove advantageous.