Modelling Soil Erosion and Vegetation Change


Soil erosion by water continues to be a major problem that has led to land degradation and adversely has affected the livelihoods in Kenya. This calls for enhanced understanding of the dynamic interactions at play in the soil erosion process. Modelling provides a useful tool in estimation and prediction of soil erosion rates at the watershed level, that can guide planning and allocation of funds in rehabilitation programmes within the watershed. This paper presents a model developed to simulate the controls on runoff and erosion for a semi-arid watershed. The model is parameterised using data from a semi-arid basin in South-East Spain. The main assumption of this model is that water is the main factor limiting productivity in semi-arid watersheds. The model explores the interactions between vegetation and erosion through available soil moisture. It is designed to simulate the hydrologic behaviour of soil and to estimate the sediment yield in a catchment, with regenerating vegetation. The overall behaviour of interactions is developed in a series of sub models; hydrology, vegetation growth and sediment yield. In the hydrology component, the infiltration and storage models are combined to generate both hortonian and saturated overland flow. Plant growth is computed as the accumulation of dry matter biomass using water use efficiency and evapotranspiration is input data. The vegetation therefore interacts dynamically with soil moisture regime through the actual evapotranspiration and hence controls the possibility of runoff generation and production of sediment yield. The generated runoff is routed within the catchment using a single direction routing algorithm, together with a Strahler network-ordering scheme to sequence the flow. This approach requires a regular gridded digital elevation model of the catchment and considers the elevation of each cell relative to its surrounding neighbours. The flow is routed by transferring the overland flow along a predefined network of pathways. The sediment yield is estimated using this outflow together with the slope gradient; soil factor and the corresponding vegetation cover characteristics, which vary spatially and temporally due to selected scenarios. The model is parameterised from field data and a variety of weather conditions over 30 years and subject to different scenarios. The results indicate that it can be used in providing indicators to guide decisionmaking. Modelling, however, does have shortcomings related to validation and data requirements. Indeed the model can be improved by incorporating other sub models depending on the objectives. However, models do remain abstractions of reality and can only be as good as the data used and the linkages used in explaining the interrelationships between the variables.