

Modelling the impact of land abandonment on runoff and soil erosion in a semi-arid catchment.

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The overall aim of this research is to evaluate the dynamic interactions between soil moisture, vegetation and erosion of abandoned land in a semi-arid setting within the context of changing climate, with a view to establishing the appropriate land use practices. This is crucial issue in semi-arid Spain, where land abandonment has been increasing in the last 40 years as a result of aridity and changing socio-economic activities.

The research adopts a multi-faceted approach to investigate the response of vegetation and the hydrology for varying rates, patterns and percentages of abandonment. This is done by integrating field measurements from a semi-arid catchment with computer modelling. Field measurements of vegetation characteristics, soil factors, slope aspects, surface characteristics and other physical variables have been collected from abandoned land in Rambla del Chortal, Murcia in South East Spain. The key parameters for the soil hydrology model were identified using rainfall simulation experiments in the same catchment.

A simple single layer soil model has been developed to simulate these interactions and to explore the impacts of land abandonment on biomass production, runoff generation and sediment yield. The basis of the model is the continuity equation described in the form of a simple water balance equation. The main assumption of the model is that water is the limiting factor to plant productivity in semi-arid areas. The soil hydrology is influenced by interception, infiltration, drainage and evaporation. Plant growth is estimated as dry matter accumulation using the actual evapotranspiration rates and a water use efficiency. A regular gridded Digital Elevation Model (DEM) of the catchment has been used for the routing of the overland flow generated, and for computation of spatial erosion rates for varying spatial patterns of abandonment. The model has low data requirements and is designed in a flexible manner to allow modifications to suit the available data.

The results indicate that vegetation regeneration in the catchment following abandonment depends largely on the rainfall amount, the timing of abandonment and the percentage and rate of abandonment. The simulated vegetation recovery curve has the characteristic logistic form, and is consistent with field measurements in Rambla del Chortal. The impact of abandonment on runoff generation and sediment yield in the catchment depends largely on the character and rate of abandonment as well as the rainfall characteristics. The runoff and sediment yield simulated by the model generally decreases with abandonment since the vegetation cover increases over time. Large magnitude events tend to produce high sediment irrespective of the vegetation cover in the catchment. For dry periods, correspondingly low sediment yield is produced implying that

increasing aridity will not necessarily lead to higher erosion rates. A positive relationship exists between the annual rainfall amount and the modelled sediment yield.

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