System Dynamics for understanding desertification processes

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Abstract
Desertification is a complex and counter-intuitive process whose study requires a multidisciplinary approach. This makes it an excellent field of research in which to apply System Dynamics (SD). It is a methodology for the construction of dynamic computer simulation models that is conceived as a support tool for the study and management of problems that, in particular, show the characteristics mentioned above. This article reviews the basics of the methodology, shows its advantages and disadvantages, and illustrates how it works with a desertification case study. Through this model, which describes a rangeland system in which both erosion and shrub encroachment are two opposing and latent threats, two of the main hallmarks of SD are explained: the detection of feedback loops and the implementation of multipliers. The former is an explicit attempt to explain the mechanisms underlying the behaviour of the system, while the "multis" demonstrate the need to consider the behaviour of a system in extreme situations, inherent to problems such as desertification. The work also presents several ways of using a SD model. Beyond the temporal evolution of the variables that make up the model, it is possible to couple different types of analysis that are very useful in the study and prevention of desertification, such as the estimation of desertification risks and sensitivity analyses that allow the detection of the most determining factors of this problem.

Author keywords
Feedback loops; Holistic approach; Risk; Sensitivity analysis; Unexpected behavior