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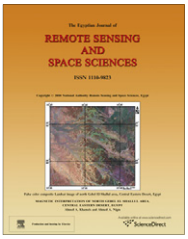

A dynamic simulation model of desertification in Egypt

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KEYWORDS

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Simulation;
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Stock and flow diagram

Abstract This paper presents the development of a system dynamic model to simulate and analyze potential future state of desertification in Egypt. The presented model enhances the MEDALUS methodology developed by European Commission. It illustrates the concept of desertification through different equations and simulation output graphs. It is supplemented with a causal loop diagram showing the feedback between different variables. For the purpose of testing and measuring the effect of different policy scenarios on desertification in Egypt, a simulation model using stock and flow diagram was designed. Multi-temporal data were used to figure out the dynamic changes in desertification sensitivity related to the dynamic nature of desert environment. The model was applied to Al Bihira governorate in western Nile Delta, Egypt, as the study area, and the results showed that the urban expansion, salinization, and not applying the policy enforcement are considered the most variables provoking the desertification.

1. Introduction

1.1. Desertification

Desertification is a major environmental, social and economic problem to many countries in all parts of the world (Breckle et al., 2001). Desertification means land degradation in arid, semiarid and dry subhumid areas resulting mainly from adverse human impact (David and Nicholas, 1994). There are many factors that can contribute to desertification; these factors include soil, vegetation, climate, demographic and human activities, each of these factors has different variables determining it (e.g. population size, arable land and livestock size). Desertification indicators or the group of associated indicators should be reliable information sources including remotely sensed images, topographic data (maps or Digital Elevation Models (DEMs)), climate, soils and geologic data (Gad and Lotfy, 2006).

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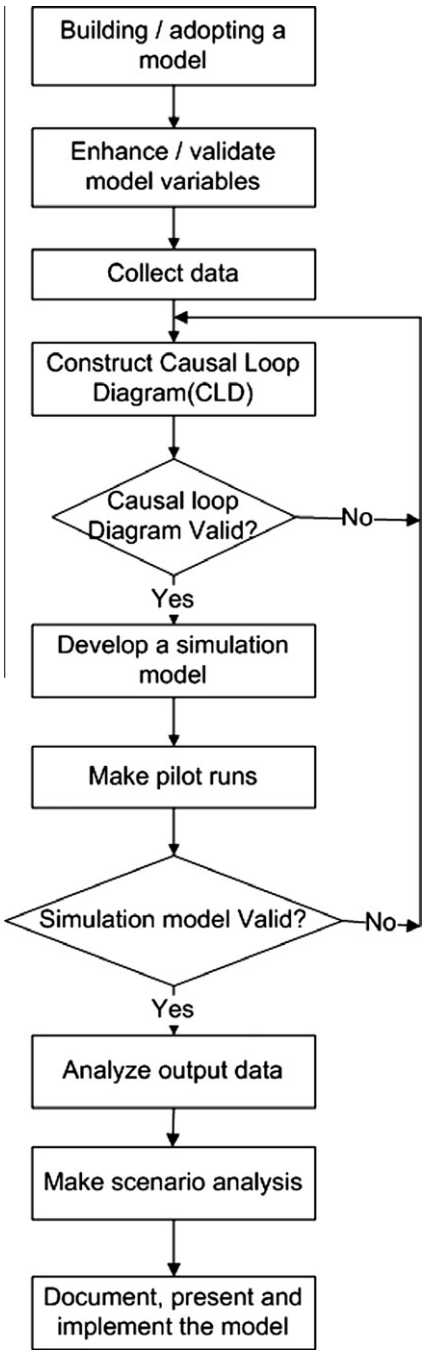

Figure 1 Steps of building a simulation model.

Computer simulation models can link current knowledge of processes driving vegetation dynamics and allow systematic investigations of the interactions between all relevant factors and their logical consequences. Also, simulation modeling is a powerful tool for controlled experimental manipulation of a large number of environmental conditions over long time spans (Florian et al., 2001).

Egypt's area (96%) is desert and only 4% is inhabited by more than 82 million people, situated mostly in the Nile Valley and the Delta. Egypt is classified as territory susceptible to very high to high desertification sensitivity. One of the main

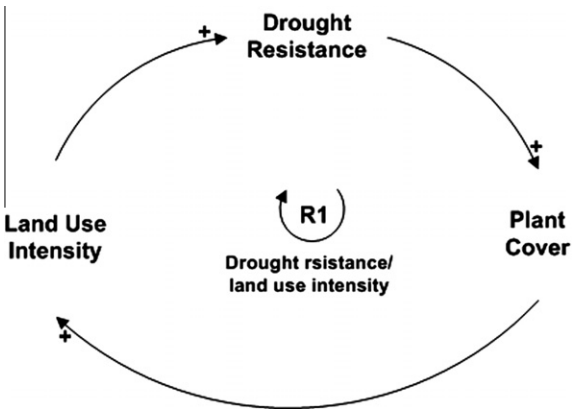

Figure 2 Drought resistance land use intensity loop.

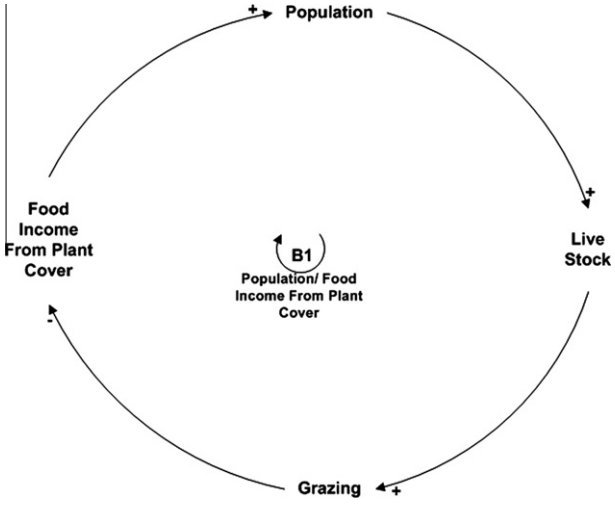

Figure 3 Population food income from plant cover loop.

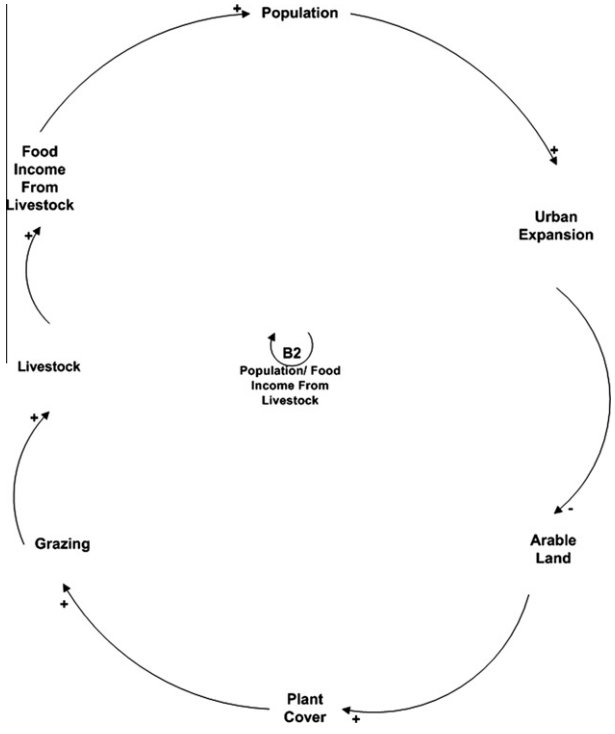

Figure 4 Population food income from livestock loop.