

Case Study 4E: Integrated Water Management

Dynamic Modeling of Groundwater Storage in an Arid Zone
Considering the Effect of a Climatic Index

Participants

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Introduction

The water crisis is already happening. In this context, promoting integrated water management cannot be postponed in order to achieve water security. However, historically groundwater has played a minor role in it, despite the fact that in many regions it represents the main source of supply for different uses and plays a substantial role in ecosystems.

The main challenge to incorporate groundwater into integrated water management is its understanding as a system and one of the aspects that is not usually taken into account for this purpose is its relationship with climatic processes. There is statistical evidence that suggests that climatic oscillations significantly influence the availability of groundwater. However, the statistical approach does not consider water uses and land use change in its analyses.

The present study seeks to describe the storage of groundwater considering the influence of a particular climatic index, the uses of water and the use of land, using the system dynamics approach. This approach will make it possible to describe the groundwater system under different climatic, demand and land use change conditions and propose actions that allow its incorporation into integrated water management.

Objectives

- Describe the storage of groundwater, associated with a climatic index, water uses and land use, in an aquifer in an arid zone using a dynamic simulation model, in order to propose tactical and/or strategic management actions of the water.
- Develop a dynamic simulation model through the identification of the system's structure, the definition of its borders and the mathematical description of the processes that influence it, in order to understand the behavior of the system.
- Implement the model in a pilot arid aquifer in order to validate its results and demonstrate its usefulness for proposing tactical and strategic water management actions.
- Based on the results of the model and the use of various scenarios, propose tactical and/or strategic actions for groundwater management to ensure the satisfaction of the demands for the different uses and for environmental protection.

Hypothesis

- It is feasible to develop a dynamic simulation model to describe the storage of an aquifer in an arid zone, considering the effect of a climate index through its influence on precipitation patterns, together with water uses and soil characteristics.
- Furthermore, this model will be useful to propose tactical and/or strategic actions to increase the efficiency of groundwater use.

Research Questions

1. How to describe the storage of groundwater in an aquifer in an arid zone for a monthly scale considering the effect of a climate index, change in land use and groundwater extraction?
2. What are the variables to which groundwater storage offers greater sensitivity?
3. Is the influence of the climatic index significant on the recharge of the aquifer?
4. Do incidental recharges make a significant contribution to storage?
5. What tactical and/or strategic actions can be implemented in the aquifer to favor the efficient use of groundwater?
6. Do the protection of recharge zones and induced recharge represent leverage points in the groundwater system?