Development of a Participatory Spatial Decision Support System for Rural Planning in East Africa

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Sustainable Management of Watersheds: Biophysical, Human and Livestock Interactions (SUMAWA)

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Abstract

A spatial decision support system is proposed for use in the River Njoro experimental watershed in Kenya that is appropriate for land management planning decisions in East Africa. This system incorporates biophysical and economic models into a single user interface.

Spatial and nonspatial data will be integrated into a spatially and temporally distributed modeling structure where complex interactions can be studied through scenario building at watershed and subwatershed scales. Integrating tools used within individual fields to a single Participatory Spatial Decision Support System (PSDSS) environment can prove beneficial to those in less developed nations who are pushing forward into improved natural resources management.

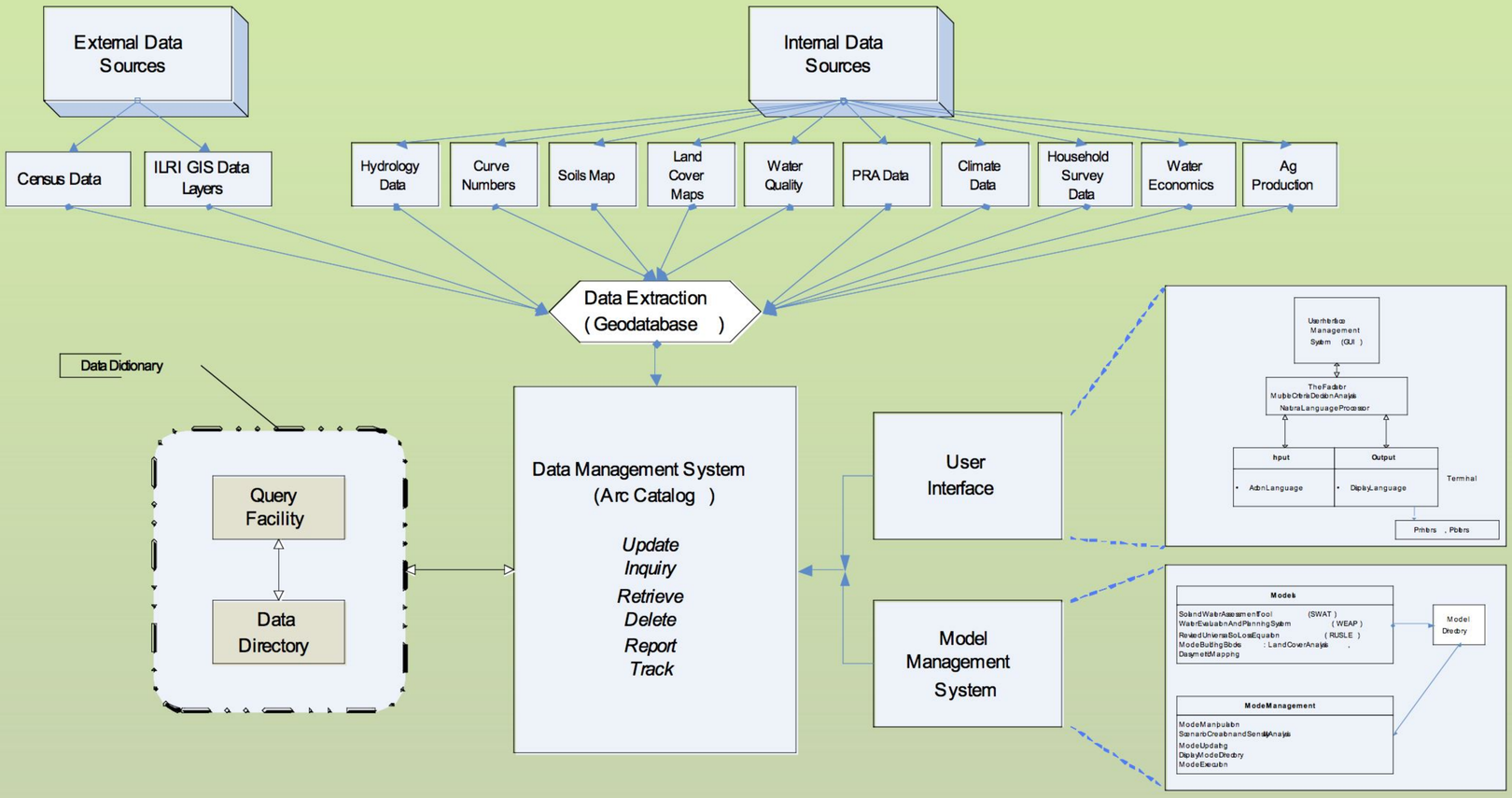
This work is an example of how models can be coupled to compliment one another in applied research and decision making. Ultimately, the tools derived from this research will allow stakeholders, researchers and resources managers the opportunity to explore and assess future land use scenarios as well as trade-offs between them at a watershed scale.

Methods

Several models and tools have been successfully employed or researched by SUMAWA researchers to quantify changes occurring in the Njoro. An ArcGIS-based extension in the form of a PSDSS that integrates these previous successes will be developed. Future scenarios can then be identified and drafted by modifying data input files based on criteria selected, weighted and scored by various stakeholder groups. The principal PSDSS modeling components are:

- SWAT (Soil and Water Assessment Tool)
  - Physically based distributed hydrologic model operating on a daily time step and uses a modified SCS – CN method to calculate runoff. SWAT quantifies the relative impact of management, soil, climate, and vegetation changes at the subwatershed level. (Neitsch et al., 2002)
- WEAP (Water Evaluation And Planning tool)
  - Characterizes water resources systems and allows trade-off analysis between water uses. Simulates changes to water resources availability through biophysical and socioeconomic changes. (SEI, 2001)
- Facilitator
  - Open source generic multiple objective decision analysis tool that uses a hierarchical decision making structure. Project independent software designed to incorporate user preferences in the decision space. (Heilman et al., 2002)

Conceptual Model



Discussion

Encompassing the River Njoro watershed, the Lake Nakuru region geo-ecosystem demonstrates a series of complex interactions where a long-established human interface strongly influences environmental processes. Meeting current needs of society without compromising the ability of future generations to also meet their needs is properly the goal of sustainable development (UNCED, 1987) and encompasses interlinked economic, ecological and community processes (Figure 1). This PSDSS furthers the goal of sustainable development in the region.

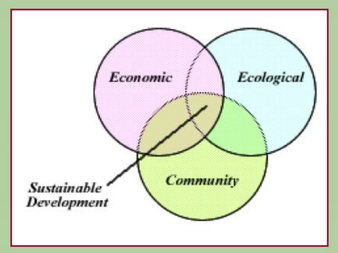


Figure 1: The interaction of the three factors encompassing sustainable development.

DSS evolved in the business and management world as a way to provide effective and efficient decision making capabilities for management personnel. The proposed PSDSS incorporates characteristics of these systems while adding spatial visualization:

➢DSS Characteristics

- ✓Used to solve ill- or semi-structured problems.
- ✓Easy to use user interface.
- ✓Combine models in a flexible manner.
- ✓Allow users to explore solution space and seek multiple alternatives.
- ✓Support multiple decision making styles based on user need.
- ✓Provides multiple, recursive and iterative paths to decision making rather than a single linear path.

➢SDSS Characteristics

- ✓Allow spatial data input.
- ✓Can represent complex spatial relationships.
- ✓Include uniquely spatial models.
- ✓Support multiple output formats (*i.e.*, maps, charts, graphs, and tables).

Expected Results

In any sustainable development scenario it is widely recognized that social, economic and cultural values must be incorporated as part of the process. It is expected that challenges will arise when integrating spatial data with social and economic nonspatial data; however, such challenges will also lead to new opportunities to explore and develop methods for combining what may on the surface appear to be incompatible data sets.

Literature Cited

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