A SYSTEM DYNAMICS APPROACH FOR LOOKING AT THE HUMAN AND ENVIRONMENTAL INTERACTIONS OF COMMUNITY-BASED IRRIGATION SYSTEMS IN NEW MEXICO.

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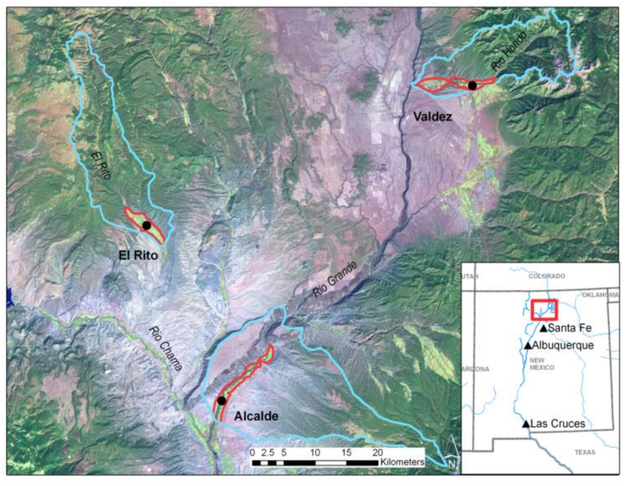
Introduction

In the arid southwestern United States community water management systems have adapted to cope with climate variability and with socio-cultural and economic changes that have occurred since the establishment of these systems more than 300 years ago. In New Mexico, these community-based irrigation systems, also known as Acequias, were established by Spanish settlers and have endured climate variability in the form of low levels of precipitation and have prevailed over important socio-cultural and economic challenges over the years. Because of their inherent nature of integrating land and water use with society involvement these community-based systems have multiple and complex economic, ecological, and cultural interactions. Current urban population growth and more variable climate conditions are adding pressure to the survival of these systems. We are conducting a multi-disciplinary research project that focuses on characterizing these intrinsically complex human and natural interactions in three community-based irrigation systems in northern New Mexico. We are using a system dynamics approach to integrate different hydrological, ecological, socio-cultural and economic aspects of these three irrigation systems. Coupled with intensive field data collection, we are building a system dynamics model that will enable us to simulate important linkages and interactions between environmental and human elements occurring in each of these water management systems. We will test different climate variability and population growth scenarios and the expectation is that we will be able to identify critical tipping points of these systems. Results from this model can be used to inform policy recommendations relevant to the environment and to urban and agricultural land use planning in the arid southwestern United States.

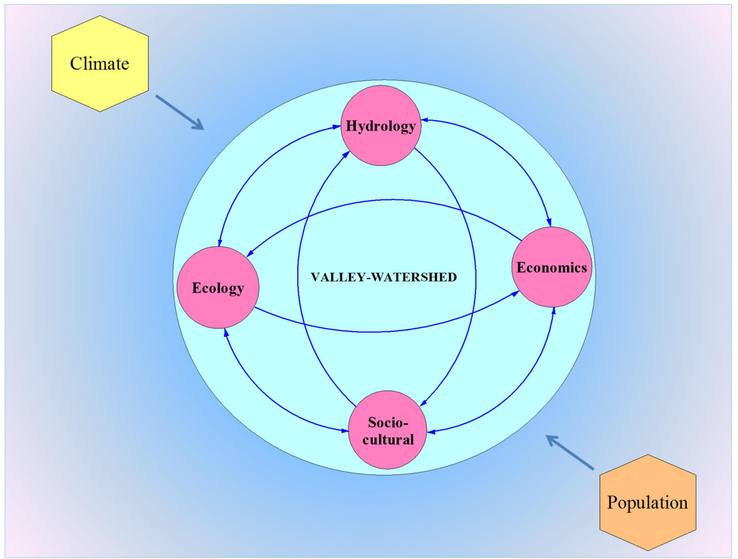
Study sites

- Three irrigated valley-watershed systems: Alcalde, El Rito, and Rio Hondo.

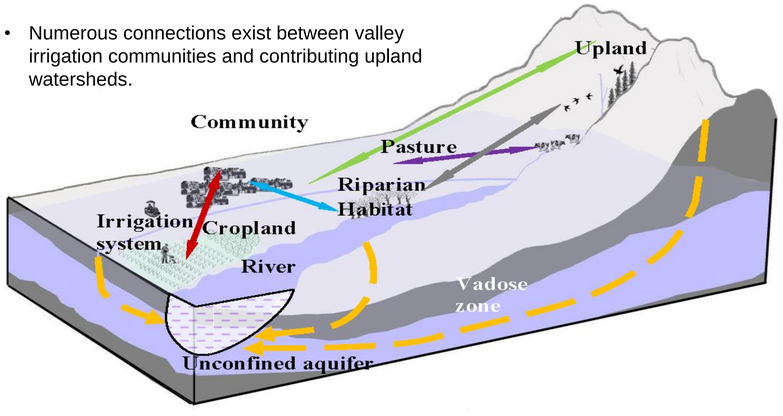


Human-Environment Interactions

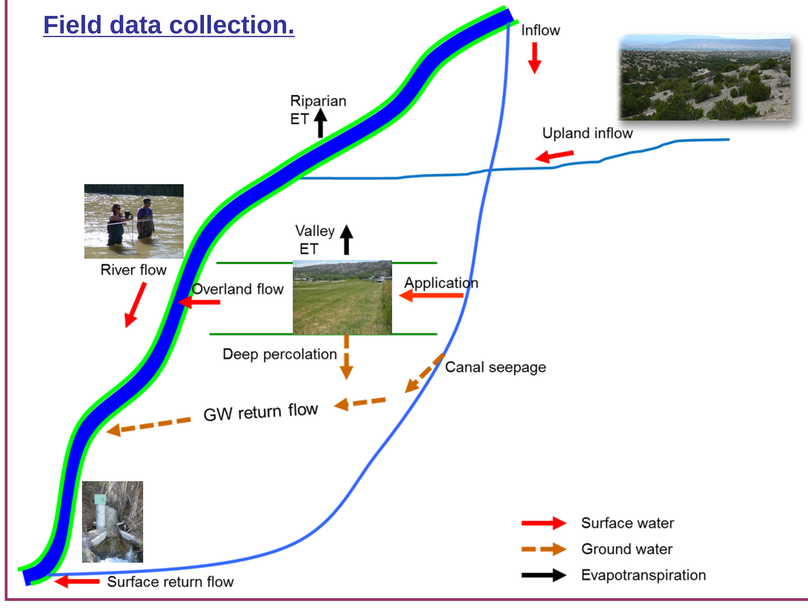
- Climate change and urban population growth may be important stressors to these community-based irrigation systems and their linked watersheds.



- Numerous connections exist between valley irrigation communities and contributing upland watersheds.



Field data collection.



- Multiple field parameters are being monitored and data is being used to populate the model.


Soil moisture/soil properties


Deep percolation


Weather


Infiltration


Stream flow

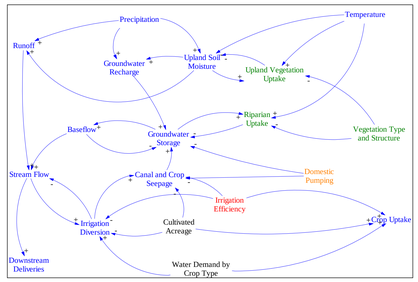

Shallow groundwater


Canal flow

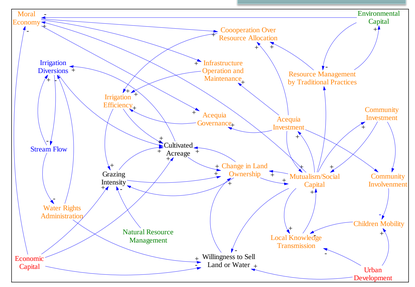

Crop water uptake

System Dynamics

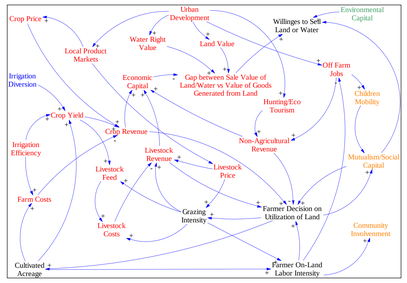
HYDROLOGY



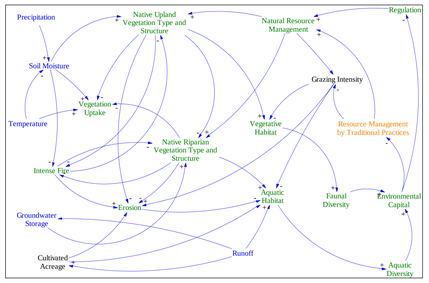
SOCIO-CULTURAL



ECONOMICS



ECOLOGY



Community participation

Support from the community has been essential for the success of this research initiative, which has grown from its beginnings at the NMSU Alcalde Science Center to include research collaborations throughout surrounding communities.

With the invaluable cooperation of many people in different communities we:

- Installed new wells and/or instrumented existing domestic wells to monitor groundwater level fluctuations;
- Conducted field campaigns and instrumented acequias and rivers for monitoring stream flow;
- Installed weather stations to measure different climate variables;
- Installed soil moisture stations and other instrumentation to calculate water budgets at the farm and valley scales; and
- Learned from people in the community who have shared with us their experiences and knowledge of acequias.


Community members and research team meeting in Santa Fe, NM

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