



Acequia Water Systems Linking Culture and Nature: Integrated Analysis of Community Resilience to Climate and Land Use Changes

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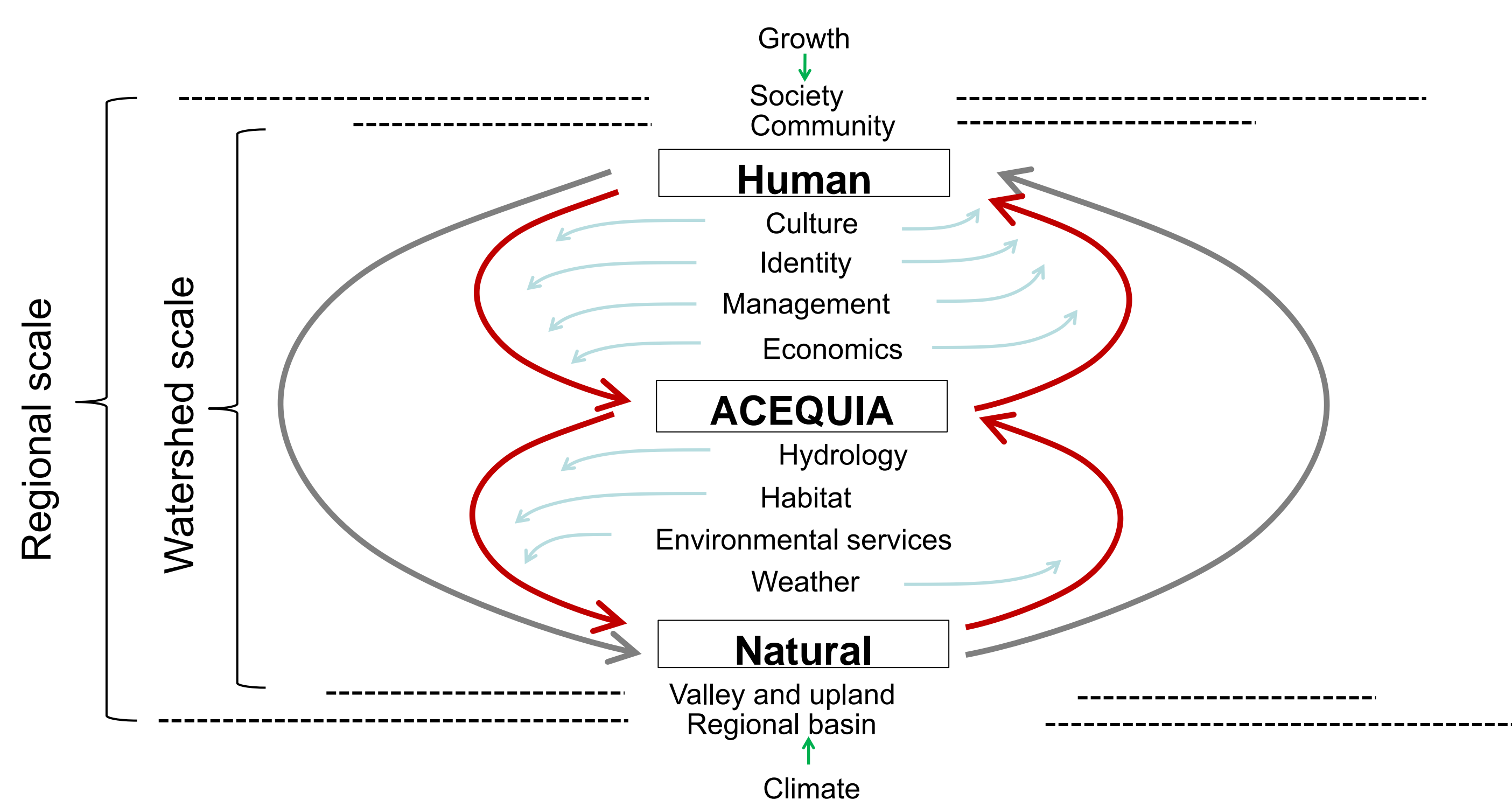


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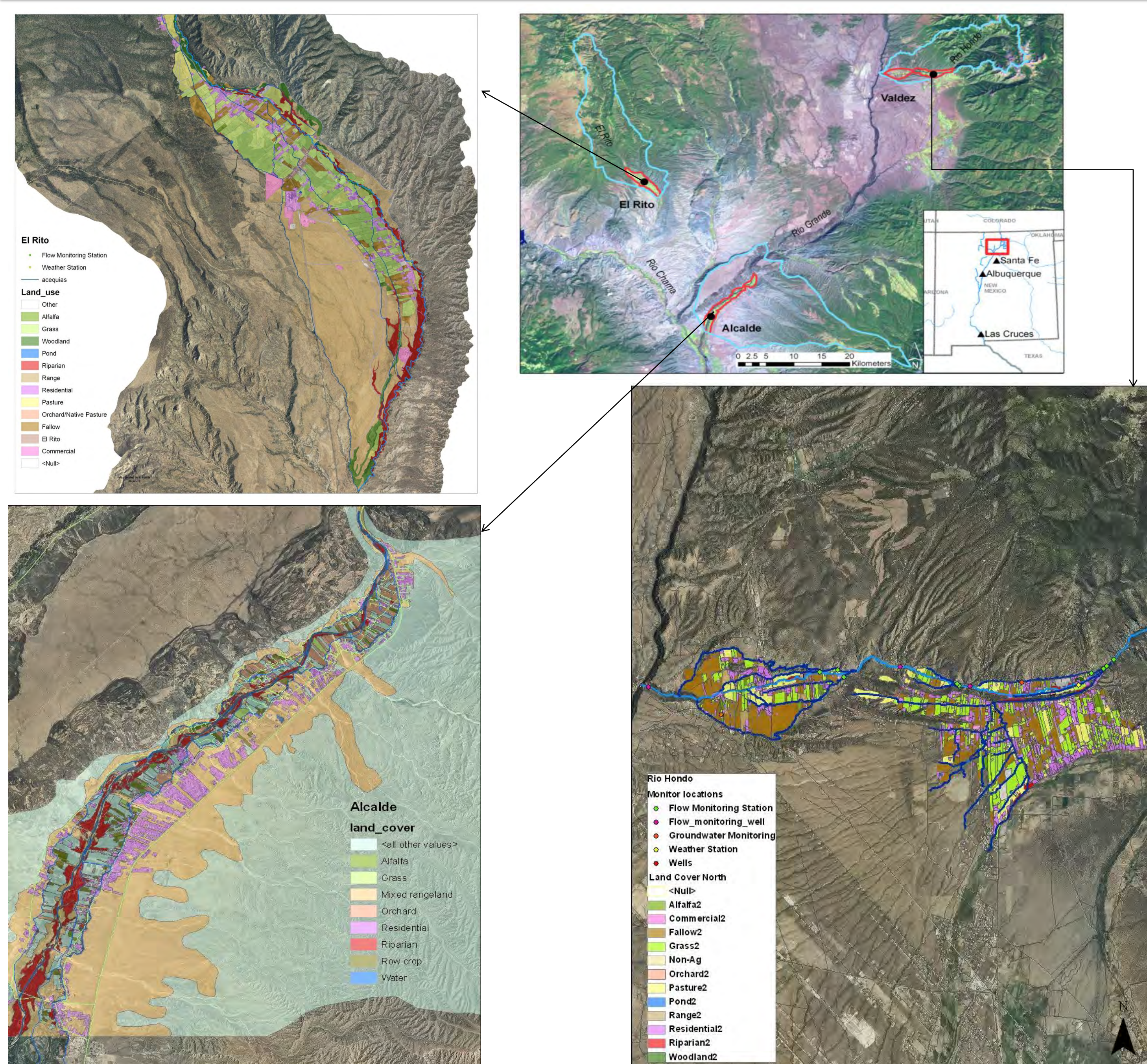
Introduction:

In arable valleys of water-limited regions worldwide, community water management systems have evolved to sustain communities in the face of unreliable precipitation. The acequias of the southwestern United States lie at the center of a set of complex self-maintaining interactions between culture and nature that appear to enable drought survival and maintain other sociocultural and ecosystem benefits. Local water management groups inherent in acequias ensure equitable distribution of water to each community, allocating less water for all users in dry years and more in wet years. Acequias help maintain community identity and cohesion, economic sustainability, enhanced floodplain hydrologic function, and wildlife habitat. Contemporary acequia-based communities face new socioeconomic and natural resource pressures that threaten their existence, however. Population growth is accelerating the change from agricultural to residential land and water uses, while climate change threatens to bring warmer winters with less precipitation and earlier spring snowmelt. Traditional acequias create and sustain intrinsic linkages between human and natural systems that increase community and ecosystem resilience to climatic and socioeconomic stresses. Greater knowledge about these interconnections and what can cause them to change or fail will be essential to determine how the communities relying on acequias can adapt to changing conditions. This interdisciplinary research project will explore socioeconomic and cultural linkages within and between acequia communities and associated landscapes; hydrologic linkages between surface water and groundwater in irrigated river valleys and contributing watersheds; and wildlife habitat and grazing distribution connections between valley riparian areas and upland forests and grasslands. The investigators will quantify the role of acequias in hydrologic function, community resilience, and ecosystem health, and they will identify potential tipping points for acequia community survival. Integrative tools informed by examinations of socioeconomic, cultural, and ecohydrological factors will indicate the resilience level of acequia-centered systems. A system dynamics model will simulate effects of climate and land-use stressors on relationships between economic, social, cultural, climatic, hydrologic, vegetation, and wildlife components. The model will quantify the magnitude of stressors needed to undermine community and ecosystem resilience. Mapping will capture spatial linkages and help communicate the findings to a larger audience. This project will provide new insights into the relationships between traditional water management systems, communities, and landscapes.



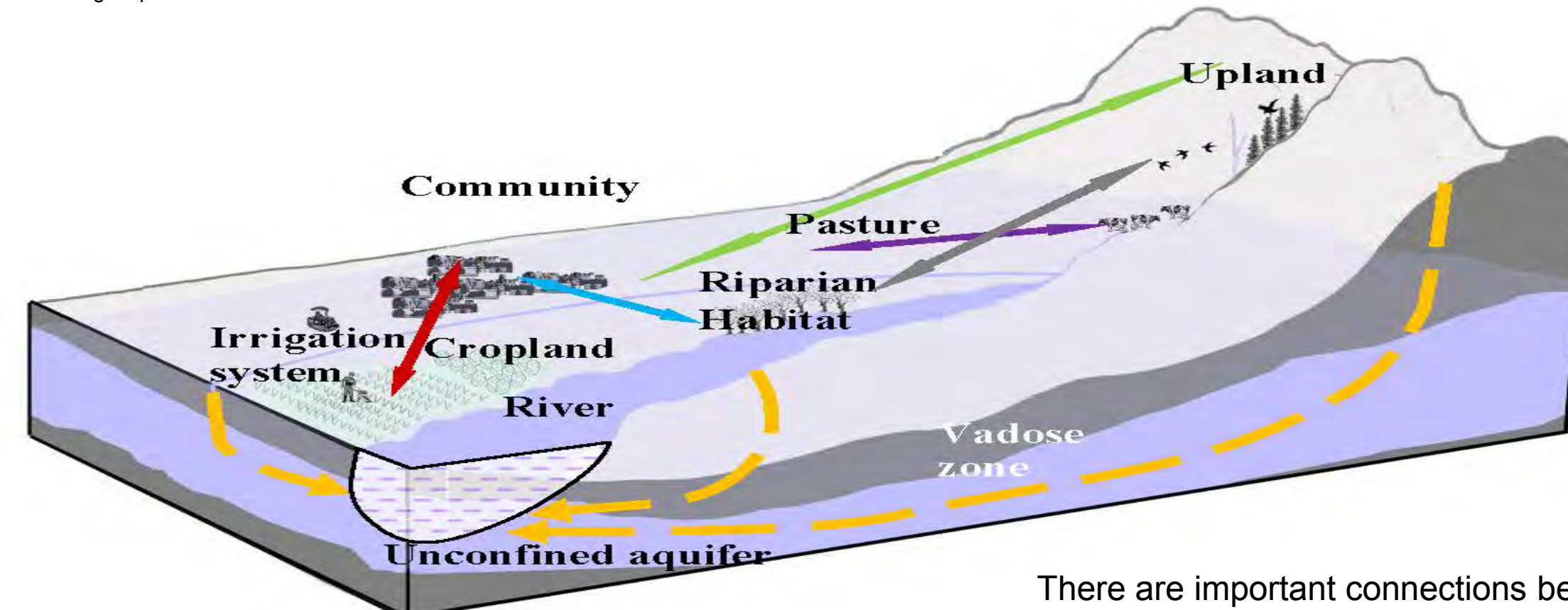
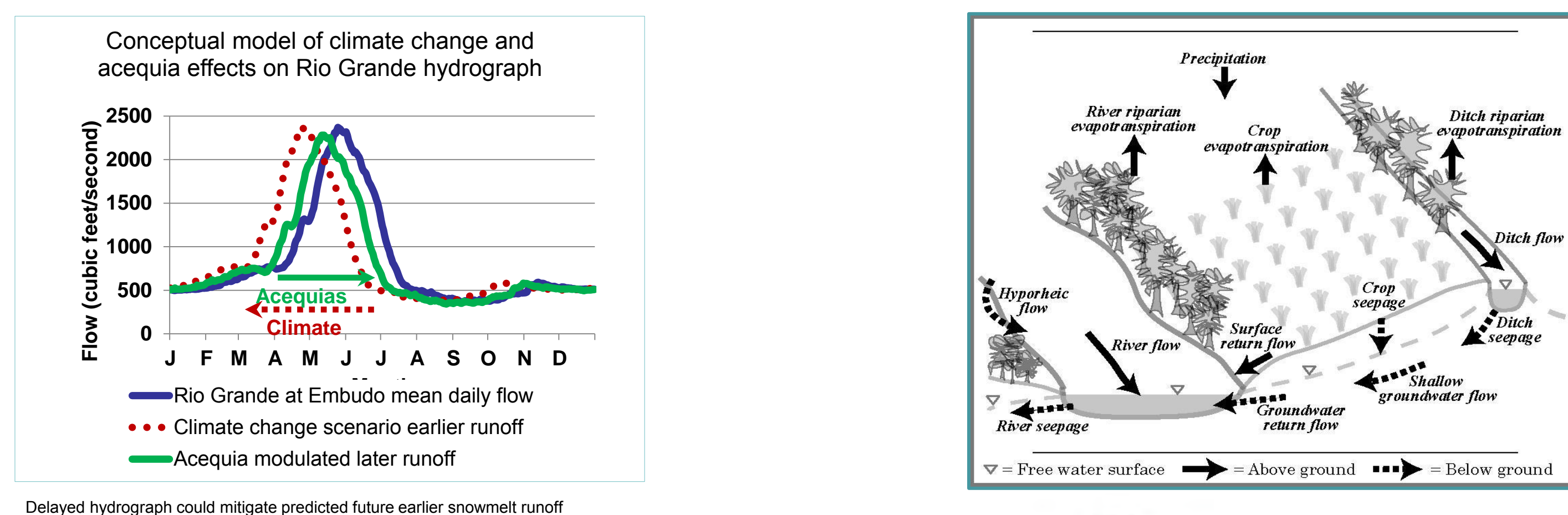
Study sites:

Three different irrigated valleys Alcalde, El Rito, and Rio Hondo were selected for their extensive acequia systems. These systems provide important discharge to the Rio Grande - one of the most important river systems in the United States.



Project connections:

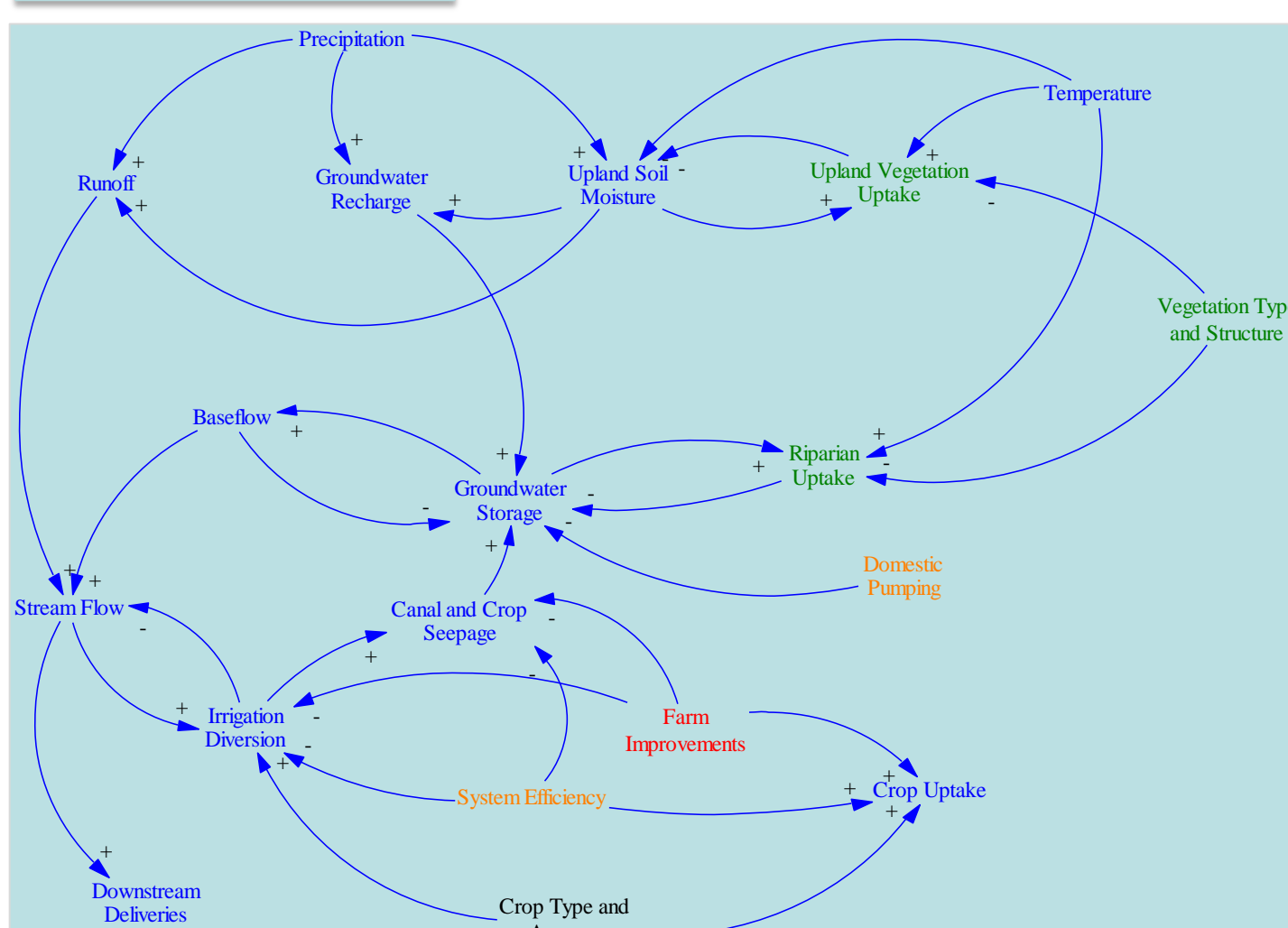
- Acequia resilience model
- Socio-cultural and agro-economic characterizations and models of acequia community resilience
- Multi-scale hydrology models
- Surface water-groundwater studies and models of acequia effects on hydrology at watershed and basin scales
- Integrated mapping
- Spatial representations of land cover, wildlife habitat, and ecosystem services
- System dynamics model
- System scale model that brings together project components to test acequia human and natural sustainability with changing climate and land use
- Interdisciplinary modeling workshop
- Multi-state effort to seamlessly integrate multiple disciplines with coordinated modeling of acequia hydrology and communities
- Comparative global perspectives workshop
- Gathering of international experts on community irrigation systems to explore new perspectives of science added to previous cultural analyses
- Educational programs
- Inclusion of K-12, undergraduate, and graduate students and the general public through research activities and museum exhibits
- Outreach
- Acequia community involvement
- Peer-reviewed articles
- Dissemination of findings through published articles for scientific advancement and policy guidance



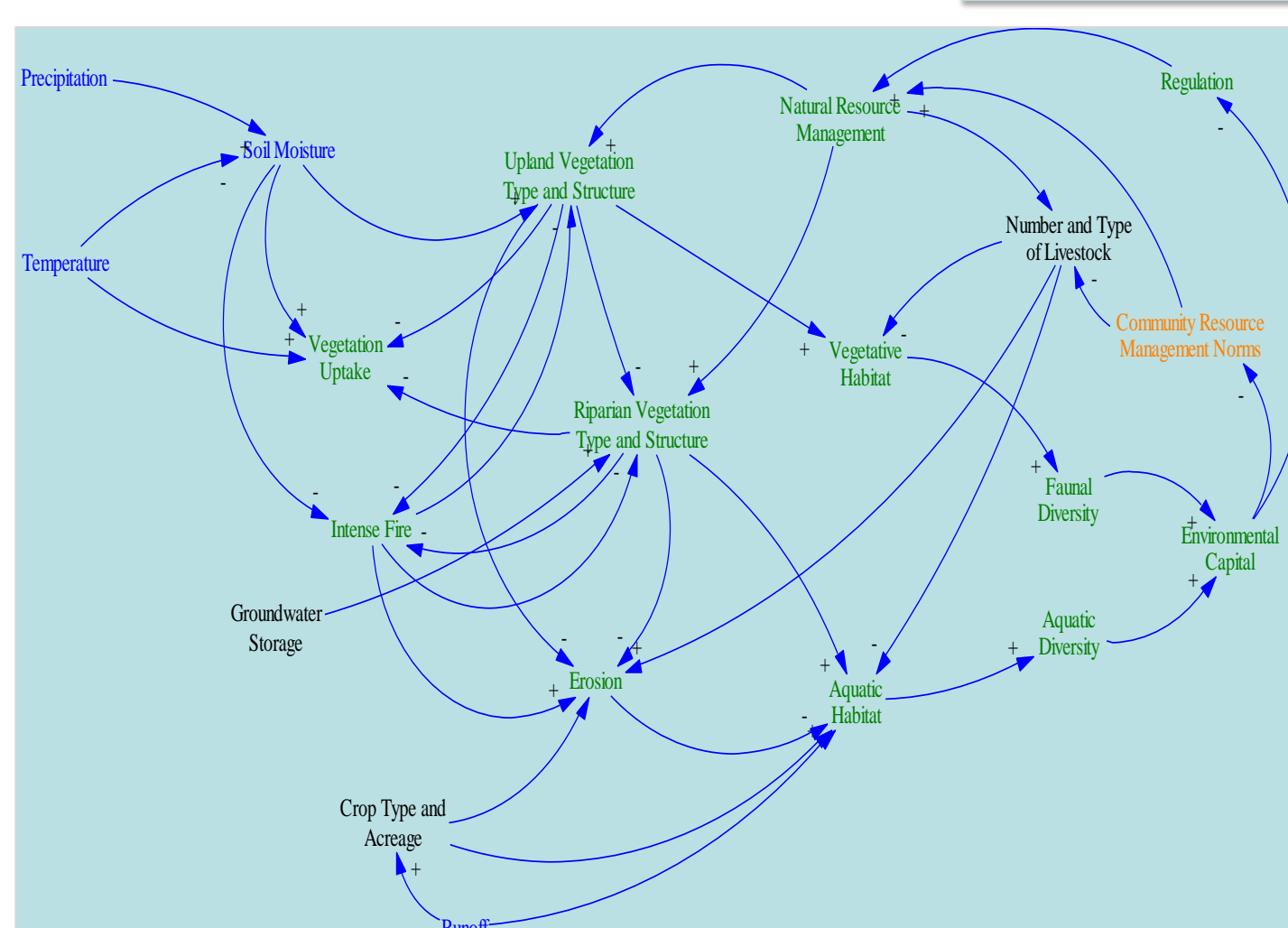
There are important connections between valley irrigation communities and contributing upland watersheds which are explored from multiple perspectives

System Dynamics:

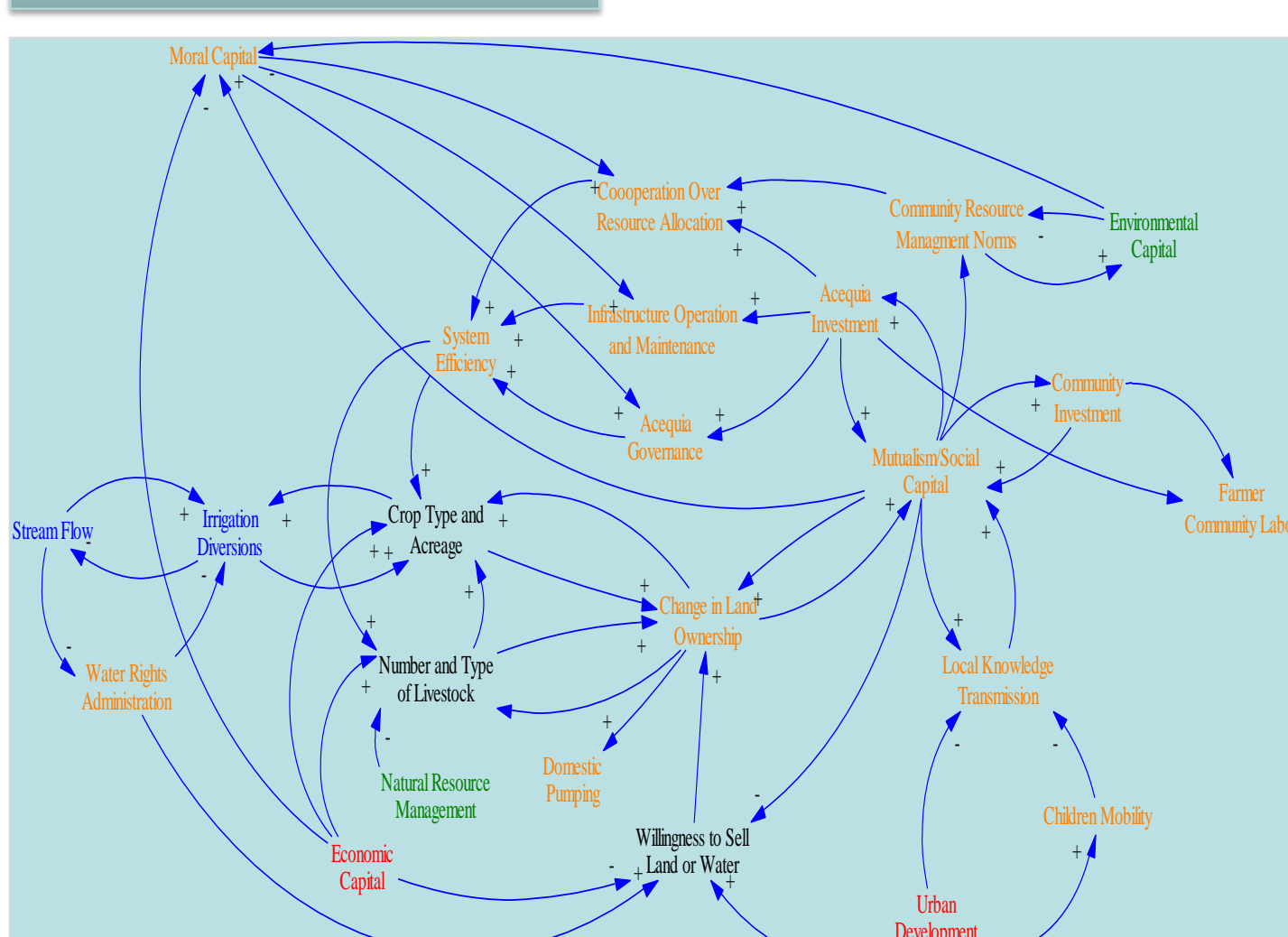
HYDROLOGY



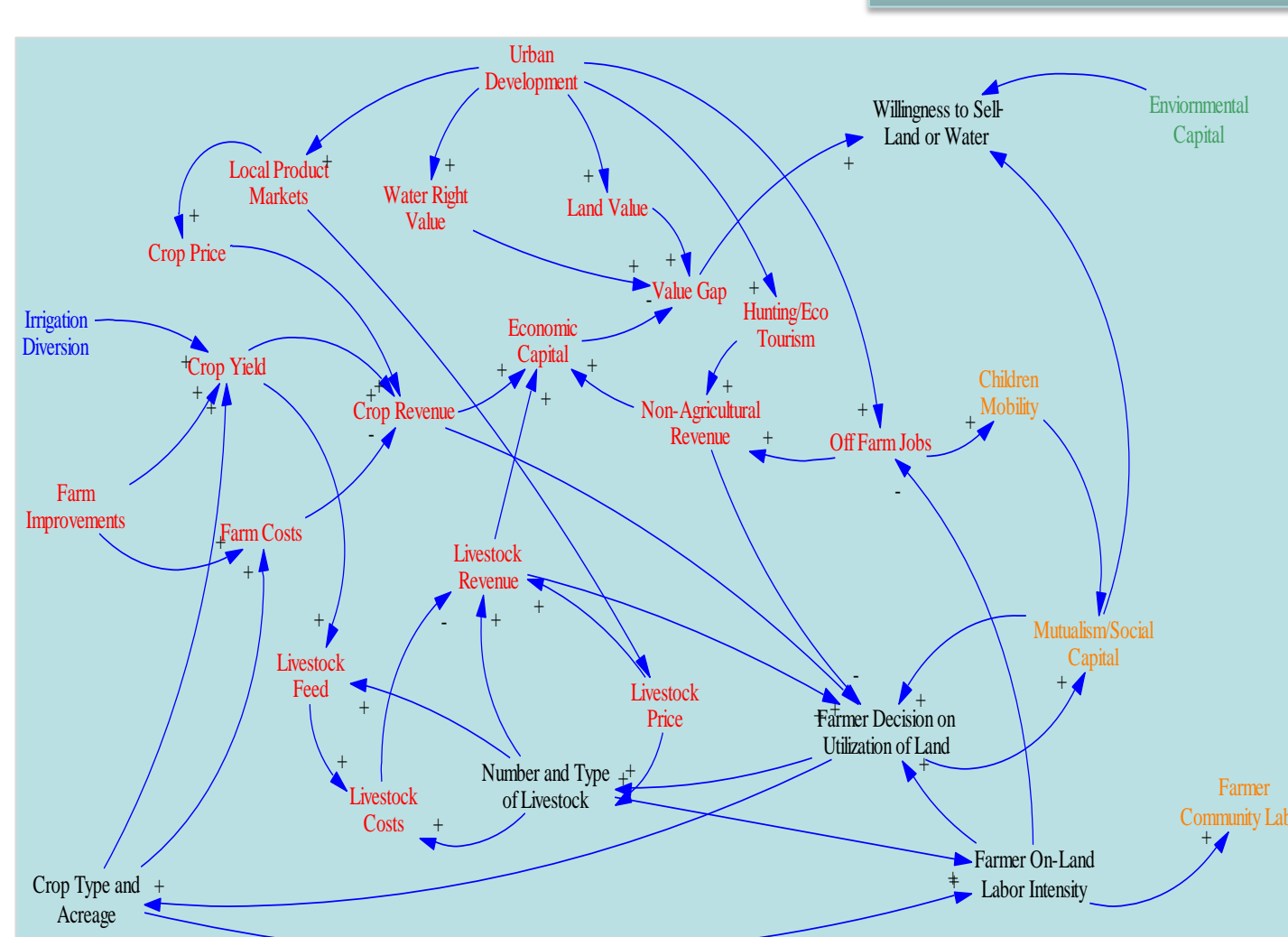
ECOLOGY



SOCIO-CULTURAL



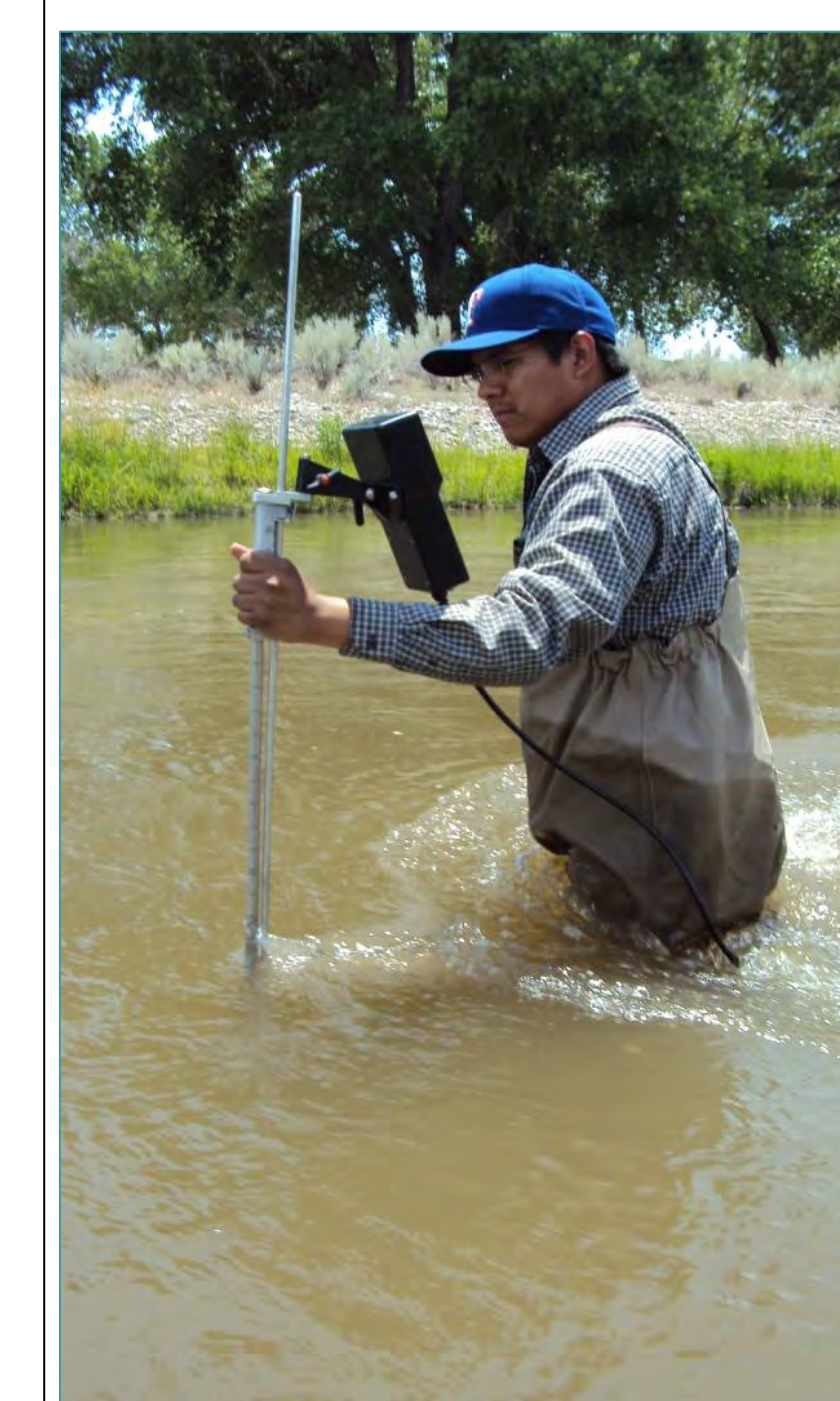
ECONOMICS



Field data collection:



A flume used to measure surface water discharge automatically (Above Left/Inset). A Stage Discharge Recorder (SDR) and data logger are used to record data automatically (Above Top Right). Inside of the stilling well; SDR float and cable (Above Bottom Left)



Acoustic Doppler Velocimeter

Campaigns of field data collection of acequia and river streamflow.



Propeller Current Meter



Acequia flow measurements being taken in Alcalde, NM



Soil Moisture Station



Weather Station

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