Freshwater Management:
Integrating Biophysical and Social Sciences

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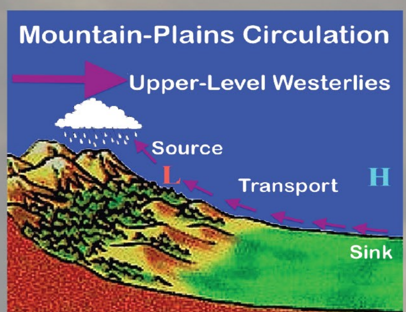
Many farmers, industries, and municipalities depend on snow run-off to supplement supplies through the dry summer months. Increasing demand and decreasing availability of freshwater as a result of climate change creates water scarcity. Our group is working to identify key research questions and methodologies to address and mitigate these pressures.

The IGERT I-WATER program integrates social and biophysical sciences to develop solutions to freshwater sustainability in the context of coupled natural-human systems. I-WATER Fellows work together in three interdisciplinary groups to address challenges confronting freshwater resources.

Hydrologic-Atmospheric-Ecological

Source

- Changes in precipitation timing and amount
- Pollutant deposition from plains acidifying streams, eutrophication potential
- Land cover disturbance (eg. fire, disease) affecting runoff, erosion, snow accumulation



The Mountain-Plains Circulation

- East-west pressure gradient develops from uneven heating
- Upslope air movement and upper-level Westerlies converge at high elevation
- Storms develop impacting Front Range and plains as they move eastward

Transport

- Surface disturbance influences terrestrial input to streams potentially reducing water quality
- Nutrient and pollutant transfer from source to sink results in low potential for sequestration or mitigation

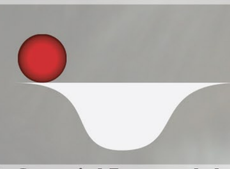
Sink

- Municipal demands are inflexible and increase with population
- Agricultural demand is high, increases with drought, and impacts pollutant return to the source
- Crop selection and irrigation practices impact evapotranspiration rates and regional circulation strength

Social-Hydrologic-Atmospheric

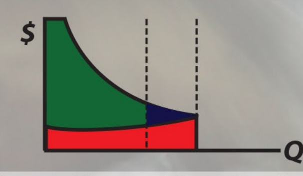
Water Scarcity Metrics:

Developing simple quantitative metrics for policy makers that clearly and efficiently highlight a region's or municipality's sensitivity, adaptability, and resilience to water scarcity. These metrics will provide insight into place-based public policy options.



***Resilience*: The ability of a system to return to its previous function after a shock.**

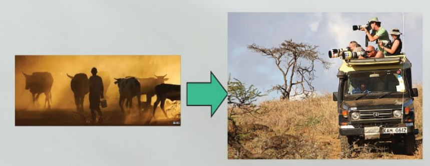
Influential Factors: Inherent ability of the system to maintain function under stress. This could be the ability to reduce water use while maintaining economic output or the ability of a system to return to an equilibrium relatively quickly after a shock. Policy may increase resiliency by creating drought mitigation policies that allow for rapid and effective response.



***Sensitivity*: Total economic loss due to a shock.**

Influential Factors: Elasticity of water within a region's economy and environment. That is, as water supply decreases, how much does the value of water change? Policy questions include how flexible water systems are to re-distributing water from low to high value uses during times of scarcity.

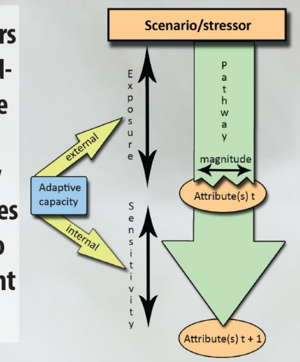
***Adaptability*: The ability of a socio-economic system to adjust its primary function while maintaining similar economic activity and levels of employment.**

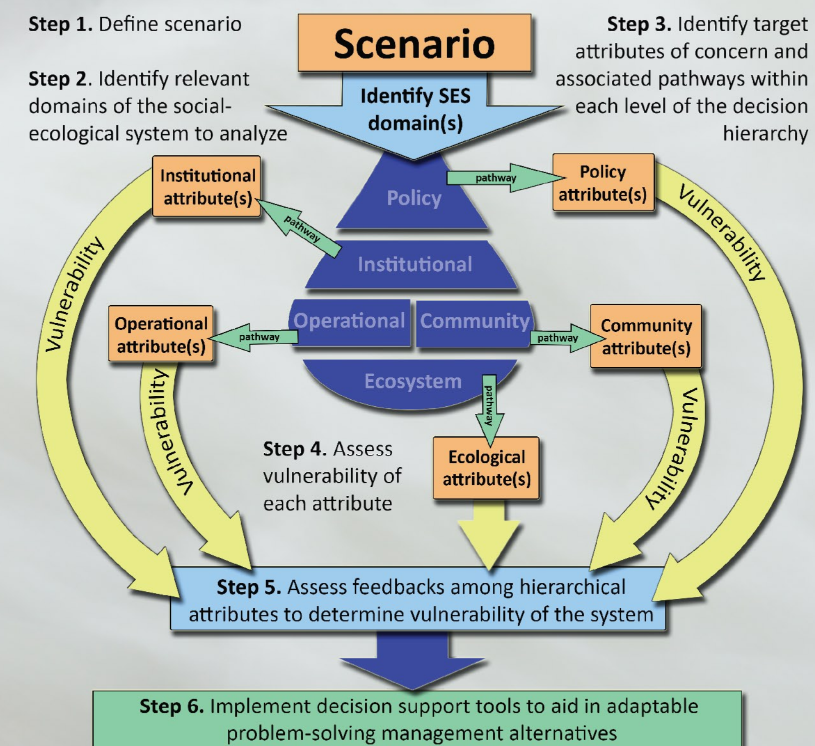


Influential Factors: The presence of economic sectors able to grow or absorb losses during times of drought. Policies that allow for flexibility within an economy that do not prop up water intensive sectors at the expense of others.

Social-Ecological-Hydrologic

The environmental flows framework allocates water in rivers to sustain ecological integrity and societal well-being. In addition to traditional hydrologic and environmental data, we emphasize the integration of social data to support holistic flow management objectives. We conceptualize a hierarchy of the social-ecological system, which includes key attributes and feedbacks within social and environmental domains, to assess vulnerability and inform water resource management under future climate and management scenarios.





Through these frameworks and evaluation methods, the I-WATER Fellows will inform freshwater management for society and the environment.

Lessons Learned:

While collaborating can add depth and robustness to research questions and methodologies, there are many challenges to working across a wide range of disciplines. These considerations include: Framing a question that appeals to each scientific field, issues of incompatible temporal and spatial scales, disagreement in appropriate assumptions, and finding common vernacular.