FACILITATING SCIENCE-BASED ADAPTATION THROUGH COMMUNITY-BASED PARTICIPATORY RESEARCH: LESSONS LEARNED FROM A CASE STUDY IN THE TRUCKEE-CARSON RIVER SYSTEM

Loretta Singletary[1] and Kelley Sterle[1]

[1]University of Nevada Reno

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Abstract

In arid snow-fed river systems, where climate change affects snowpack accumulation and snowmelt timing, community-based participatory research that engages scientists and stakeholders can shape research agendas to support local climate adaptation and produce decision-relevant science. This presentation provides an overview of a community-based participatory research project underway in the Truckee-Carson River System in the Western United States. The authors: (1) describe the participatory research framework developed for this case study which features an interdisciplinary science team; (2) explain the selection and role of a diverse group of stakeholders representing diverse water use communities that regularly interacts with scientists; (3) highlight selected results of a local climate resiliency assessment and research activities to date; and (4) share successes and challenges to date useful to establishing best practices that may guide the replication of this research framework elsewhere. Our findings indicate that climate change is mobilizing local adaptation strategies that include communicating with other water managers, collecting data to monitor climate impacts, and planning for future water supply variability by investigating the performance of institutionalized water management regimes. To guide community decisions and support managers' science information needs, researchers are developing stakeholder-informed climate scenarios and simulating locally identified adaptation strategies. Best practices identified to date underscore the importance of early stakeholder engagement to clarify case study boundaries, prioritize research questions of interest, and identify a core stakeholder group willing to participate in research. This sets the stage for a transparent and responsive process, which aids in building trust in the research design as demonstrated through scientists seeking and incorporating local knowledge and input. Related to this transparency is the need to acknowledge power disparities that may exist among stakeholder communities including historically marginalized groups with high stakes in sustaining water resources. A thorough stakeholder analysis should address these considerations and comprises a critical component of the research design.

Facilitating Science-based Adaptation through Community-based Participatory Research: Lessons Learned from a Case Study in the Truckee-Carson River System

Loretta Singletary[1] & Kelley Sterle[2]

[1]Department of Economics and Cooperative Extension, University of Nevada, Reno

[2]Graduate Program of Hydrologic Sciences and Cooperative Extension, University of Nevada, Reno

INTRODUCTION and BACKGROUND

Research Program Overview

What: A case study in the Truckee-Carson River System, western United States, utilizes a participatory research approach to assess climate resiliency

Why: Snow-fed river system communities are acutely sensitive to climate change. A warmer climate:

- changes snowpack and snowmelt, altering surface and groundwater supply
- increases precipitation falling as rain versus snow, resulting in winter and spring floods
- challenges water management practices that assume a stationary climate

How: Develop and implement a collaborative modeling research design (see right) that convenes local water managers and researchers to:

- examine water supply challenges under variable hydroclimate conditions
- specify hypothetical yet plausible climate scenarios
- simulate hydrologic change and water management implications using a suite of hydrologic and operations models tailored to the river system (see below)
- identify strategies to adapt to simulated hydroclimate variability
- collaboratively review simulation results

Who are the local water managers?

Water managers include local experts who represent the diverse and competing municipal and industrial, environmental, agricultural, tribal, and regulatory water use communities from headwaters to river system terminus

Face-to-face semi-structured interviews conducted at the program's onset (2015) identified the Stakeholder Affiliate Group - **12 key water managers** willing to partner voluntarily and regularly with project researchers throughout the life of the research project (2015-2019)

Who are the researchers?

An interdisciplinary team of physical scientists, social scientists, and engineers with combined expertise in surface and groundwater hydrology, climatology, and hydrologic and operations modeling, resource economics, and political science

Researchers meet with key water managers during **Stakeholder Affiliate Group** workshops held biannually to track ongoing water supply challenges, identify science information needs to support local adaptation, and revise research accordingly

METHODS

Primary data collection
harnesses local managers' knowledge and assesses science information needs

Semi-structured Interviews · Focus Groups · Workshops

Climate scenarios,
informed by local water managers, produce temperature and precipitation inputs to simulate changes in hydrology

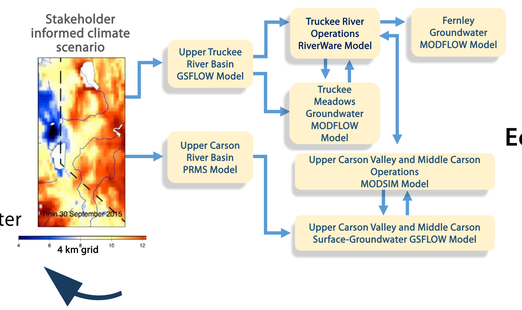
Hydrologic models
examine changes in surface and groundwater conditions including snowpack accumulation, snowmelt, streamflow, and groundwater

Evapotranspiration estimates
to quantify changes in consumptive use and irrigation water demand

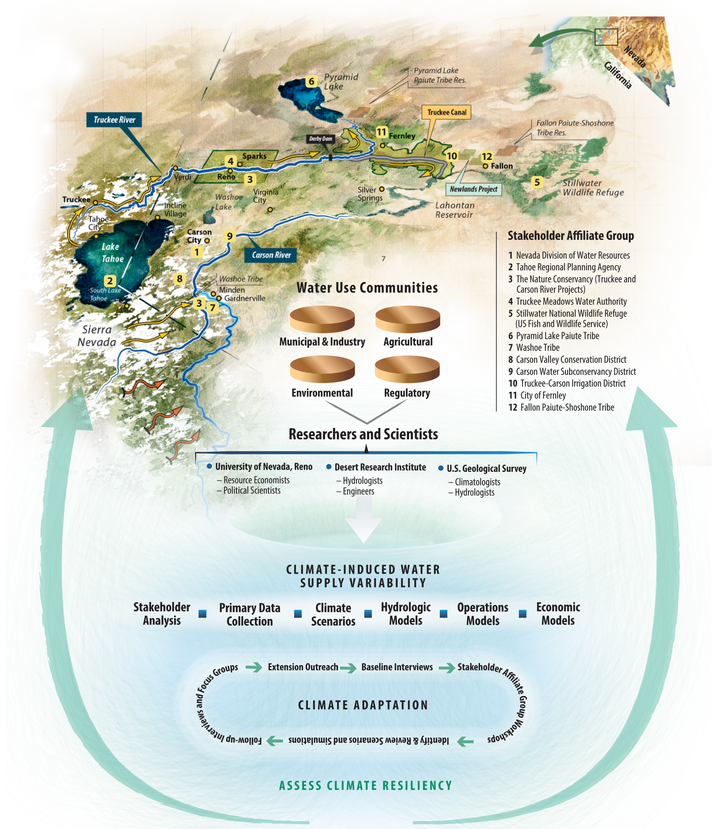
Econometrics models
explore agricultural water use to analyze irrigation decisions under variable water supply and existing water law

River and reservoir operations models
to evaluate operational challenges and simulate alternative water management strategies

Integrated Hydroclimatic Model



Truckee-Carson River System Collaborative Modeling Research Design



CASE STUDY AREA

- **6,990 square mile area** that originates as snowpack in the **Sierra Nevada** (7,000 feet) of eastern California and terminates in the **Great Basin** of northwestern Nevada (3,800 feet)
- **Truckee River** flows 121 miles from Lake Tahoe to Pyramid Lake with seven upstream **surface water reservoirs** mitigate flood and regulate water supply and demand
- **Carson River** flows 131 miles to Lahontan Reservoir, supplying primarily agricultural irrigation water to the Upper Carson Valley and Newlands Irrigation Project
- **Interbasin transfer** diverts Truckee River flows through the **Truckee Canal** to supplement Carson River flows into Lahontan Reservoir
- **Prior appropriation based water law** allocates surface and groundwater rights to diverse and competing water use communities across the river system

RESEARCH PARTNERS

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RESULTS and DISCUSSION

Local Climate Resiliency Assessment

Local managers demonstrate a need for science-based information tailored to the river system to inform climate adaptation, mobilized as a result of recent hydroclimate variability (water years 2012-2018)

- 90% (n=66) request science-based information and improved communication to enhance their respective individual adaptive capacity

Co-identified research and outreach activities include:

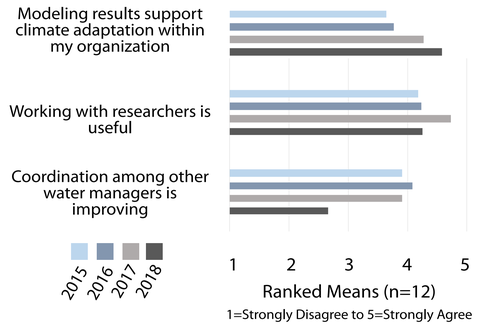
- project local climate impacts through plausible climate scenarios
- simulate system-wide effects of alternative water management operations/practices
- improve communication and coordination among water managers
- investigate Prior Appropriation water allocation efficiency
- educate the public about climate change impacts and adaptation strategies

Stakeholder Affiliate Group Workshop Evaluation

Evaluation results suggest that participatory research findings inform local managers' adaptation planning and decision-making

What additional information would be useful?

"Best practices from other mountain towns… the best science on the topic, realistic climate, snowpack, and runoff scenarios and projections at timescales relevant for our planning outlooks." - Water Manager



Best Practices

Evidence to date underscores the importance of early and frequent engagement to:

- clarify case study boundaries and water use interests
- identify key water management challenges under climate change
- cater climate scenarios to ensure climate stressors depict salient impacts
- review integrated modeling capabilities, limitations, and inputs/outputs
- co-develop research questions that reflect pressing challenges and research interests
- prioritize research activities that support local information needs
- identify local metrics to report model simulation outputs to ensure results are useful
- validate the on-the-ground potential of simulation results to further prioritize research

Additional best practices that can guide other case studies to more effectively use their resources include:

- conducting a thorough stakeholder analysis at the case study's outset to identify historical and emergent power disparities that may exist among diverse local water use communities, thus setting the stage for a transparent and responsive process
- ensuring scientists can satisfy professional expectations to conduct high quality scholarly research with generalizable and publishable findings

CONCLUDING REMARKS

Community-based participatory research that systematically engages researchers and local decision-makers can help support adaptive water management in snow-fed river basins

Best practices should evolve to ensure that research timelines and outcomes satisfy the utility needs of local decision-makers and researchers alike

For additional information contact singletaryl@unce.unr.edu and/or refer to:

Singletary, L., and K. Sterle (2017). Collaborative Modeling to Assess Drought Resiliency of Snow-fed River Dependent Communities in the Western United States: A Case Study in the Truckee-Carson River System. Water, 9, 1–19.

Singletary, L., and K. Sterle (2018) Participatory Research to Assess the Climate Resiliency of Snow-fed River Dependent Communities: A Collaborative Modeling Case Study in the Truckee-Carson River System. Addressing Climate Change at the Community Level in the United States, P.R. Lachapelle and D. Albrecht, Eds., Routledge, New York, NY.