Characterizing Water Risks and Solutions Cross-Culturally: Results from the Global Ethnohydrology Study

Rhian Stotts[1], Kelli Larson[2], Amber Wutich[1], and Alexandra Brewis[1]

[1]School of Human Evolution and Social Change, Arizona State University, [2]School of Geographical Sciences and Urban Planning, Arizona State University

Arizona State University

Central Arizona-Phoenix Long-Term Ecological Research

CAP LTER

Background

The Global Ethnohydrology Study is a transdisciplinary, multi-year, multi-site research project designed to survey cross-cultural understandings of water issues. This comparative approach allows us to examine how developmental status and climatic context affect perceptions of water risks and management solutions.

Data Collection

- Semi-rural or peri-urban communities sites were selected in four countries to compare differences based on development status and water scarcity (see below table).
- A purposive sampling strategy was used to capture local residents' cultural and institutional knowledge. A total of 135 respondents participated.
- Face-to-face interviews elicited responses to questions on water and climate issues as well as respondent demographics.
- The survey items analyzed herein included three open-ended questions asking respondents to list local, natural sources of water, threats to those sources, and solutions to address threats.
- 630 statements were collected and analyzed in this study.

Four Study Sites Classified by Water Scarcity & Development Levels

	Water Scarce	Water Rich
Economically Developed	Phoenix, United States (n=30)	PioPio, New Zealand (n=27)
Economically Developing	Cochabamba, Bolivia (n=41)	Viti Levu, Fiji (n=37)

Data Analysis

Using a content analysis approach, we created mutually exclusive codes to classify statements as follows. We then used chi-square tests to see if these risk perceptions varied by water and/or economic conditions.

- Threats: water quality (pollution) & quantity (lack of water)
- Solutions: individual behaviors, collective technologies & policies

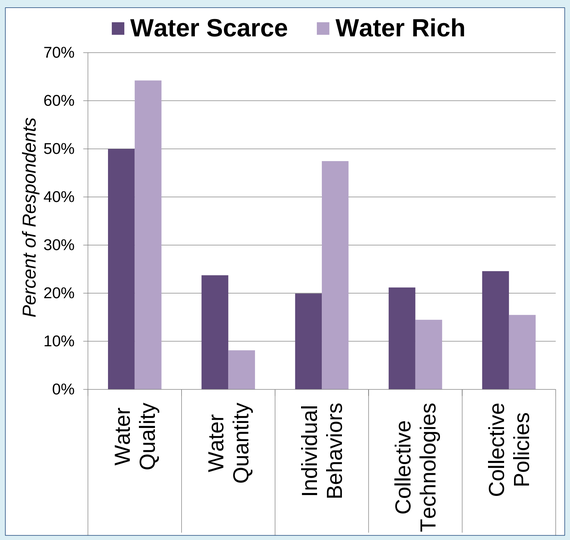
How do perceived water risks and management strategies vary across different environmental and socioeconomic contexts, specifically in relation to water scarcity and level of development?

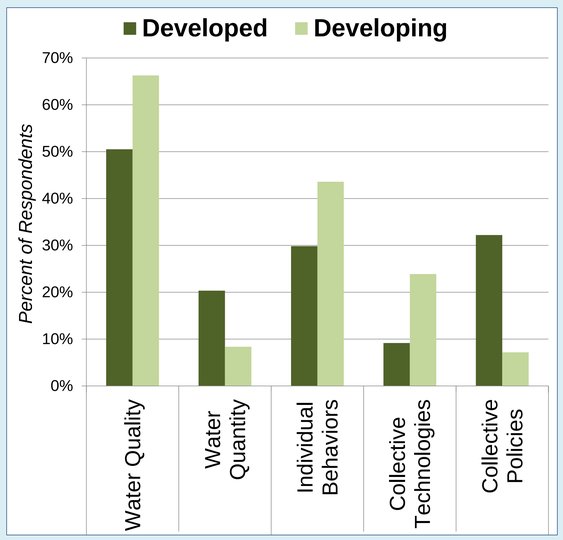
Hypotheses	Water Scarce Regions *(relative to water rich ones)*	Less Developed Nations *(relative to developed ones)*
Perceived Threats	> Quantity < Quality	> Quality < Quantity
Suggested Solutions	>/= Individual Behaviors > Collective Technologies > Collective Policies	>/= Individual Behaviors > Collective Technologies < Collective Policies

Results

- As hypothesized, **pollution concerns** were higher in water rich and developing countries compared to water scarce and more economically developed ones.
- Water **quality risks** were of higher concern than water quantity risks overall, but as expected lack of water was more of a concern in water scarce and developed nations.
- Individual **behavioral changes** were more often suggested in developing countries and water rich areas, in part linked to pollution concerns (e.g., 'do not contaminate').
- Also consistent with hypotheses, residents of water-scarce and less-developed areas more commonly suggested **technological solutions** compared to their counterparts.
- Lastly, **collective policies** were more commonly mentioned by residents of water scarce and developed nations we surveyed.

Perceived Water Risks and Management Strategies by Water Scarcity (Left) and Development Level (Right)





All differences in perceptions in the above figures are statistically significant, all but one at the p<0.01 level. For the association between collective technologies and water scarcity, the Pearson's chi-square was 4.73, p=0.02. Other chi-sq. values ranged from 8.0 to 64.19

Thematic Findings

The tables below summarize the primary themes (and subthemes), along with *peripheral* themes, identified in residents' comments across the sites sampled.

Perceived Threats	United States (Phoenix)	Bolivia (Cochabamba)	Fiji (Viti Levu)	New Zealand (Pio Pio)
Water Quality Risks	Contamination (pesticides, chemicals, pollution, runoff)	Contamination (bugs/animals, trash, chemicals) Dirtiness (washing in river, brown like dirt) *Bad infrastructure* *Health issues*	Health Issues (diarrhea, skin, illness/ disease) Animals (piggeries, cow waste, insects) Housing (construction, sewage) *Mixing with salt water*	Contamination (chemicals, didymo, giardia) Farming (animal waste, fertilizers) *Recreational pollution*
Water Quantity Problems	Physical Shortages (drought, low rains/water table) Institutional Shortages (dams upstream; lose water to CA) *Overpopulation*	Drought	Drought	Drought *Overuse*

Suggested Strategies	United States (Phoenix)	Bolivia (Cochabamba)	Fiji (Viti Levu)	New Zealand (Pio Pio)
Individual Behaviors	Chemical usage	Do not contaminate (or trash) Build infrastructure (water tank, cover it, 200 liter drums) *Chlorine*	Boil water Animals (secure animals/ pasture, move animals, get rid of animals) Do not pollute (stop dumping, rubbish) *Chlorine*	Fencing (rivers/ streams, keep animals out, stop polluting, stop burning) Usage of fertilizers Tanks (maintain tanks, cover tanks) *Keep birds out* *Clean*
Collective Technologies	Water storage (building dams/ reservoirs) Sewer system (new piping, use chemicals)	Build infrastructure (wells, tanks, channels, pipes, houses to cover wells) Fix infrastructure (engines, water pipes, clean wells) *Store in tank*	Build infrastructure (tanks, purifying system) Cover well	Water treatment
Collective Policies	Regulations (enforce existing, implement new ones) Rationing *Education* *Oversight*	*Leaders working on it*	Regulations (on dumping, farming) *Education*	Education (awareness) Regulations (on, companies, tourists, farms, individuals) *Monitoring*

Conclusion

This study identifies perceived risks and possible solutions to water issues across 4 international sites. The findings identify concerns and solutions particular to social and environmental contexts, thereby advancing knowledge of cross-national perceptions and case-specific opportunities and challenges to water governance reform.

Acknowledgements: The Global Ethnohydrology Study was conducted with funding from National Science Foundation award SES-0951366 (Decision Center for a Desert City II: Urban Climate Adaptation), National Science Foundation awards BCS-1026865 and DEB-0423704 (Central-Arizona Phoenix Long-term Ecological Research), and the Arizona State University Late Lessons from Early History initiative.