

Colorado Basin Incentive-Based Urban Water Policies: Review and Evaluation

Bonnie G. Colby & Hannah Hansen

Professor and Research Assistant, Department of Agricultural Economics, University of Arizona

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Co-author Hannah Hansen is now Associate Water Planning Analyst with Salt River Project (SRP), in their Water System Projects group. The work in this article was completed prior to her accepting a position with SRP.

Logos below acknowledge Colby research funders.



Innovations at the Nexus of
Food, Energy and Water
Systems (INFEWS)



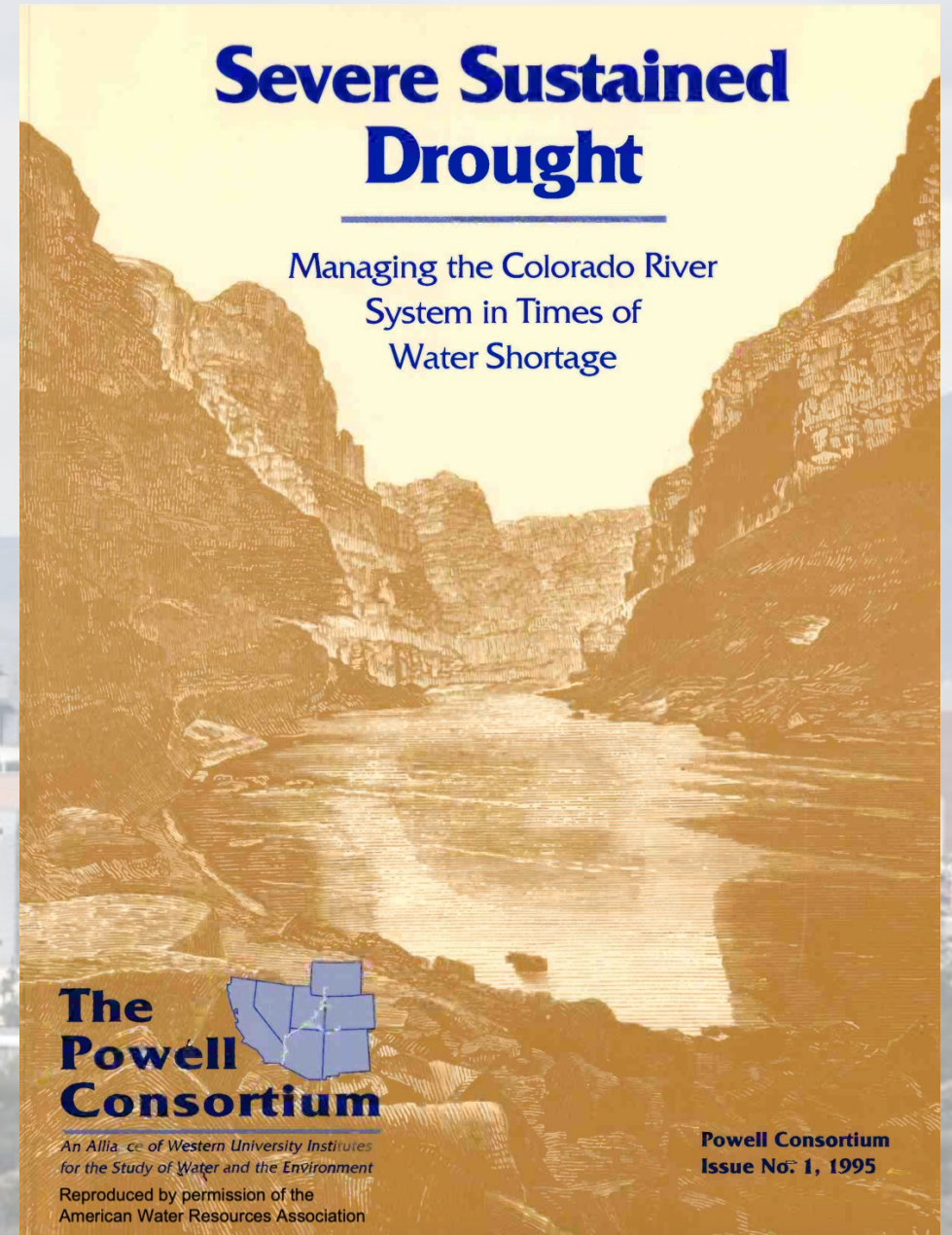
National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

Appreciating colleagues who have passed away
since our SSD work together 1989 -1995

Bob Young

Bill Lord

David Getches



Urban demand reduction and watershed protection programs rare at time of SSD Project

Now important tools to cope with drought and regional aridification



Colby-Hansen 2022 article examines incentives provided to:

- reduce urban water use
- protect watersheds that supply CRB cities

Reviewed largest city/cities in six CRB states (excluding California)

Phoenix

Tucson

Salt Lake City

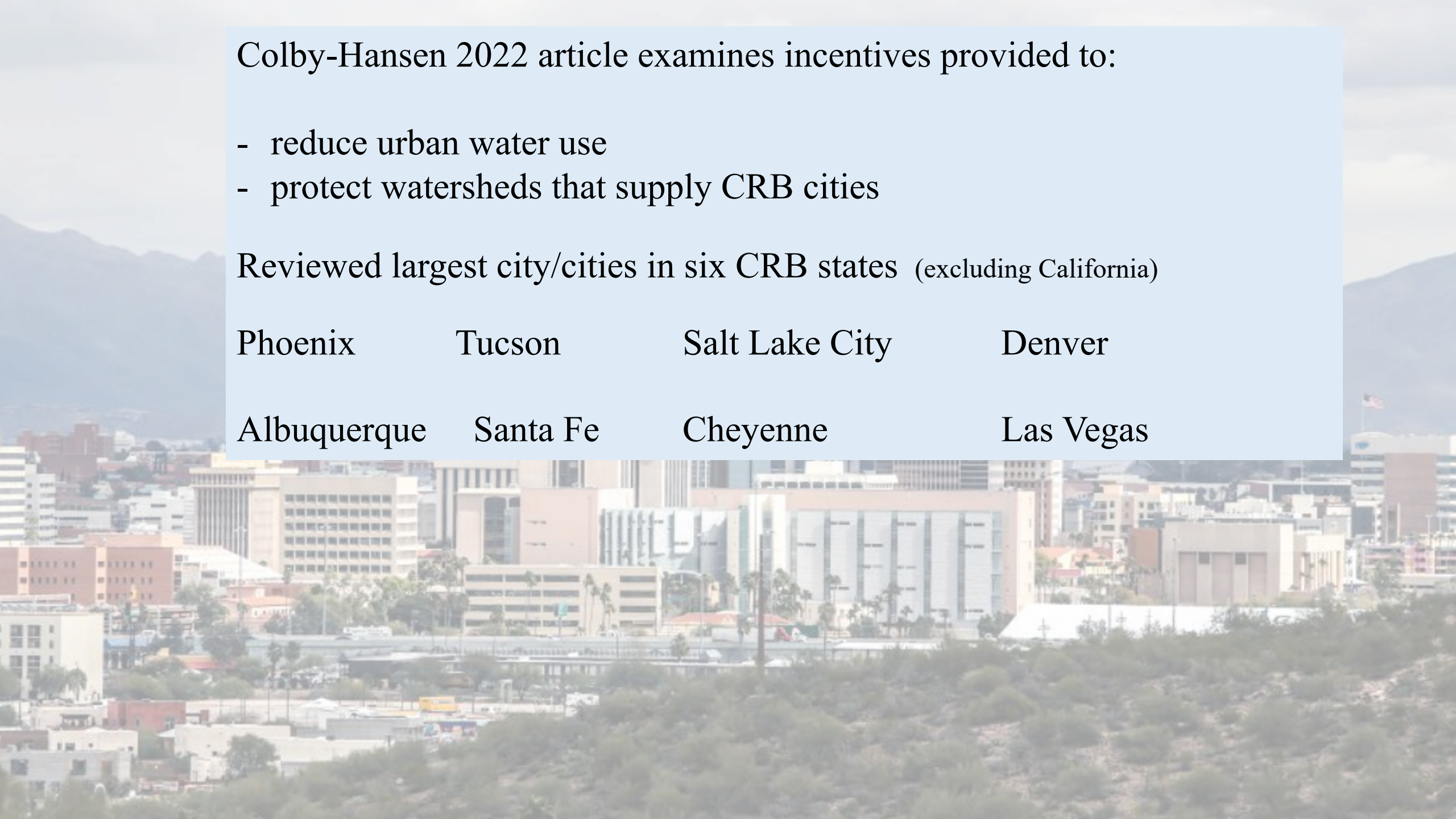
Denver

Albuquerque

Santa Fe

Cheyenne

Las Vegas



Despite significant population growth from 2000 -2020

- per capita water use decreased
- total use declined or grew far less than population growth
- trends continue even after 07-09 recession effects faded

Table 1. Municipal Population Trends

Cities	2000		2010		2020	
	Population	% Change	Population	% Change	Population	% Change
Albuquerque	448,627	16%	545,559	22%	564,559	3%
Cheyenne	52,763	5%	59,466	13%	65,132	10%
Denver	554,636	19%	600,158	8%	715,522	19%
Las Vegas	478,868	85%	583,756	22%	641,903	10%
Phoenix	1,320,994	34%	1,445,632	9%	1,608,139	11%
Salt Lake City	181,456	13%	186,440	3%	199,723	7%
Santa Fe	61,805	8%	67,947	10%	87,505	29%
Tucson	486,591	16%	520,116	7%	542,629	4%

Table 2. Municipal Water Utility Gallons|Per Capita Per Day Use Trends

Cities	2000		2010		2020	
	Use (GPCD)	% Change	Use (GPCD)	% Change	Use (GPCD)	% Change
Albuquerque	216		157	-27%	121	-23%
Cheyenne	192		157	-18%	134	-15%
Denver	220		163	-26%	144	-12%
Las Vegas			144		110	-23%
Phoenix	205		165	-20%	155	-6%
Salt Lake City	285		210	-26%	206	-2%
Santa Fe	137		104	-24%	93	-11%
Tucson	165		139	-16%	119	-14%

Most cities have multi-tiered rate structures, higher rates for higher monthly volumes

Several have seasonal rates to reduce summer outdoor use

(data collected in 2020-21)

Table 5. Municipal Pricing (prices per unit volume)

Cities	Tier 1		Tier 2		Tier 3		Tier 4	
	Volume (Gallons)	Price (per 1,000 gallons)	Volume (Gallons)	Price (per 1,000 gallons)	Volume (Gallons)	Price (per 1,000 gallons)	Volume (Gallons)	Price (per 1,000 gallons)
Albuquerque	All Units	\$2.70						
Cheyenne	0-6000	\$4.42	6,000-24,000	\$5.46	24,000-42,000	\$6.78	42,000+	\$8.44
Denver	0-Average Winter Consumption (AWC)	\$2.36	AWC + 15,000	\$4.25	Greater than AWC + 15,000	\$5.66		
Las Vegas	0-167	\$1.34	167-334	\$2.39	334-667	\$3.55	667+	\$5.27
Phoenix	0-4,488 Oct-May & 0-7,480 June-Sept	\$1.04 Oct-May & \$0.62 June-Sept	All Usage above Tier 1	\$4.29 Dec-Mar, \$5 Apr, May, Oct, Nov, & \$5.48 Jun-Sept				
Salt Lake City	748-7,480	\$1.84	8,228-22,440	\$2.51	23,118-44,880	\$3.47	44,880+	\$3.70
Santa Fe	0-7,000 Sept-April & 0-10,000 May-Aug	\$6.06	All usage above Tier 1	\$21.72				
Tucson	748-5,236	\$2.77	5,984-11,220	\$5.11	11,968-22,440	\$11.10	23,188	\$17.32

Urban Water Demand Price-Responsiveness (elasticity)

Price elasticity of demand measures how water use responds to change in water price.

Ex: city price elasticity of -1.10 \Rightarrow price increase of 10% decreases city water use by 11%

Price elasticities below for several cities in Basin (more provided in article)

Tucson price elasticity -0.20 in January, varies seasonally
(Clarke, Colby, & Thompson, 2017)

Phoenix: -0.36 for single-family use (Fullerton & Cardenas, 2016)

Salt Lake City: -0.391 (Coleman, 2009)

CRB cities (including S. California cities) range from -0.10 to -0.76 (Bruno and Jessoe, 2021)

Other Programs to Reduce Urban Use

Gray Water Reuse – utilized in all cities, varying incentives and regulations

Effluent Use – common among cities for irrigating large turf areas, pricing incentives vary.

Turf Retirement & Xeriscape Incentives - prominent incentives in Las Vegas. Other cities: info & technical support.

Urban Stormwater Capture -- all cities manage urban stormwater for flood management and aquifer storage

Rainwater Harvesting – practiced to varying degrees in all cities, financial incentives offered in a few cities

(programs reviewed in detail for each city, in article)



Evaluating Programs to Reduce Urban Use

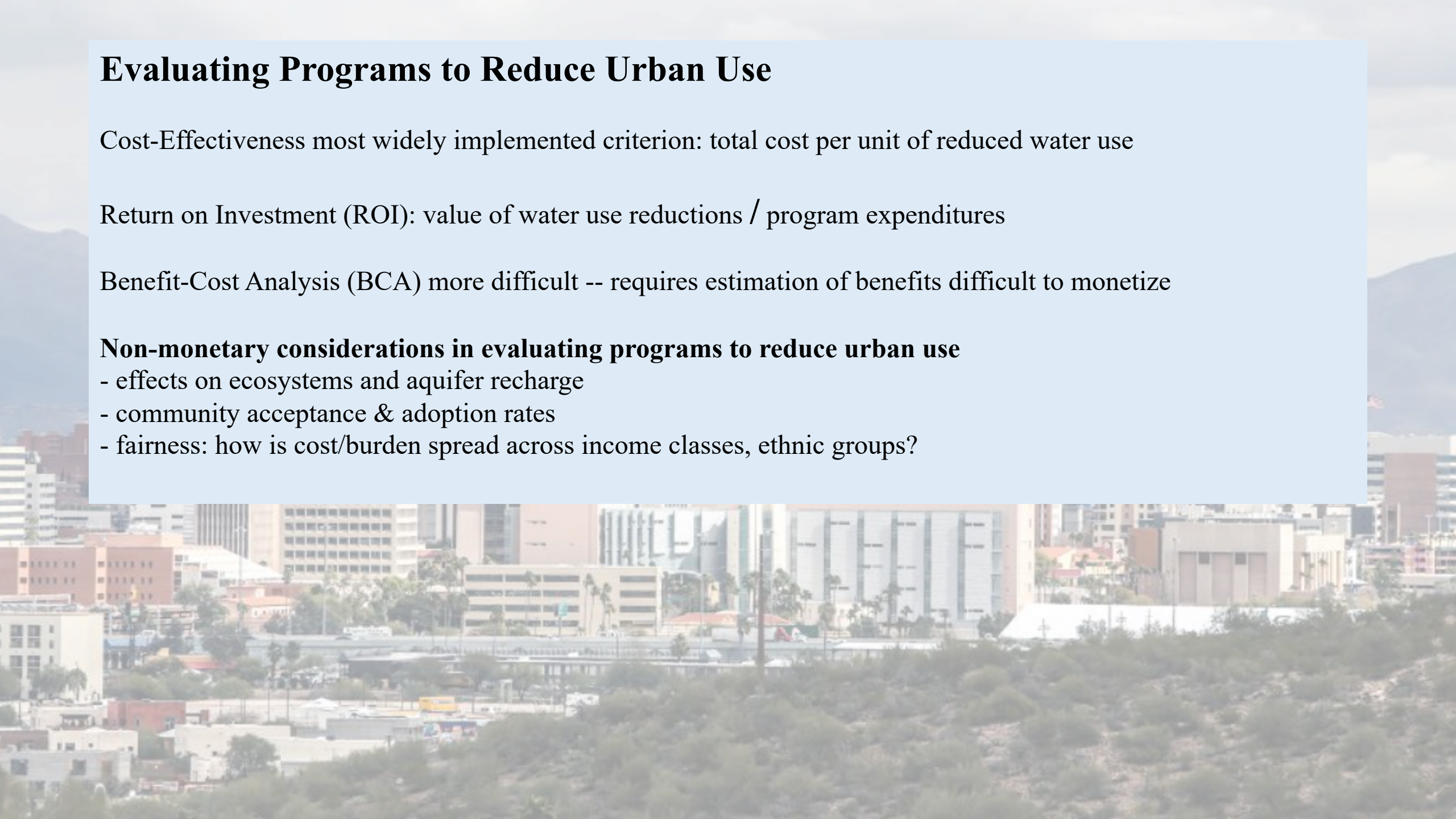
Cost-Effectiveness most widely implemented criterion: total cost per unit of reduced water use

Return on Investment (ROI): value of water use reductions / program expenditures

Benefit-Cost Analysis (BCA) more difficult -- requires estimation of benefits difficult to monetize

Non-monetary considerations in evaluating programs to reduce urban use

- effects on ecosystems and aquifer recharge
- community acceptance & adoption rates
- fairness: how is cost/burden spread across income classes, ethnic groups?



CRB now has many programs to protect watersheds supplying cities

Fires

- impair water quality
- reduce soil moisture
- diminish reservoir storage capacity
- exacerbate flooding

CRB cities are partnering with federal agencies and NGOs (Water Funders Initiative)

Evaluated using Cost-Effectiveness, ROI, BCA & effects on regional economy

Examples:

SRP Healthy Forest Initiative, Northern Arizona Forest Fund,
Upper Verde River Watershed Protection Coalition, Four Forest Restoration Initiative

Colorado Forests to Faucet program New Mexico Rio Grande Water Fund

(details and more examples provided in article)

Summary

Cities actively using water rates, other incentives to reduce per capita use and outdoor use

Urban use responsive to water rate increases (elasticity varies seasonally & over time)

Watershed protection programs becoming widespread and generating multiple benefits

Evaluation of program effectiveness becoming more widespread & systematic

Colby current areas of focus:

- economic activity effects on regional groundwater conditions
- innovative multi-sector agreements to adapt to shortages
- improved water negotiation protocols
- economic resilience and climate adaptation in rural West

bcolby@arizona.edu

<https://economics.arizona.edu/person/bonnie-colby>

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