Sustainability of water resource use and options towards increased resilience

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Introduction

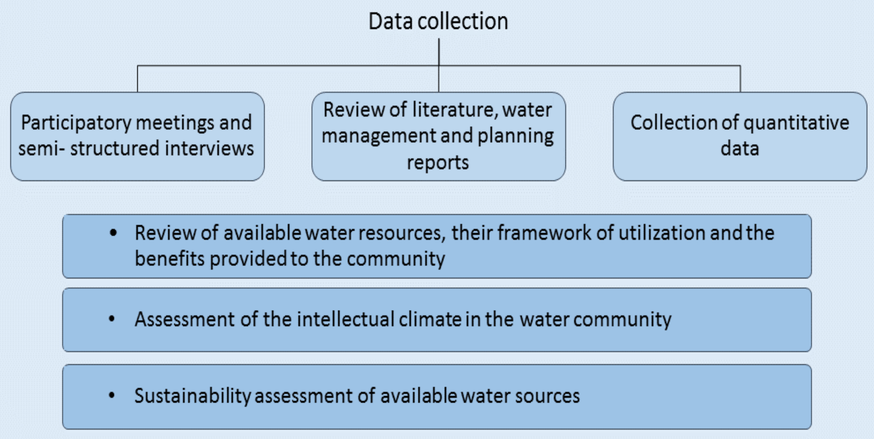
Problem statement

- Water management studies on regional and local scale consistently identify a gap between projected water demand and supply within a few decades throughout the Colorado River basin as well as the City of Tucson (ADWR, 2014, Tucson Water, 2012, USBR, 2012, WRDC, 2011).
- Relatively few renewable water resources are available in relation to the increasing demand. However, not all available sources are utilized significantly.
- New water sources and conservation strategies that help balance the gap between supply and demand need to be found for the Tucson Area in order to reach and maintain safe yield in the future.

Research question

- What is the potential of the available water sources for municipal and environmental use and how sustainable is their utilization?
- Under what circumstances could Tucson (as a social-ecological system) enhance the resilience of its water management in regards to water supply and environmental conservation?

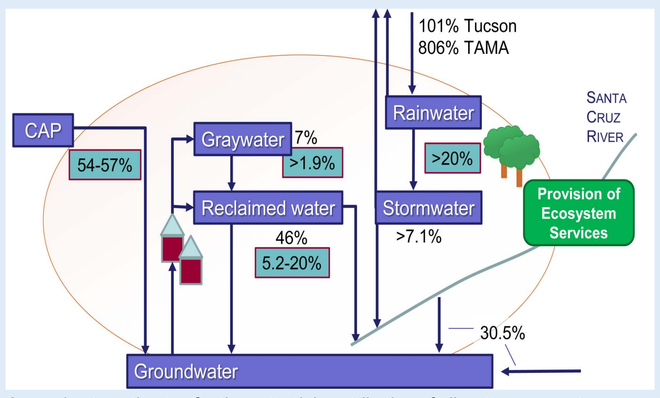
Methods



Insight on the dynamics and sustainability of the water supply system for municipal and environmental needs and understanding of potentials and benefits in order to increase resilience of Tucson as a social-ecological system

Results

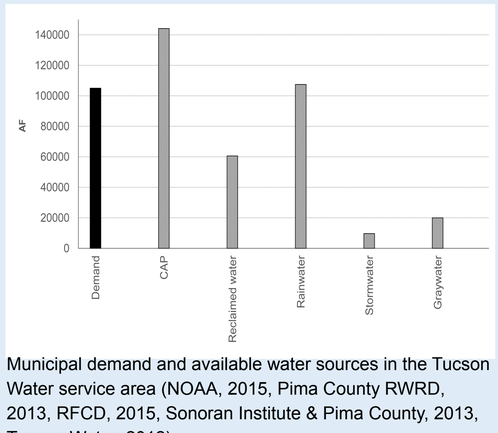
Characterization of available water sources



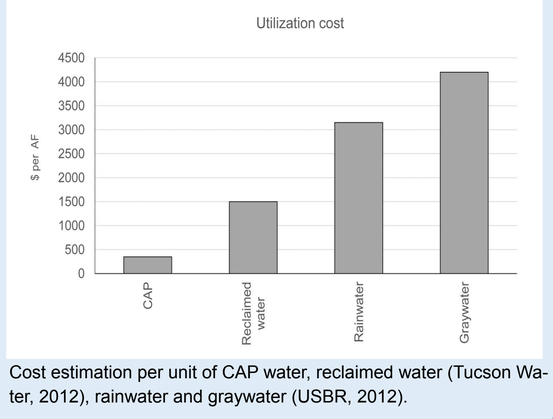
Approximate estimates for the potential contribution of all water sources to cover municipal demand in the TAMA 2025.

Municipal demand in the Tucson Active Management Area (TAMA) is projected to reach 310 mm^3 (251,018 AF) by 2025 based on the lowest reasonable water demand (ADWR, 2012).

The development of alternative water resources like rainwater, stormwater and graywater holds potential to cover more than 20% of projected demand. However, economic feasibility is currently the main obstacle for augmented utilization.



Municipal demand and available water sources in the Tucson Water service area (NOAA, 2015, Pima County RWRD, 2013, RFCD, 2015, Sonoran Institute & Pima County, 2013, Tucson Water, 2012).



Cost estimation per unit of CAP water, reclaimed water (Tucson Water, 2012), rainwater and graywater (USBR, 2012).

Insight to the water community

- Environmental groups and other non-profit organizations perceive Tucson as defined by a rather traditional water management view, focusing mostly on gray infrastructure, designed with relatively little innovations, and which could do significantly more to adjust its water supply and demand scheme to become more sustainable.
- Government representatives and water agency officials view Tucson as having an ensured water supply for a minimum of 25 years, with little change in practice or policy, and are therefore ahead of numerous other communities. Comparisons are often drawn between regulations and practices in Arizona and those in drought-affected California. Comparisons are also drawn between Tucson and other regions in Arizona that either have no access to CAP water or less underground storage and recovery capacity.

Ecosystem services provided by green infrastructure

Benefits of alternative water resource use for green infrastructure and urban vegetation include:

- provisioning services such as the reduction of of potable water used for landscape irrigation and food supply
- regulating services like urban heat mitigation, flood regulation and reduction of noise and air pollution
- cultural services including increased potential for recreation, tourism, educational systems and improved health and quality of life.

Sustainability assessment

	Renewable	Local	Reliability	Potable	No impact on water quality of the aquifer	Absence of instit. conflicts	Independent of energy intense system	Feasibility (cost)	Feasibility (effort)	Ease of use
Groundwater	-	+	-	++	+	-	+	+	+	++
CAP Water	+	-	-	++	-	-	-	++	-	++
Reclaimed water	++	++	++	+	-	+	+	-	-	+
Graywater	++	++	++	-	++	+	++	-	++	-
Rainwater	++	++	+	++	++	++	++	-	++	+
Stormwater	++	++	+	-	++	+	++	-	++	-

Conclusion

- Increased groundwater use in the future will be necessary if water demand develops as projected, calling for the intensification of conservation efforts. While CAP supply is threatened on the long term by climate change and institutional arrangements, Colorado River water will be the predominant source in the next decades. Intensified use of reclaimed water and treatment to potable standards will likely be necessary in the future in order to cover demand without further groundwater over-exploitation.
- The utilization of rainwater and stormwater has the potential to reduce pressure on the aquifer and cover more than 20% of municipal water demand in the TAMA. Graywater re-use could contribute up to 2% without affecting sewer flows. These sources can have significant impact on both water provision and re-greening of urban areas. Their utilization can be understood as an adaptive approach to reduce vulnerability and improve resilience of the social-ecological system.
- High implementation cost is currently the main constrain for the utilization of these alternative sources. Efforts of water managers, stakeholders from the environmental community and city planners should be coordinated to intensify research on best practices and cost-effectiveness.
- The integration of ecosystem services and the contribution of both riparian ecosystems and urban greenery to human well-being should be better integrated in cost-benefit analyses and water resources planning.
- The implementation of a specific stormwater utility that provides funding and service for municipal GI projects may be needed to utilize rainwater and stormwater in a significant and meaningful way.

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