

Navigating through Whitewater: Understanding the Challenges and Opportunities in the Colorado River Basin

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Many scholars working on the economics and policy of water in the Colorado River Basin benefited from ideas and research findings of works conducted in the Colorado River Basin over the years by Robert A. Young. Bob was a leading water economist, a teacher, a colleague, and a friend who inspired many of us with cutting-edge research dealing with economic aspects of water quantity and quality issues in the Colorado River Basin. This thematic issue on understanding challenges and opportunities in the Colorado River Basin is dedicated to the memory of Bob.

The Colorado River and its tributaries supply water to nearly 40 million people, both within and outside the Colorado River Basin (CRB), and irrigate almost 4 million acres of agricultural land (Crespo et al. 2023a,b). The Colorado River Compact of 1922 and its subsequent agreements and court decrees regulate the allocation and management of the Colorado River water among the seven basin states (Wyoming, Colorado, Utah, Nevada, Arizona, New Mexico, and California), Native American Tribes, and Mexico (U.S. Bureau of Reclamation, 1945).

The water system of the CRB currently faces significant challenges due to climate-change-induced aridification processes, overallocation issues, and proposed developments of new water uses. The U.S. Bureau of Reclamation (USBR) reports that the average flow of the Colorado River in the twenty-first century (12.4 million acre-feet) is so far about 18% lower than the twentieth-century average of 15.2 million acre-feet (USBR, 2021). Some scientists argue that these long-term climate-change-induced changes will continue to deplete flows and fundamentally alter the basin's hydrology, leading to aridification and a "new normal" of reduced runoff and lower river flows (Overpeck and Udall, 2020). These complex issues involve various stakeholders with diverse interests, including agricultural, hydropower, environmental, and municipal sectors.

This thematic issue of *Choices Magazine* highlights the challenges facing the CRB and explores potential solutions from multiple perspectives. The issue consists of seven articles, offering background information on basin-wide policies and regulations as well as analyses

Articles in this Theme:

- **Climate Crisis Is Straining the Colorado River's Complex Policy Architecture**
Frankel, Z., N. Halberg, M. Nemati, A. Dinar, and D. Crespo
- **Climate and Choice in the Colorado River Basin**
Booker
- **Economic Impacts of Climate Change on the Agricultural Sector of the Colorado River Basin**
Crespo, D., N. Mehdi, A. Dinar, Z. Frankel, and N. Halberg
- **Threading the Needle: Upper Colorado River Basin Responses to Reduced Water Supply Availability**
Asgari, M., and K. Hansen
- **Water Justice Concerns in the Colorado River Basin**
Colby, B., and Z. Reed-Spitzer
- **Agricultural Producer Decision-Making around Water Conservation in the Upper Colorado River Basin**
Mooney, D., and K. Hansen
- **Arizona Policy Responses to Water Shortage: Can They Have an Impact?**
Frisvold, G

of local policies at the state or regional levels. The articles focus on various sectors, including agriculture, Native American tribes, urban centers, and energy.

Frankel et al. (2024) present an overview of water resources in the CRB, examining current allocation and governance rules while evaluating their impact on effective management. The article provides background information on the various policies and regulations governing the CRB over time. It assesses how these policies and regulations have either created or limited opportunities for effective CRB management moving forward.

Booker (2024) presents future water supply and demand scenarios projected into the year 2100 to evaluate potential policy options. The paper addresses the choices that will confront water users and the institutions governing future allocations, emphasizing the economic consequences of different pathways. The study focuses on anticipated changes in supply and demand and the economic decisions required to adapt to these changes. Five supply-side sectors are considered: streamflow, risk reduction (managed by reservoirs and groundwater), wastewater recycling, brackish water desalination, and water imports. Additionally, five demand-side sectors are examined: irrigation for lower- and higher-valued agriculture, municipal and industrial uses, environmental purposes, and risk reduction (managed by institutions).

Crespo et al. (2024) focus on the impact of climate change on the agricultural sector, the major water user in the CRB. The results indicate that while alfalfa, hay, and cotton are affected by a reduction in water availability due to their large share of the total cultivated area, the impacts on net income at the basin level and within irrigation districts are relatively small compared to the amount of land left fallow. Net income losses from a 10% reduction in water availability are estimated at around \$8 million (about 1%), while losses for a 30% reduction are approximately \$69 million (or about 5%). However, there is significant heterogeneity across water districts in terms of the level of loss. Under extreme water scarcity, the reduction in water availability results in the fallowing of 606,000 acres of irrigated land, representing 28% of the baseline cropland. In this scenario, crops with higher water intensity and lower economic value are prioritized for fallowing.

Colby and Reed-Spitzer (2024) investigate various water justice issues concerning the tribal nations and acequias in the CRB and their involvement in CRB policies. Their findings reveal that many CRB tribes face ongoing barriers to participating in water transactions and shortage-sharing arrangements. Acequias members hold senior water rights that predate statehood, which are typically integrated into state water rights systems and can be sold or leased. However, individual water sales can weaken the collective strength of acequias.

Significant differences exist between tribal nations and acequias regarding water entitlements, access to reliable water supply, representation in policy-making, and community resilience. Both groups have historically been marginalized, although progress has been made in recent decades. Many water justice issues remain unresolved.

Asgari and Hansen (2024) explore the challenges and trade-offs faced by Upper Basin states as they navigate the 1922 Compact to fulfill their obligations to the Lower Basin. Changes in water usage and location are expected under curtailment or demand management programs, with varying impacts on communities depending on the scale and frequency of these policies. The article also discusses patterns of water transfers and exchanges and their implications for rural agricultural communities and ecosystem services. Additionally, Mooney and Hansen (2024) focus on agricultural water conservation programs (AWCPs) proposed to address CRB shortages. They evaluate the potential of AWCPs to conserve water from the perspective of agricultural producers in Colorado's Upper Basin, examining the technical and economic feasibility of practices such as fallowing, deficit irrigation, and crop switching.

Finally, Frisvold (2024) investigates several policy responses in Arizona, a lower CRB state, to the Colorado River water cutbacks, including (i) water supply augmentation, (ii) subsidies for the adoption of efficient irrigation technologies, and (iii) restricting foreign-owned operations of irrigated cropland. These high-profile responses have captured the attention of water policymakers in the state. This article considers how well these policies can address the state's water scarcity issues in a cost-effective, timely, or comprehensively.

The CRB plays a major role in the economy and livelihood of a main region of the nation, affecting also indirectly markets of agricultural products outside of the CRB. The fragile structure of the water economy and its present institutions have been challenged by changes in population trends and by climate change-induced water scarcity that will be worsened in the future. The purpose of this thematic issue is to provide the reader with a sample of works that represent the efforts to analyze sectoral and regional consequences of future water scarcity scenarios as well as ideas for possible policy interventions to address water scarcity and other impacts of climate change on the basin. While the sample of works has impressive coverage, it is still not comprehensive in that it excludes important issues such as the impact on and the protection of the environment and the fragility of the energy sector. These and other omitted issues due to space may be addressed in future thematic issues of *Choices Magazine*.

For More Information

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