

**The Role of Governance in Shaping Freshwater Management in America: Toward
Integrated Resources Planning**

Sara Hughes

National Center for Atmospheric Research

shughes@ucar.edu

Robert Wilkinson

University of California, Santa Barbara

Wilkinson@es.ucsb.edu

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Freshwater is one of the world's most precious resources, and managing it sustainably is a critically important goal. Fresh water and healthy aquatic ecosystems provide valuable services that society has come to depend on (Daily 1997). While many factors determine the outcomes of freshwater management in the U.S., the aim of this paper is to examine the extent to which we can attribute these outcomes to the operation and evolution of governance systems. In this paper, we refer to "governance" as the steering influence of the rules, decision making processes, and incentives provided by both governmental and non-governmental actors, including the private sector and civil society.

In short, while the principles and objectives for freshwater management have changed significantly over the last 100 years, governance has remained a key factor determining freshwater management outcomes in the U.S. Governance systems have helped to distribute authority and incentives in freshwater management; they shape our responses to social and environmental change, and they determine whose voices are heard, and in what decision making venues. In turn, governance systems have created freshwater management challenges and solutions, and they will continue to do so in the future. As society's goals for freshwater management change, our governance systems may also need to be changed. New challenges and expectations are confronting local, state and national level agencies in the U.S. that are designed to execute basic service functions in a static environment (Gleick 2003; Christian-Smith et al. 2012). Governance innovations – such as integrated resources planning and collaborative decision-making – have important potential to address these new challenges.

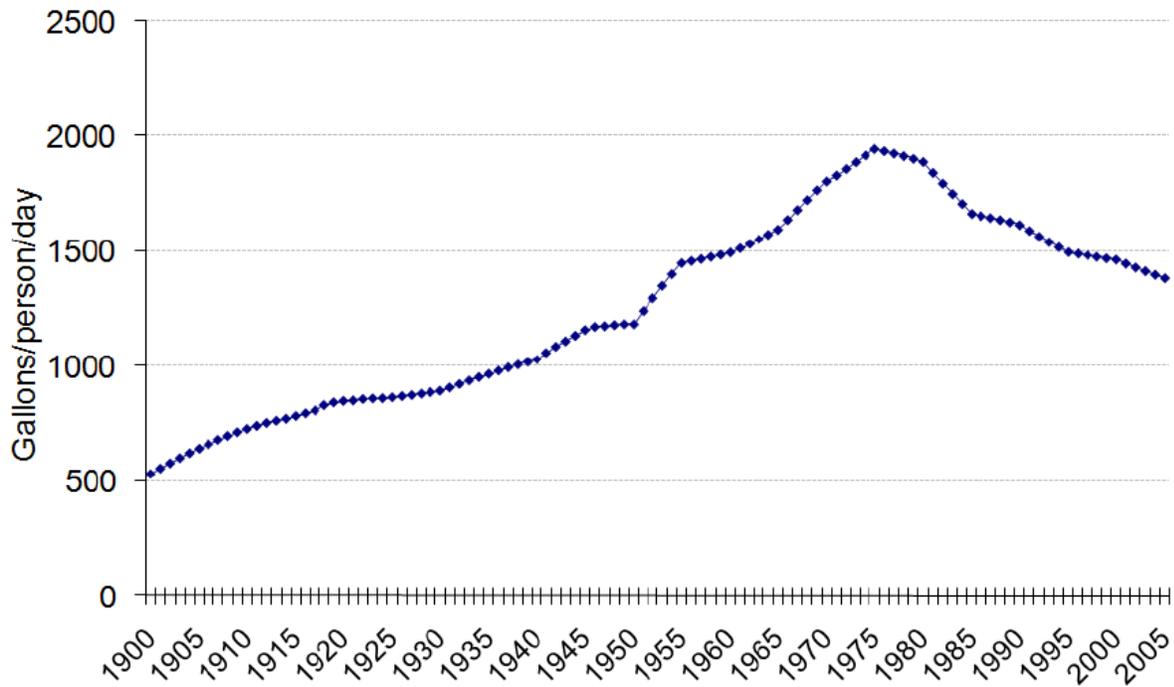
This paper examines the role of governance in U.S. freshwater management chronologically: first in the historic dam-building era of 1900-1970; second in the current demand-management era from 1970 to the present; and finally in the context of addressing the challenges of the future, including climate change and aging infrastructure. We conclude that innovations in governance are a key to achieving long-term freshwater sustainability in the U.S.

History of Freshwater Management: 1900 to 1970

In 1902 the U.S. government established the U.S. Reclamation Service – later to be known as the Bureau of Reclamation (<http://www.usbr.gov/>) – which had the task of overseeing and initiating water development projects in the western states. Together with the Army Corps of Engineers (established in 1802; <http://www.usace.army.mil/>), the Bureau of Reclamation became a lead agency in building water projects for irrigation, navigation, and flood protection in the U.S. In many ways the creation of the Bureau of Reclamation and the federal government’s intentions for water development are emblematic of freshwater management priorities between 1900 and 1970: to build large water projects, encourage settlement in the west, and expand irrigated agriculture in the U.S., all with an eye toward economic development. This also marked a shift from previously local and private freshwater management to development to public, large scale, and federally-funded water projects. From a management perspective, emphasis was on ensuring and expanding readily available and reliable supplies of water. Many water projects were also designed to generate hydroelectric power (the Bureau of Reclamation is the second largest producer of hydroelectric power in the Western U.S.), which often helped to justify the projects and helped to pay for them.

During this time of construction and supply enhancement, environmental impacts were largely ignored or discounted. There were no federal laws in place to require environmental impact assessments, and few protections for wildlife or the control of water quality. Per capita water use nearly quadrupled (Figure 1).

Figure 1: Per capita water use in the U.S. 1900-2005; per capita water use peaked in 1975 and has been declining (Source: Produced by Pacific Institute using data from the USGS)



There are two prominent examples from this time period of the large-scale federal efforts to develop water resources for the economic benefit for the country: the Tennessee Valley Authority and the Hoover Dam. Both projects were initiated as part of the country's efforts to combat the economic effect of the Great Depression.

The Tennessee Valley Authority (TVA) was established by the U.S. Congress in 1933 as part of President Roosevelt's New Deal. It was a unique entity, "a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise (letter from Roosevelt to Congress, April 10, 1933)". The TVA was essentially a development agency that used water projects – dams, channelization, and irrigation schemes – to (rather successfully) revitalize a depressed region of the U.S. Its jurisdiction covers most of Tennessee and parts of Alabama, Mississippi, Kentucky, Georgia, North Carolina, and Virginia. The water works projects of the TVA are administered jointly with the Army Corps of Engineers. To date, the TVA has 29 hydroelectric dams and a 650-mile navigation channel along the Tennessee River, and remains the largest regional planning agency of the federal government.

The Hoover Dam is perhaps the most visible federal water development project in the U.S. and one of the largest water development projects of the Bureau of Reclamation. The dam was built between 1931 and 1936 on the Colorado River, a river that had previously been considered uncontrollable. It was the largest concrete structure to have been built at the time, and today it supplies a portion of the water supply for over 8 million people and over 1 million acres (400,000 ha) of land in Nevada, Arizona, and California. Following the construction of the Hoover Dam, the federal government funded and built an average of ten large dams each decade and thousands of smaller dams (Reisner 1986).

Role of governance in the early period

The governance systems in place from 1900 to 1970 played a role in shaping freshwater management priorities and outcomes. A generally active federal government and, more specifically, federal subsidies encouraging western expansion and resource use, help to explain the emphasis on large-scale water projects and supply-side management in the U.S.

During this time period, and especially during the 1930s and 1940s, the federal government was playing a very large role in driving the U.S. economy and natural resource management. Programs like the New Deal and nation-building efforts, including irrigated agriculture, in the American West were products of the federal government's dominant governing role at the time. Water management and development was one piece of a broader federal agenda. This fact is exemplified by the projects funded by the River and Harbor Act (later to be called the Water Resources Development Act), legislation that was revised by Congress each year as a way of identifying and prioritizing water development projects. The 1940 version of the River and Harbor Act authorized funding for a long list of channels and flood control structures ("beneficial uses") to be built by the Army Corps of Engineers in states from Maine to Hawaii (P.L. 76-868, 1940).

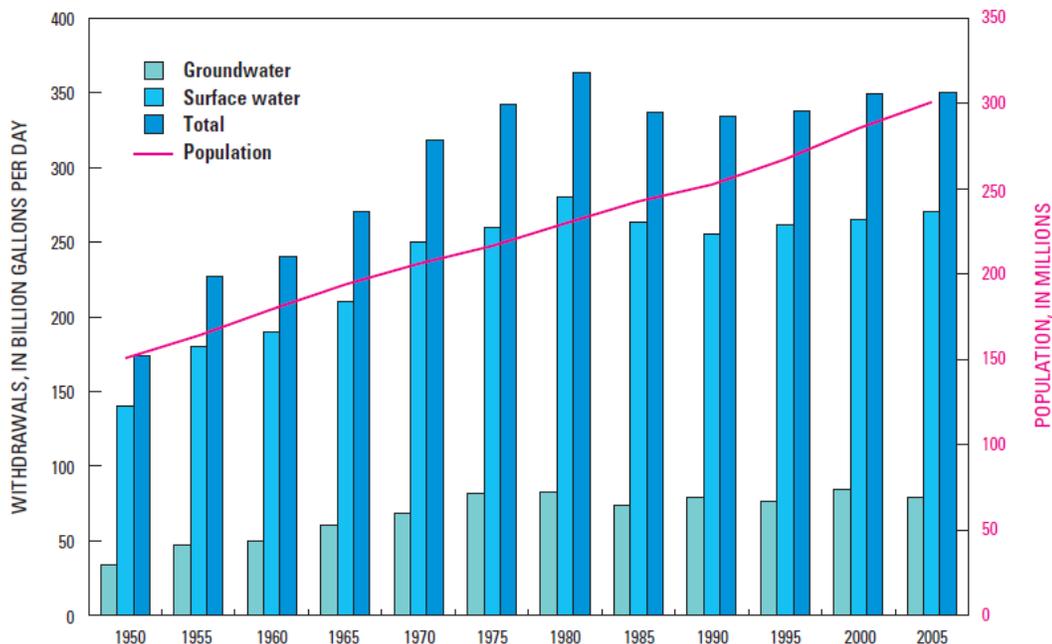
The rapid increase in freshwater use in the U.S. during this time, demonstrated by Figure 1, can be attributed in part to federal subsidies and other incentives to use water. The water supplied by large federal projects (including the TVA, Hoover Dam, and other projects) was sold at a price that did not recoup the cost of the projects, and power was explicitly subsidized. The western water rights doctrine of "use it or lose it" – if an existing water right is not put to beneficial use for a period of years, that right will be forfeited and become available to other users (AIER 2011) – also encourages inefficient water use.

In addition to governance, other factors were at play that shaped freshwater management in the U.S. between 1900 and 1970. The growing nation's energy needs helped to drive the push for big projects, and population growth contributed to rising demands.

Freshwater Management: 1970s to present

Since the 1970s there has been an important shift in freshwater management in the U.S. Per capita water use peaked in 1975 and has been declining since then (Figures 1), and total water withdrawals have remained fairly steady since 1980, despite a growing population (Figure 2).

Figure 2: Total freshwater withdrawals in the U.S. 1950 to 2005; withdrawals have remained steady since 1980 despite growing population (Source: Kenny et al. 2009)



Where previously the principles and objectives of water management had focused on supply, large projects, and increasing uses, beginning in the 1970s management priorities started to move toward demand management and freshwater ecosystem restoration and protection.

Water use efficiency and demand management measures have helped to maintain water withdrawals at a steady (or declining) volume since 1980; efficiency has particularly improved in irrigation and industrial water use (The Pacific Institute 2005), two large water uses in the U.S.

During this time we have seen water management priorities expanding to include environmental and ecosystem concerns and a more holistic approach to water resources management. For example, the 1974 Water Resources Development Act (P.L. 93-251, 1974) established an erosion prevention and control program for the Army Corp of Engineers, a study of how land use practices affect water development projects, and the acquisition of land for fish and wildlife resources and “environmental purposes”. By the year 2000, the Water Resources Development Act (P.L. 106-541, 2000) includes provisions for watershed management projects, ecosystem restoration, and even dam removal.

Role of governance since the 1970s

As in the earlier period, governance systems played a role in shifting freshwater management priorities and outcomes toward demand management and environmental protection. Many of the water sector’s most pressing problems today are the result of policies that failed to consider the long term or environmental consequences (Folke, Colding, and Berkes 2003; Gleick 1998; Hanak 2007; Hundley 2001). Dams were once the go-to solution for meeting expanding water supply, but they are expensive and are receiving declining political support. As a result, local and state water agencies are increasingly engaging in innovative, adaptive governance

processes such as demand management and environmental protection, entering new markets and adopting new technologies (Brown, Farrelly, and Keath 2009; Lach, Ingram, and Rayner 2005; A. Roy et al. 2008).

There has been a shift from a strong federal role to more decentralized decision making broadly in U.S. government, which extends into freshwater management. Federal government funding for large water projects declined dramatically in the 1970s and has remained low ever since (Carter and Stern 2011). The lack of federal funding for projects and the accompanying fiscal decentralization means that demand management (a cheaper and less capital-intensive alternative to dam building) is now a more attractive option for local water providers who can no longer rely on unlimited supply development. In many places demand management and efficiency measures have now been institutionalized. For example, the state of California has a set of Best Management Practices for urban water conservation that have helped to demonstrate the effectiveness of measures like low-flow toilets and outdoor irrigation efficiencies (Hughes 2012a). And while the federal government may not be funding large infrastructure projects, federal funding opportunities have spurred local water suppliers to develop new water sources such as recycled water (Hughes 2012b). In fact, federal law now requires efficient plumbing devices throughout the U.S. (U.S. Energy Policy Act, H.R. 776, 1992); the changed reduced the water use of toilets to 1.6 gallons per flush (Blanco et al. 2012).

There have also been broad changes in environmental governance that have had significant effects on freshwater management. For example, the passing of the Endangered Species Act in 1973 set guidelines for establishing minimum flow levels for fish species, and the National Environmental Policy Act requires environmental impact assessments for new projects. Perhaps the best example of how these broader governance changes have shaped freshwater

management objectives and priorities is the city of Los Angeles (Hughes, Pincetl, and Boone (Forthcoming)). In this case, regulatory changes reduced the amount of water available to be delivered to the city, while political and institutional changes within the city generated a demand for more environmentally-oriented water management strategies. These changes in governance have led the city to increase its focus on demand management – the city’s population grew by 1 million people between 1980 and today but water use has remained constant – and to participate in ecosystem restoration efforts at the headwaters of their water supplies.

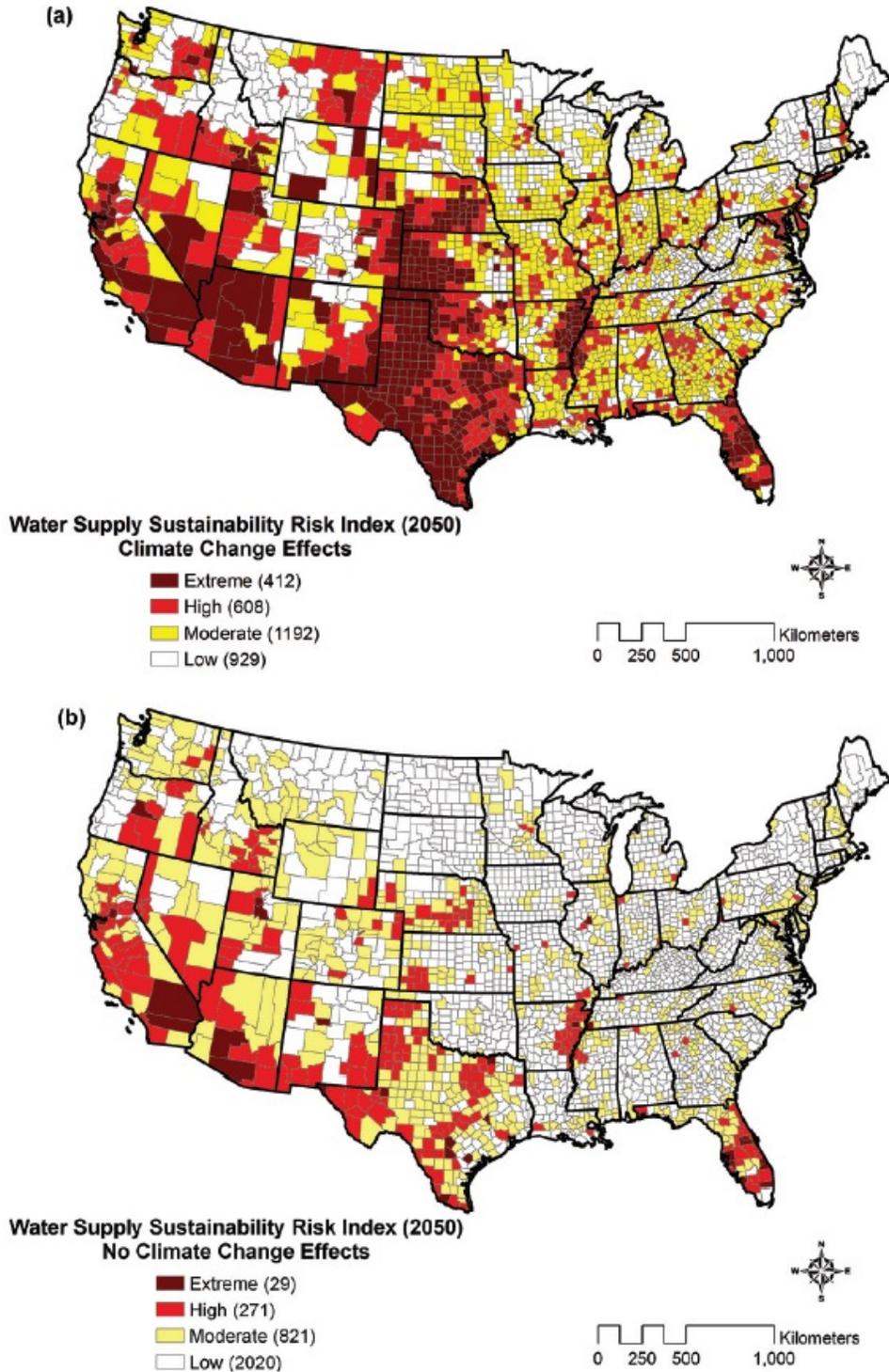
In addition to governance, other factors have helped to drive the shift in freshwater management observed between 1970 and the present. Increasingly visible environmental problems (e.g., species declines and water contamination), floods and droughts, shifts in environmental values, increased competition and scarcity concerns, and rising energy costs have helped shape the new focus in freshwater management.

Looking Forward: What do we need from freshwater governance in the U.S.?

The shift from supply-side approaches to demand management and diversification of sources has helped to curb growing freshwater use in the U.S., and the increasing emphasis on environmental restoration and protection is helping to improve the quality of our aquatic systems. However, challenges remain. In many places water resources are fully (or over) allocated, damaging ecosystems and degrading water quality. While some emphasis is being placed on watershed management and environmental protection, in some cases these considerations are secondary to political interests. Decision-making about freshwater management often occurs in isolation from decisions about land use, energy, and health.

In addition to these challenges, the U.S. also faces two looming threats to freshwater sustainability: climate change and aging infrastructure. Freshwater management strategies have been developed under a particular set of climate patterns and energy prices. Both of these are likely to be affected by climate change and will require a significant amount of adaptation by water providers. Climate change will increase the potential for water supply sustainability risk (accounting for water use, development, susceptibility to drought, growth in water withdrawal, increased need for storage, and groundwater use) in many areas of the U.S. (S. B. Roy et al. 2012; Figure 3).

Figure 3: Water Supply Sustainability Risk Index in 2050 (a) with available precipitation computed using projected climate change and (b) with available precipitation corresponding to 20th century conditions, i.e., 1934-2005 (Source: S.B. Roy et al. 2012).



New climate patterns mean that the timing, magnitude, and distribution of water are already changing in many places and are predicted to change in most (Arnell 1999; Barnett et al. 2004). Current and predicted changes in climate patterns have significant implications for where, when and how much water is available to meet economic and environmental needs. Most research suggests that the risks of climate change are likely to worsen water supply (Gleick 2010). Water planners and governments will need to adjust to these changes and can work now to anticipate the consequences for their water supply systems. Many water observers are suggesting that water agencies enhance the adaptive capacity of their management strategies and integrate climate change into water planning.

The second new challenge will be replacing aging water infrastructure, either with similar systems or with new approaches better suited to future conditions. In 2009 the US EPA produced their fourth report to Congress titled *Drinking Water Infrastructure Needs Survey and Assessment*. The report found that, “the nation’s drinking water utilities need \$334.8 billion in infrastructure investments over the next 20 years (U.S. EPA 2009)”. This gap is largely the product of deferred maintenance, new regulations, inadequate capital replacement, population growth, and a generally aging infrastructure (U.S. EPA 2002; U.S. EPA 2009). In the U.S. “the local tax base in many places is obsolete, and federal and state aid continues to decline. Local taxpayers want more and better services, but are unwilling to pay for them” (Morgan and England 1999). At the federal level, there is a lack of political support in Congress to support infrastructure funding because it is often seen as earmarks and many feel the government should be prioritizing deficit reduction over new investments (Cooper 2011).

With the loss of national subsidies for new large-scale water systems of any kind, the financial burden for new water projects is falling on local users, who are themselves financially

constrained (Gleick 2010). The growing need for infrastructure upgrades and replacement is an important opportunity for testing and expanding alternatives – such as “green” infrastructure and decentralized systems – and many communities in the U.S. are taking advantage of this. Many would like to see the conversation about water infrastructure shift from “how much infrastructure do we need?” to “what kind of infrastructure do we want?” This infrastructure funding gap may also be a place where the private sector becomes more involved in water management in the U.S. (Goldman Sachs 2013).

Governance Innovations: A key to sustainable freshwater management in the U.S.

We have established that governance plays a role in determining freshwater management outcomes in the U.S. Addressing the current and future challenges in freshwater management will require new governance approaches. There are many new approaches to water management that are emerging in the U.S. It is yet to be seen what their impact will be on freshwater resources, but they are promising.

New integrated water management approaches are one promising governance innovation for freshwater management. Integrated management typically seeks to establish tools and processes with which decisions about freshwater management can be coordinated across areas of water management (e.g., sanitation and water supply); geographic areas of water service (e.g., regional planning); or sectors (e.g., water, land, health, and energy). There are several examples of states and local areas that have initiated integrated strategies for freshwater management.

Both California and Oregon have developed integrated freshwater management programs. In 2008 the state government of California initiated a strategy to increase collaboration in freshwater management by passing the incentive-based California Integrated

Regional Water Management Planning Act (IRWM Act) (Hughes and Pincetl Forthcoming). The aim is to, “encourage local water agencies to cooperatively manage their water supplies for regional benefit, that coordination among agencies will improve regional water management, and that the framework provided by the bill is intended to facilitate that regional coordination (Costa 2002, vol. Section 10530, sec. Section 10530).” Funding for the program was approved by voters in 2002 (\$380 million) and again in 2006 (\$180 million) (Griffin, Leventis, and McDonald 2010; Lubell and Lippert 2011). The program is based on an incentive system in which state funds for local project planning and implementation are conditional on the project being proposed to and vetted by an IRWM decision making body. The IRWM Act states that at a minimum a region consists of a set of neighboring local agencies and that it will maximize opportunities for integrated water management and integrate programs within the funding area. The approved regions then write planning and implementation grant proposals for water supply, water quality, and water development related projects. To date there are 49 approved IRWM sub-regions within the 11 funding areas (Figure 1) and approximately 25 of these have applied for grant money (Griffin, Leventis, and McDonald 2010).

The state of Oregon has also recently developed an Integrated Water Resources Strategy (IWRS) (State of Oregon 2012). The IWRS is the outcome of legislation passed by the Oregon Legislature in 2009 (House Bill 3369). The aim of the new strategy is to integrate different aspects of water management into a comprehensive planning framework, meaning “unlike traditional water supply plans, this Strategy considers in-stream needs...along with out-of-stream needs...including water quality, water quantity, and ecosystem needs (State of Oregon 2012).” Two key components of the IWRS are (1) taking stock of the state’s freshwater resources and

water demands and (2) preparing for “coming pressures” including climate change, improving coordination between water and energy and water and land use, and upgrading infrastructure.

A more local-level example is the Integrated Resources Plan developed by the city of Los Angeles (Hughes, Pincetl, and Boone (Forthcoming)). In the past the Los Angeles Department of Water and Power (LADWP, the agency responsible for water delivery) was a relatively independent and single-purpose, powerful agency. However, this is changing and today LADWP is collaborating with other departments. A prominent example is the recent collaboration between the LADWP and the Bureau of Sanitation to develop an Integrated Resources Plan for water in the city. The development of recycled water (wastewater that has been treated for purposeful reuse) has been a key component of this collaboration because it requires direct and continuous collaboration between the two agencies – the Bureau of Sanitation, which is responsible for the collection and treatment of wastewater and LADWP, which has the responsibility of then delivering the treated water to customers in the region.

Collaboration in watershed management is another governance innovation gaining traction in the U.S. Sabatier et al. (2005) have gone as far as calling the current period of freshwater management the “Collaborative Era,” noting that,

“collaborative watershed institutions are marked by (1) the use of hydrographic watersheds as the principal jurisdictional boundary, (2) the involvement of a wide variety of stakeholders (including interest groups, experts, and agency officials from multiple levels of government), treated more or less as equals; (3) a reliance on face-to-face negotiations with agreed-on procedural rules (and often a professional facilitator) designed to ensure civility and engender trust; and (5) a fairly extensive fact-finding

phase designed to develop a common understanding of the seriousness and causes of relevant problems (p. 49).”

The shift to collaboration is notable in that it replaces traditional agency practices with more collaborative approaches, a large range of government and non-governmental actors are involved, and decision making is not left to bureaucratic experts (Sabatier et al. 2005). The emphasis on process is part of a broader shift in environmental governance toward “new environmental policy instruments” (Fiorino 2006). While not all watershed collaborations have been successful, we are beginning to understand some of the conditions for their success.

Challenges to Governance Innovation

Changing the governance systems of freshwater management is not easy, in part because water reform is filled with political risk (Dinar, Balakrishnan, and Wambia 1998) and water agencies are notoriously risk-averse, driven by a desire to minimize their public profile (Lach, Ingram, and Rayner 2005). Our governance systems play a role in shaping the incentives water agencies have to take on these risks; they can thwart efforts to change urban water management practices and are also essential processes in achieving change. However, the mechanisms through which they exert influence and the variation of outcomes they produce are not well studied. In fact, "institutional research, as it relates to water resources, has unfortunately been negligible in the past decade or two at a time when new and innovative institutions will surely be part of the solution to the world's emerging water problems" (Jury and Vaux 2005). In the U.S. changing governance systems is often a slow process due to many checks and balances in our federal system. It may be that we will witness the types of change that many analysts think are

necessary for freshwater sustainability when the system reaches a crisis point: “state changes arising from periods of crisis are irregular but not infrequent occurrences (Young 2010)”.

Cumulative changes in regulations, politics, and climatic conditions can initiate these conditions and lead to change, as is the case in Los Angeles (Hughes, Pincetl, and Boone (Forthcoming)).

As we continue to experiment with governance innovations we will learn more about the types of changes that are feasible and sustainable.

Conclusion

Freshwater management in the U.S. is shaped by dynamic governance systems at multiple scales. From 1900 to 1970 the focus of freshwater management was on large water development projects, expansion and irrigated agriculture – the “beneficial uses” of the country’s freshwater resources – and water use increased rapidly. This was due in part to an active federal government intent on using freshwater resources to further the economic development aims of the U.S. In the 1970s the focus of freshwater management shifted to demand management and environmental protection, and per capita water use has remained constant or declined until the present. This shift was due in part to a decentralization of authority and reduction of federal support for supply projects, as well as broader environmental legislation and regulatory efforts. As a result we are seeing some improvement in some of our aquatic systems, but there is still work to be done. Governance innovations such as integrated resources planning and watershed collaborations hold some promise to achieving sustainability in freshwater management in the U.S.

While the principles and objectives underlying freshwater management approaches have changed significantly over time, governance remains a primary determinant of freshwater

management outcomes in the U.S. since 1900. It is therefore critical that changing our governance systems plays a role in addressing our remaining freshwater sustainability challenges. Unfortunately, previous prescriptions for reforming urban water management have not often resulted in changes in practice. Many of the same ills that plagued the sector in the 1970s, the UN Decade of Water, and in the 1990s, when a “water crisis” was declared (Gleick 1993), seem to pervade today. Successful experiments with new approaches – like those in California and Oregon – provide useful models for the ways in which governance changes can take place. Increasing stress on freshwater management systems is also likely to be a driver of change. Given the importance of freshwater resources to the people, economy, and environments of the U.S. achieving sustainability in this sector is of the utmost importance.

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