Innovation and New Public Water

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Abstract

Technological innovation has made significant improvements to water services but water delivery remains largely unchanged since Victorian times. This is because water is an essential, non-substitutable resource with little potential for economies of scale. By contrast, there has been dynamic innovation in the *governance* of water services, with privatization now giving way to a significant shift back to public ownership and management, with new and creative forms of societal engagement. This article reviews these governance changes through the lens of a 'hydrosocial cycle', arguing that innovations in 'new public water' can only be achieved by recognizing how water-society relations take place.

Policy highlights

- A review of the history of technological innovation in the water sector and the extent to which technological use and uptake differs (or not) between public and private water operators
- A review of the meaning of the 'hydrosocial cycle', how it compares to a 'hydrological cycle' and its implications for innovative water governance
- A review of the changing nature of water governance over the past 150 years
- A discussion of the growing shift back to public water management globally, with a focus on how the hydrosocial cycle is informing innovative policy making strategies amongst a new generation of public water operators

Keywords

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Introduction

Proponents of water privatization have long argued that private ownership of water services encourages technological innovation. Self-maximizing individuals in private firms, it is argued, are forced by competition to constantly adopt new technologies in an effort to reduce costs and win contracts. Public sector bureaucrats, by contrast, lack the incentives needed to seek out technological change, preferring instead to protect the status quo (Johnson and Walzer 2000, Levin and Sanger 1994, Windrum and Koch 2008).

In reality, there is no evidence to support these claims. Public water operators appear to employ the same technology as their private sector counterparts, and there is ample indication of innovative use of technology in the public sector (Demircioglu and Audretsch 2017, Gil-Garcia et al 2014, Torfing 2016). There may be variations in how

technologies are employed, but for the most part public and private water operators use the same equipment, provided by the same third party suppliers.

The reasons for this technological parity are inherent to the biophysical limitations of water itself, and the fact that water is an essential resource demanding risk-averse management. Even if private water companies were inherently more technologically innovative than their public sector counterparts the implementation choices available to them are limited by the nature of the water services they are trying to provide.

Innovations in water *governance*, on the other hand, are dynamic, with dramatic changes and fluctuations having occurred over the past 150 years. The most recent and widespread of these innovations have been neoliberal forms of water governance, which have seen the introduction of market-driven pricing, privatization, and individualized consumption (Bakker 2010, Castro 2007, Harris and Roa-Garcia 2013). Much of this reform has been driven by private water companies, but public water operators have played a significant role in commercialization as well, with a dramatic increase in stand-alone water utilities that operate much like private firms, with a focus on their financial bottom line (Furlong 2010, McDonald 2014).

A new generation of public water operators has also begun to emerge, however. These new public water agencies are rejecting neoliberal logics while at the same time challenging older statist models of water governance that were driven by top-down welfarist and socialist-era planning. They are reclaiming and reimagining what public water services look like. And although there is no singular form of 'new' public water there are innovative characteristics that serve to redefine the nature of innovative governance in the water sector today.

The paper begins with a review of technological change in water services, laying out the scope of innovation in the past, as well as its inherent limitations for the future. I then examine innovation trends on the governance side, using the concept of a 'hydrosocial cycle' to identify and evaluate what I argue to be fundamentally new forms of public water management. My intent is not to suggest an 'ideal type' of governance innovation, but rather to highlight the relative importance of hydrosocial relations to the re-invention of public water, and to concretely illustrate what these changes look like in practice. None of these reforms are guaranteed to work at all times in all places, but they do signal a fundamental shift away from the dominance of technocratic and market-driven forms of water governance towards more democratic, equitable and sustainable forms of public water service innovation in the future.

It Ain't Rocket Science

Innovations in material science, information systems and other forms of technological advance have transformed many public services. Electricity, in particular, is undergoing revolutionary technological change, with new discoveries altering the ways in which energy is produced, stored and distributed. On the production side, improvements in solar, wind, tidal, thermal and other forms of energy creation have opened up a broad

array of new sourcing possibilities. Energy storage is also undergoing rapid change, most notably with new battery developments. So too is the distribution side changing, with blockchain technologies and decentralized networking systems serving to decrease leakages and strengthen the robustness of larger grids (Swan 2015, Gil-Garcia et al 2015, Murkin et al 2016, Morris and Jugjohann 2016). As an indicator of this change, investments in electricity production surpassed that of oil and gas in 2016 for the first time in history (IEA 2017, 2). Similar technological disruptions are taking place in health care, transportation and other service sectors (Blyth et al 2016, Hwang and Christensen 2008)

Water services are not without their own technological innovations. Improvements in water treatment, leak detection/repairs, nutrient recovery, energy reduction, piping materials and water recycling/desalination have been significant, while advanced computerization and information technologies have changed the ways in which water services are managed (eg. smart metering and web-based digital mapping) (Gil-Garcia 2012, Giusti et al. 2013, Stewart et al 2010). There are countless books, journal articles and conference reports dedicated to technological change in the water sector, as well as websites mapping examples of innovation from around the world (eg. the OECD's Observatory of Public Sector Innovation). There is enormous excitement, in particular, about the potential for artificial intelligence to "transform" the water services industry (Badruddin 2017).

But as important as these technological innovations have been they are necessarily limited and incremental in nature when it comes to the delivery of potable water (a more dynamic set of technological innovations are at play with sanitation, but are beyond the scope of this paper (eg. Jenkins and Sugden 2006)). For the most part, water collection, treatment and distribution remains the same as it was "in the Victorian era": it is extracted, cleaned and pumped through a network of pipes. Thomas and Ford (2005, 9-10) use this fact to point to a "crisis of innovation", noting that the water sector "as a global whole unquestionably lags behind even the average rate of progress of technical change and institutional development of the societies in which they operate".

There are several reasons for this slow pace of change. First, water is an essential service and cannot fail. As such, water operators and their regulators are inherently risk-averse and unwilling to adopt uncertain technologies. Second, water is a non-substitutable good. Even if water operators and regulators were willing to take risks the options for innovation are extremely limited. Unlike sectors such as health care and energy – where different technologies offer multiple choices of end products – water's physical characteristics do not change. Water is water is water; there are no known substitutes. Developments in desalination have pried open some alternative sourcing possibilities but this is a proverbial drop in the bucket relative to global demand for freshwater (and actually delivers a sub-standard product in the end) (Gaffour et al 2015, Liyanaarachchi et al 2014).

Third, the fact that water is heavy and difficult to transport means that it is largely a local good: treated, distributed and consumed within a relatively small distance. Efforts to

divert water long-distances to overcome this problem have been impressive – from Roman times to China's current South-to-North Water Diversion Project – but these diversionary schemes are mere brute-force engineering, and have done little to advance water technology or transform the local nature of water challenges. In China's case, it merely "buys a little time in which to get water policies right", despite being the "most expensive infrastructure enterprise in the world" (Economist 2018, 35-6; see also He et al 2014).

In short, the biophysical characteristics of water fundamentally limit its potential for technological disruption. Little wonder then that "the water industry is notoriously slow to implement change, often embracing tradition and tried-and-true methods for achieving their goals". Expecting water utilities to "increase the importance of innovation within the current environment is perhaps naïve" (~~Speigth~~Speight 2015, 302).

Is there any difference in this respect between public and private water operators? Remarkably, there is no systematic research comparing the uptake or application of technologies by public versus private water utilities. We are left with little more than anecdotal evidence and meta-analytical reviews, both of which suggest very little difference between the two. Despite claims that private water firms are "making waves in innovation" (Clancy 2014, 1), in practice they are bound by the same biophysical constraints and risk-averse regulatory standards as their public sector counterparts. Private water companies have no magical inventions to offer. In fact, public and private water utilities "generally rely on [the same] external parties, either research institutions or supply chain companies, to perform the research work and deliver pre-tested advances" (~~Speigth~~Speight 2015, 302), with external R&D agencies equally keen to sell their products to public and private buyers (as any water industry trade show attests to).

Thomas and Ford (2005, 12) go so far as to argue that private water companies are "exemplar" of a lack of innovation, pointing to the UK water sector in particular. ~~Speigth~~Speight (2015, 302) supports their argument, noting that UK water companies "are reported to invest just over one half of one percent of their capital expenditures on research and development."

Macro comparisons of public and private water operators reinforce this point, with overall operational efficiencies showing no significant difference between public and private agencies on a global basis, suggesting no substantial variance in the uptake and employment of productivity-enhancing technologies (Bel et al 2010). Indeed, it is the very lack of difference in efficiencies which appears to have prompted many towns and cities to remunicipalize their water services, recognizing that water can be provided in-house for the same cost (or less) than by private firms (Hefetz and Warner 2004). The city of Paris, for example, saved 35 million euros a year after ending its private sector contracts in 2010, even after having to rebuild an entire IT system because the private companies refused to pass along their data and software (Pigeon 2012).

If there is any difference in the way that technology is employed between public and private water agencies it may be related to its impact on revenues and profitability.

Technologies that enhance cost recovery and serve to discipline nonpayment (prepaid water meters for example) appear to be popular with private companies (and commercialized public ones) (Bond 2004, Ruiters 2007). Technologies that reduce water revenues on the other hand – such as water saving devices in households – may be less likely to be adopted by private firms because they can reduce revenues. Again, there is no systematic research on this topic, but anecdotal evidence lends support to these conclusions.

In sum, technological change has had limited effects on the water sector, and there is no evidence that private firms are inherently better at adopting innovative technology than public ones (or vice versa). This is not so much a "crisis" in technology as a recognition of water's biophysical restrictions and the limits these place on technological innovation.

The real "crisis" in water services lies in the fact that 700 million people do not have access to safe potable drinking water around the world, with profound social, economic and environmental consequences (WHO/UNICEF 2015). No amount of technological innovation is going to resolve this crisis. Innovations in governance are what is required.

Innovation in Governance

Fortunately, the potential for innovation in water governance is enormous. Evidence of this can be found in the dramatic swings in water management practices over the past 150 years, shifting back and forth between public and private ownership, with variations in scalar organization, pricing systems and state-society relations. From municipal socialisms to neoliberal privatization, water governance has undergone frequent and considerable change (Castro 2007, Djanibekov et al 2016, Finewood and Holifield 2015, McDonald 2016a, Swyngedouw 2014).

But much of this governance has also been dominated by a (Western) scientific understanding of the 'hydrological cycle' – a belief that water has universal properties that render it "the province of agencies and experts with technical knowledge…and the power to engineer it" (Linton and Budds 2014, 171). As such, modern water governance – be it on the left or the right of the political spectrum – has tended to be fixated on technology. Socialist and welfare-era water services were dominated by this hydrological perspective – "characterized by an emphasis on the development of water supplies by state agencies, the view of water as a resource to be exploited, and the equation of water management to hydraulic engineering" (Linton and Budds 2014, 171-2; see also Sehring 2009) – as are neoliberal models, with their emphasis on business-like management (Bakker 2010). The goal, it seems, has been to strip social meaning from water, rendering water governance a seemingly apolitical act.

A new breed of public water operators, by contrast, has begun to flip this hydrological cycle on its head. Instead of trying to find technological solutions to every water challenge, they have begun to take seriously the notion of a '*hydrosocial cycle*', putting social meaning at the center of water governance, examining the "socio-natural process

by which water and society make and remake each other over space and time". Rather than treating water as homogenous and apolitical, the hydrosocial cycle "directs analysis towards the hybrid nature of different waters by attending to water's different states, forms and qualities, which make it act and give it meaning in distinct ways". As such, the hydrosocial framework acts "as an analytical tool by compelling us to look for relations and patterns that we might otherwise ignore" (Linton and Budds 2014, 170, 176-7; Swyngedouw 2009).

Not all 'new' public water operators employ this hydrosocial lens, and few would utilize such academic language, but there is an emerging practice of public water governance which has moved explicitly away from techno-centric management practices in an effort to ~~hydrosocial perspective allows them to~~ engage differently with the physical properties of water and to better incorporate ~~as well as~~ water's varied cultural and political interpretations. Some of this rethink is coming from existing public water operators, but the most dramatic changes are to be found in the growing phenomenon of remunicipalization, with newly constituted public water utilities not only taking back public control of water services but also rethinking what water means in a democratized public sphere.

Over the past 15 years there have been at least 267 cases of water remunicipalization in 37 countries, affecting more than 100 million people (Kishimoto and Petitjean 2017). Not all of these remunicipalizations have been done for progressive reasons – some have been undertaken by autocratic governments wanting more control over water services and some are being run like private companies once back under public control (McDonald 2018) – but there are disruptive forms of hydrosocial remunicipalization taking place, and it is these cases that I will focus on in the remainder of this paper.

The most widely studied and celebrated of these examples are social-democratic governments introducing more equitable pricing policies and sustainable environmental management systems (Heller 2007, Spronk et al 2014, Tankha and Fuller 2010). There are also cases of anti-capitalist states and civil society movements searching for non-commodified forms of water delivery (Spronk and Webber 2007, Terhorst et al 2013) as well as anarchist/autonomist movements seeking alternative ways of delivering water that are not controlled by state or corporate interests (Driessen 2008, Gorostiza et al 2013, Marston 2013). These new public water operators are profoundly changing the ways in which water is governed, rethinking managerial structures and approaches to equity. Much of this innovation is motivated by a rejection of neoliberalism, but it is also a refusal to return to a supposedly golden-age of welfarism or socialism, where public management was often top-down, exclusionary, opaque and blindly technological and productivist in its orientation (*cf* Newman and Clarke (2009) for a discussion of the UK experience in this regard).

I will highlight three particularly important areas of governance innovation that these new public water operators are exploring: co-production, de-commodification, and public-public partnerships. While not the only forms of hydrosocial innovation taking place (and still only practised by a minority of public water operators worldwide), these

innovations are nevertheless fundamentally different in theory and practice to the dominant hydrological water governance practices of the past. They are disrupting the commercialization pressures of contemporary neoliberal water services while at the same time distancing themselves from the overly bureaucratic water management practices of state-centric water systems of the welfare era.

Although far from perfect – and not without their own internal contradictions and tensions – the hydrosocial principles outlined here represent some of the most innovative models of water governance reform in a century. Other public water operators are taking notice, with some water agencies forming new clusters of progressive public water associations to share best practices amongst themselves, often in collaboration with trade unions and citizen groups (eg. Aqua Public Europea, the Catalan Association of Municipalities and Entities for the Public Management of Water, RedVIDA).

It is not my intent to suggest that 'new' public water operators are the only ones introducing innovative governance practices. Many private and commercially-run public water operators have adopted similar-sounding reforms, with 'public engagement' and 'sustainability' being central to the rhetoric (if not the practice) of most water operators in the world today (Sharp 2017). My argument – as we shall see below – is that a new breed of public water operators is offering a fundamentally different approach to such governance innovations – ones that involve citizens in meaningful ways, which (re)value water in decommodified forms, and which promote a more holistic approach to pro-public service reforms (often in collaboration with other public service operators such as health care and electricity, cutting against the grain of sector-specific silos introduced by new public management (McDonald 2014)). Private and commercially-oriented water companies might include co-production and collaboration in their development strategies, but their goals are far more instrumentalist, and often serve to reinforce – rather than challenge – the commodification of water. In this respect, new public water operators can offer governance innovation that is simply not available to their private and commercial counterparts.

Co-Production of Water Services

Co-production refers to the active engagement of citizens in the development and delivery of water services. It can range from decision making about investments in water infrastructure to the digging of trenches for pipes. Typically associated with the work of Elinor Ostrom (1996), co-production is intended to move beyond the binaries of market/state and government/civil society to a concept of a 'commons' in which citizens are not just clients to be acted upon but where they are conscious participants in the production and distribution of public goods and services that are of consequence to them.

But not all co-production is created equally. Critics of Ostrom argue that her work was "never imagined in a revolutionary frame" (Springer et al 2016, 276), serving to reinforce concepts of state failure and promoting notions of rational decision making in quasi-

market systems. The widespread embrace of the concept of co-production by neoliberal policy makers attests to this point, with notions of entrepreneurial citizenship promoted as a justification for a reduced role for the state and an off-loading of production costs onto citizens in the name of participation (Caffentzis 2010). As Spronk (2009) notes in the case of neoliberal-era water reforms in Bolivia, the mobilization of poor people's labour in the construction of urban water and sewage systems was simply used to shift the costs associated with service delivery onto the poor and deflect accusations of elite decision making.

New generation public water providers, by contrast, see co-production and citizen engagement as a tool to disrupt commercial logic, openly challenging hierarchies of power in the state and the market. Co-production in these cases is intended to empower citizens and give them a sense of ownership/control over water services. Participatory budgeting is one concrete example, with developments in Brazil being the most robust, where tens of thousands of residents participate in annual decision-making processes on how municipal budgets are spent (Wampler 2010). The model has since spread to other parts of Latin America and beyond and has been taken up in other service sectors (Goldfrank 2012, He 2011, Sintomer 2008).

There are also examples of co-production that include hands-on labour, but rather than merely off-loading labour costs onto residents these engagements are intended to conscientize citizens and open up new democratic spaces for decision making. In Colombia, for example, community aqueducts have transformed the social and political role that citizens play in water governance, “generating new forms of political participation and citizenship”, serving to challenge former power relations through the development of governance initiatives with “communitarian characteristics”. These new forms of citizenship are grounded in self-organization and “based on claims of sovereignty over natural, common goods” and are “gradually transforming Colombian democratic space” (Arias 2015, 77). Similar initiatives have emerged in Venezuela, where participation in water committees is seen as a form of empowerment and “part of a wider political agenda” intended to “engage citizens in a broader process of social change, promote rethinking of the concept of citizenship” while at the same time “avoiding elite capture” (McMillan et al 2014, 201; see also Allen at al 2017).

One must be careful, of course, not to exaggerate the transformative potential of co-production; the devil is always in the details. In many cases it is still the most marginalized people that are expected to ‘participate’, while real power remains in the hands of a relatively small elite. Participatory budgeting has come under particularly intense scrutiny in this regard, with accusations of tokenism being levelled at many such efforts (Baiocchi and Ganuza 2014). All forms of co-production are necessarily “tense and riddled with power asymmetries and political aspirations” that go beyond the goal of water provision (Ahlers et al 2014, 2) and no single model of citizen engagement fits all situations.

What differentiates new forms of co-production from their statist and neoliberal predecessors are their attempts to situate citizen engagement within a contextualized

understanding of the hydrosocial cycle, with culturally appropriate forms of co-production being distinct to each place. What works in Brazil might not work in Germany, and what works in rural areas might not apply to urban ones. Innovative forms of co-production are those that commit to a participatory process that are more transformative than exploitative. They represent a demonstrative shift from the marketized forms of co-production promoted by neoliberal organizations such as the World Bank while at the same time refusing to revert back to the top-down bureaucratic models of 20th century welfarism and socialism.

De-commodification

Another way in which new models of public water governance are changing is in their approach to valuing water. Neoliberal water governance is largely about 'getting the prices right' – i.e. letting market-oriented price signals shape consumer patterns and assist with the recovery of production costs. The assumption here is that people respond to market-oriented prices because they are self-interested, self-maximizing individuals seeking to optimize utility. Cost-reflexive pricing, it is argued, will reduce waste while at the same time raising revenue to extend and improve water services (Araral 2008, OECD 2010).

New public water operators do not ignore pricing signals, but they see a multiplicity of ways in which people attach value to water. Spiritual beliefs, ecological concerns and social justice all play into the complex processes of thinking about water production and consumption. In most cultures water is a source of inspiration as much as it is a biophysical necessity. In Hinduism all water is sacred. For Buddhists, water is said to symbolize purity, clarity and calmness. In Judaism water plays an important role in ritual cleansing practices, while in Christianity it is associated with environmental stewardship. In Islam water is seen as a gift from God not be bought or sold (Schelwald-van der Kley and Reijerkerk 2009).

Incorporating non-commodified values of water into hydrosocial governance is not easy, but many public water operators are attempting to recognize and implement alternative valuation principles through enhanced ecological practices, stronger social tariffs and by listening to indigenous voices (Dellapenna 2001, Pigeon 2012, Jackson 2006, Dumontier et al 2016). The intent is to work towards de-commercializing water services as well as reducing consumption patterns and challenging the growth mantra of the hydrological model where any increased use of water is impulsively associated with progress. True decommodification is admittedly difficult in a global market economy where water (and water pricing) plays a central role in all facets of social and economic life, but efforts to challenge the centrality of unit-based cost-recovery and market-based pricing schemes do represent a significant shift in governance innovation and a willingness to see the broader spectrum of water's value within the hydrosocial cycle.

Public-public partnerships

A third innovative feature of water governance being developed by new generation public water providers is that of public-public partnerships (PUPs). Defined as two or more public agencies working together on a not-for-profit basis with the aim of improving and promoting public service delivery, PUPs have been in operation in the water sector since the 1980s but the practice has accelerated since the early 2000s (Hall 2000; Hall et al. 2005, Boag and McDonald 2010). The advent of the UN-based Global Water Operators' Partnerships Alliance (GWOPA) in 2009 hastened this process further, with PUPs now operating in every region of the world (see www.gwopa.org).

PUPs are multi-scalar and multi-stakeholder in their orientation, involving government agencies, public sector unions, NGOs and social movement representatives working within and across jurisdictions, on topics ranging from public education systems to information technology. Not all PUPs are designed to dislocate mainstream water governance logic (some are explicitly about cost recovery, and the private sector has attempted to insert itself into the GWOPA process (Hall et al 2009)) but many are an unambiguous rejection of hierarchical statist models and commercialized neoliberalism, with the most progressive public water operators often working together to advance their mutual agendas (eg. Dumontier et al 2016).

Equally important is the inter-departmental collaboration that is being (re)built by many new public water operators, much of which was eroded by corporatization and the creation of managerial silos under neoliberalism (Nor-Aziah and Scapens 2007; Pollitt 2006; Pollitt and Talbot 2004). Some public water operators have managed to work creatively around this isolating effect, creating robust cross-departmental engagement through strong political commitment to collaborative planning and the inclusion of non-state actors in the cooperative process, such as unions and community organizations (McDonald 2014).

Of particular interest with PUPs is the recent revitalization of public banks. Now constituting some 25% of global banking assets, public banks have begun to re-assert themselves into debates about the financing of public services, pointing to the advantages they offer over private banks in terms of counter-cyclical lending, commitments to green infrastructure, and reduced borrowing costs (Butzbach and von Mettenheim 2015, Marois 2016, Mazzacuto and Penna 2015). As Mazzcuto (2017) argues in her advocacy of "mission-oriented public investing" within the public sector, real public innovation is only possible with public investment because of the long-term time horizons and multi-sectoral perspectives required. Although formal partnerships between public water operators and public banks are still relatively rare, they hold promise for addressing the massive infrastructural gaps that exists in the world today while at the same time improving transparency on financing costs and accountability. These and other forms of PUPs promise to be some of the most innovative forms of public water governance in the future.

Conclusion

With a growing number of public water operators committed to new forms of hydrosocial governance there is a profound shift underway in how we think about 'innovation' in the water sector. But change will not be easy. The majority of the world's water operators remain entrenched in old-school hydrological models of technology-driven change, while financing agencies continue to promote innovation in the form of commercialization and privatization. Private water companies remain powerful actors in policy making arenas and many municipalities are forced by austerity or political pressure to adopt or expand neoliberal water governance agendas.

Another barrier to new forms of public water innovation is the existence of performance metrics that favour neoliberal hydrological models. Benchmarking in the water sector is highly technocratic, promotes commercialization and imposes universalistic (and Eurocentric) values on a heterogeneous water sector (McDonald 2016b). Developed in large part by private companies and pro-privatization agencies such as the World Bank, the aim of most water benchmarking frameworks is to promote competition and celebrate "financially viable" water operators: "the ultimate value of utility benchmarking" (Van den Berg and Danilenko 2011, 8). Improved cost recovery and reduced expenses have become the gold standard in the water sector, with financial indicators such as 'unpaid-for water' or 'employees per 1,000 connections' often serving as proxy for overall water service performance. Financial criteria are not the only standards in the 260+ indicators that make up the ISO 24500 series that form the basis for most water benchmarking models (ISO 2012)) but they attract a disproportionate share of attention from policy-makers and funders, reflected in part by the massive literature on financial outcomes and cost recovery in the water sector (Alexander 2005, Breen and Doyle 2010).

Developing new benchmarking standards will be necessary to the growth and recognition of non-hierarchical, non-commercialized forms of water governance innovation. Once again this will not be an easy task, especially given the authority and resources of mainstream benchmarking organizations with vested interests in existing models. So too will many public water operators resist change, particularly those that have sunk resources and political capital into current benchmarking frameworks. Even public sector water managers and policy makers who share the concerns raised in this paper will find it difficult to change benchmarking standards given the inertia of existing systems and the time and energy required to shift analytical and operational gears. It has taken two decades of intense funding, lobbying and institutional support from major international organizations such as the International Water Association to get water benchmarking to where it is today. Changing the ways in which we measure innovation is not going to happen overnight.

Innovation can take place without performance metrics, of course, and in a world of hydrosocial complexity there is some philosophical merit in rejecting universal indicators. As Zwarteveen and Boelens (2014, 151-2) note, "knowledge about water will

always and necessarily be uncertain and provisional," reminding us that we must "remain vigilant about the temptation to unequivocally use 'science' and the objectification it entails in dealing with water's complexity." And yet, without metrics for measuring change, new generation public water operators may find it difficult to gauge their progress, engage citizens in transparent decisions on water governance futures, or share 'best practices' around the world. As dull as it may sound, the most important change in water innovation may come from the very ways in which we measure it.

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