

Crow-Miller, B.; Webber, M. and Molle, F. 2017.
The (re)turn to infrastructure for water management?
Water Alternatives 10(2): 195-207



The (Re)turn to Infrastructure for Water Management?

Britt Crow-Miller

School for the Future of Innovation in Society, Arizona State University, Tempe, AZ, USA; bcm@asu.edu

Michael Webber

School of Geography, The University of Melbourne, Melbourne, VIC, Australia; mjwebber@unimelb.edu.au

François Molle

Institut de Recherche pour le Développement (IRD), Montpellier, France; francois.molle@ird.fr

ABSTRACT: This paper introduces the papers in this special issue and uses them as evidence through which to examine four questions. First: are we witnessing a widespread (re)turn to big infrastructure projects for water management? The evidence suggests that large-scale infrastructure development has remained largely unswayed by the 'ecological turn', or the promotion of demand management or 'soft path' thinking, despite a drop in investments observed at the turn of the 20th century. Second: do these new projects have different justifications from those of the past? The papers in this issue provide evidence that the need to justify capital-intensive infrastructure in the face of commitments to sustainability, while borrowing from the conventional grammar of project justifications, has generated a few innovative tropes and rhetorical devices. Third: what does a (re)turn (or enduring commitment) to big infrastructure tell us about the governance and wider politics of large-scale infrastructure problems? Some of the traditional interest groups are well represented in the stories told here – the corporations that demand water or compete to build pipes and dams; the large-scale irrigators that rely on water to expand their production; the engineers and consultants who seek money, prestige, career advancement or even satisfaction from 'controlling' nature; the politicians who can extract 'rents' from all this activity. Even so, the history of each particular project involves many contingencies – of the society's history, of previous rounds of infrastructure and of capital availability. Fourth: have there been changes in the scale at which water is managed within countries? In general, it seems there has been an increase in the scale of projects, generally involving a shift in power away from regional and up to multi-regional agencies of governance, such as the central state. Sometimes these shifts in scale and power have no effect on the salience of local voices – because in the past they were never heard or generally suppressed anyway. Sometimes the shifts in power and scale have been accompanied by increasing suppression of local voices of opposition. In one case – South Africa – the change in scale has seen a stand-off between representatives of new voices and the infrastructure-focussed engineering elite.

KEYWORDS: Hydraulic mission, infrastructure, water demand management, governance, hydro-politics, scale

Infrastructures are networks that enable the flow of goods, people or ideas and allow their exchange over space (Larkin, 2013). Their topology and physical form influence the speed and direction of movement. Infrastructures, in this sense, are technological objects. Water distribution systems are thus networks that link water in rivers, lakes and storage sites to plumbing in people's homes, to irrigation pipes in farmers' fields, or to outlets in factories, enabling that water to perform economic but also social functions. Infrastructures mediate between societies and their environments. In the most general sense, water infrastructure consists of dams, levees, canals, pipes, pumps and water treatment plants (machines). Such infrastructures also include the links between those machines that allow them to

function as a system, as well as techniques of organisation – corporations, accounting, bureaucracies and the like (Molle et al., 2009b). These infrastructures, of course, exist in society, and often embody, reflect, and, in turn, shape their political, economic, and social surroundings.

Humans have relied on water management infrastructures since the dawns of civilisations. Dams, river control constructions and water delivery canals were important objects of state activity in ancient Egypt as in China, in Mesopotamia and, more recently, in the southwestern United States. Such objects tend to be rooted in supply-side management principles: provide more water to meet demand or anticipated growth in demand. Yet, alongside the attempts to deliver more water has co-existed an understanding that rising demand for water must ultimately be constrained. Even in ancient Rome, more than adequately supplied with water and believing that flowing water was a sign of a high standard of living, water-saving devices (such as taps and storage cisterns) were widely deployed (Bruun, 1991: 103).

With increasing human population – in both numbers and concentrations – has come the proliferation of arguments for both enlarging water supplies and for the development of new demand management strategies. The apparent acceptance of each argument has fluctuated over time and across space. Recently, in the 1990s and 2000s we saw a turn toward 'softer' approaches to water management. For example, the World Bank, historically a major funder of large water infrastructure projects, shifted away from funding large dams in the mid-1990s. This trend spread, particularly following the publication of the now-well known World Commission on Dams report, 'Dams and Development', which condemned the social and ecological consequences of large dams (WCD, 2000). While the publication of this report points to a shift away from supply-side approaches that was already being promoted under different guises (see Postel and Richter, 2003; Brooks et al., 2009; Gleick, 2002), it also catalyzed further change along those lines. Across much of the world (with some important exceptions), in agriculture, mining, manufacturing, construction and the service industries, and from the world's largest development institutions to the smallest non-government organisations, the emphasis came to be largely on increasing the efficiency with which water was used. The underlying goal of this approach was to restrain consumption with the hope – for some – of reserving more water for environmental purposes. With a dramatic drop in the construction of new dams (particularly large dams) and other large projects, the turn of the century seemed to give way to 'softer' approaches and demand management, with a focus on pricing, water markets, user participation, awareness raising, precise scheduling, retrofitted appliances, and the like.

More recently, however, we have begun to see a resurgence of large-scale water infrastructure projects, from inter-basin water transfers and massive dams, to desalination plants, sea walls, and tidal barriers under development in Asia, Africa, Europe, and South America. Many such projects are documented in the papers of this special issue. While we note that some of these projects (China's Three Gorges Dam, for example) were underway even as softer approaches came to dominate in many parts of the world, taken together, the resurgence of these types of concrete-heavy forms of water management suggests a turn back to the high-modernist (and earlier) reliance on big infrastructure as a strategy for addressing a range of water-related issues, including regional scarcity, sea-level rise, and flooding.

The World Bank, once a global leader on, and good barometer for, the engagement of multilateral lending institutions in big infrastructure construction, has quietly returned to financing large dams since the mid-2000s, including Bujagali in Uganda and Nam Theun 2 in Lao PDR. It has developed new language ('high-risk high-reward projects', 'sustainable hydropower', 'triple bottom-line', etc), "[r]e-engag[ed] with agricultural water management" (World Bank, 2006) and has recently put dams centre stage again as necessary tools for climate-proofing (World Bank, 2016). As Peter Bosshard, former Executive Director of International Rivers noted in 2013, "The World Bank (...) still finds it easier to spend billions of dollars on mega-projects than to support the small, decentralised projects that are most effective at expanding energy access in rural areas. It appears to be caught in the development

model of past decades" (Bosshard, 2013). The pendulum, it seems, has begun to swing back in the other direction, especially as newer global financing organisations like the Asian Development Bank and the Export-Import Bank of China begin to gain in influence.

Using examples of these types of projects, the papers in this special issue explore the questions of whether and, if so, why, we are seeing a return to a 20th century water management paradigm centred on big infrastructure and, often, supply-side management principles, and what this (re)turn to big infrastructure tells us about the political-economic forces driving water management today. The issue features twelve articles, spanning every inhabited continent except Australia, ten countries, and a range of theoretical frameworks and disciplinary traditions.

Beginning in Asia, where several countries struggle with severe water stress, growing urban populations, and the environmental externalities of rapid economic growth, we have three papers. First, Luxion analyses the politics of the Narmada Drinking Water Pipeline in Gujarat, India and the various political roles of this megaproject. Crow-Miller, Webber and Rogers address the techno-politics of big infrastructure in China and the nature and functioning of what they term the 'Chinese Water Machine'. Colven demonstrates how a geographically and historically contingent techno-political network has driven the construction of Jakarta's Great Garuda Sea Wall (GGSW) Project as a solution to urban flooding, even as it fails to address the root cause of the city's flood challenges. She uses the case of the GGSW, a project with strong post-colonial ties to the Netherlands, to point to "a need to provincialise emergent narratives charting the apparent, rise, fall and return to big infrastructure" (Colven).

Next, in the only paper about Europe, Osti examines anti-flood detention basin projects in Northern Italy, and reflects on whether they depart from the conventional infrastructural projects of the past. To the south in Africa, two articles provide historical accounts of the legacy of colonial structures and attitudes on current water management practices. Blomkvist and Nilsson recount the history of water supply to Nairobi, Kenya, examining in particular the past and current policy choices that have underpinned the construction of the Northern Collector Tunnel project. In the context of post-apartheid South Africa, Bourblanc examines the decisions about the second phase of the Lesotho Highlands Water Project to illuminate the difficulties of managing water demand in the context of the struggles between a black water bureaucracy and a white water engineering fraternity.

Four articles focus on Latin America. Warner, Hoogesteger, and Hidalgo examine the recent wave of hydropower, flood control and irrigation projects in Ecuador and how they coexist with the promoted 'soft' ideology of 'buen vivir'. In Mexico, McCulligh and Tetreault explore water management and infrastructure issues, arguing that a 'concrete-heavy' focus on water projects has persisted through the late 20th and into the 21st century, despite national turns in both policy and discourse toward sustainability-oriented water management strategies. What has changed in recent decades, they claim, is the level of private-sector participation in the space of water infrastructure, as well as the level of resistance to such projects by local communities. Mills-Novoa and Hermoza analyse the advent of a trans-Andean tunnel in Piura, northern Peru, where water from the Andean slope of the Andes is to be transferred to develop irrigation on the Pacific slope. They show how the decision-making process of megaprojects remains centralised and unaffected by demand-management rhetoric. Much of the same is reported from Brazil by Roman, who recounts the tribulations of the São Francisco inter-basin water transfer project (*'transposição'*).

Finally, two papers examine projects in the United States. Welsh and Endter-Wada look at how the Southern Nevada Water Authority is trying to build a pipeline to appropriate groundwater from rural basins to serve the Las Vegas metropolitan area and mitigate risks or relying on the Colorado River for water. They point to a history in the American West of government subsidies for water infrastructure to promote economic development in arid regions, which have created a growing, region-wide dependency on increasingly uncertain water supplies. Lastly, Perry and Praskievicz address the

emerging need for additional water storage in the U.S. West as climate change brings increased uncertainty to regional water supplies. Drawing on cases in California and Oregon, they illustrate the rise of auxiliary infrastructure, including the augmentation of existing dams, but suggest that demand-side strategies must also be expanded.

Collectively these articles attempt to shed light on a number of important questions. Foremost, we ask the question of whether or not we are currently witnessing a widespread (re)turn to big infrastructure projects for water management. The promotion of demand-management is often seen as a reaction to the shortcomings, third-party impacts, or failures of conventional engineered responses to water scarcity, and therefore as a 'counter-policy'. Does this mean that supply augmentation options and infrastructure projects have been put on the back burner? It is apparent that both supply- and demand-side policies and their associated discourses often coexist. While the justification generally given is that the water situation in a given place is so serious as to necessitate the pursuit of all types of 'solutions' in conjunction, it is interesting to examine how hard and soft policies coexist, discursively and practically, in national policies and political discourses.

In countries such as Kenya (Blomkvist and Nilsson)¹, there never was a turn away from big infrastructure, merely a period of stasis in the building programme. Likewise in Indonesia (Colven), the soft approach never came to dominate in the first place and (big) infrastructure has never been phased out, with the US\$40 billion Garuda Great Sea Wall megaproject as an extreme illustration of the persistence of this approach. In Gujarat, India (Luxion), limited energy has been spent on advancing demand management strategies and the Gujarat Water Regulatory Authority, formed in 2012 in anticipation of the state water policy, was defunct within a year. The prevailing discourse has centred on a supply-side approach hinging on the Sardar Sarovar Project as well as the battles for appropriating Narmada's waters at the federal level and increasing the height of Sardar Sarovar Dam.

In the western U.S., changes in climate and growing urban water demand have prompted a return to the supply-side water management approaches that dominated for much of the 20th century, but were supplanted by conservation policies by the 1980s. Perry and Praskievicz argue that the return to big infrastructure is not limited to developing countries and that it is not always about constructing new infrastructure, but also about leveraging existing infrastructure to increase water-storage capacity. "Auxiliary infrastructure projects are attractive to water managers because they purportedly work within the modern framework of environmental regulation that often precludes the development of new large dams in developed countries" (Perry and Praskievicz). However, these approaches are not sufficient for coping with emerging challenges and must be pursued in tandem with demand-side strategies.

But the opposite argument is often made, even within regions. In Las Vegas, the Southern Nevada Water Authority (SNWA) has worked hard to conserve water and reduce the city's extravagant per capita water use from 1314 litre/capita/day (l/c/d) in 1990 to 488 l/c/d. This has been possible through indoor and outdoor water conservation strategies, wastewater reuse, education campaigns, water use restriction programmes, and various incentives, such as those that encourage the replacement of traditional lawns with more water-efficient landscaping. Welsh and Endter-Wada explain that these efforts in water demand management have helped the SNWA justify additional water supply and infrastructure projects, arguing that demand management is not enough when the Colorado River is in continual shortage and climate change brings additional uncertainty about both short- and long-term water supply.

In South Africa (Bourblanc), demand management is rhetorically salient in strategic policy documents, but its implementation has proved to be very challenging, as illustrated, for example, by the problematic establishment of decentralised basin-level management agencies. The Water Use

¹ In the remainder of this article, authors cited without reference year are contributors to this special issue.

Efficiency Directorate is mostly confined to education and awareness campaigns, or documenting use efficiency in various sectors. Recently, the government has reiterated its faith in big infrastructural solutions with the announcement of plans for the construction of new dams, including the Lesotho Highlands Water Project.

McCulligh and Tetrault show that while dam-building in Mexico has been on the decline since roughly 1980, there has been increased spending on water supply and sanitation over the last decade and a half. They argue that under an institutional arrangement that encourages private-sector investment in physical infrastructure, concrete-heavy projects continue to dominate management approaches for urban water supply despite increasing government rhetoric around environmental sustainability and demand management. They highlight "the increasing dissonance between official state discourse, with its stress on ecological sustainability and political participation, and the actual orientation of water policies and projects". The case of Mexico demonstrates a formal engagement with globally circulating discourses around sustainability and Integrated Water Resources Management (IWRM) that has little substance in actual practice.

A similar situation is found in Peru by Mills-Novoa and Hermoza, where the promotion of agribusiness and private investments justifies several megaprojects, including trans-Andean tunnels that transfer water from the Amazonian slope of the Andes to develop irrigation on the Pacific slope and the coast. In this case, the soft/participatory turn has been useful to attract money from the Inter-American Development Bank and other donors in support of the establishment and the capacity-building of river basin councils (Mills-Novoa and Hermoza). While Peru's 2009 Water Resources Law emphasises IWRM principles and 'soft-path' management strategies, it also creates mechanisms by which hydraulic projects that are considered to be an "exceptional measure for national public interest" can be approved and implemented.

Warner et al., explore the case of Ecuador where the *sumak kawsay/buen vivir* (good living) concept has been developed as a counter-hegemonic discourse of respect for Mother Earth (pachamama) and an alternative to exploitative Western practices. At the same time, dams have been promoted as providers of clean energy and 'good living' for Ecuadorians. Ecuador has claimed to be a champion of a green and sovereign economy that does not use fossil fuels and has deployed the so-called Yasuni ITT initiative, whereby the country would receive international compensation for leaving its oil in the ground. Yet the state has massively reinvested oil revenues in infrastructures such as hydropower dams, irrigation schemes and flood control structures. Between 2007 and 2015, US\$ 5.9 billion was invested in the simultaneous construction of eight hydropower plants in the country.

In Brazil most of the priorities stated in the National Plan for Water Resources 2012-2015 relate to institutional reforms (supporting the creation of basin committees, defining criteria for water licensing, monitoring of water bodies, water charges, development of conflict-solving institutions, etc) that are in line with IWRM 'best practices' (Roman). Yet, the state is pushing ahead with a massive programme of hydroelectric dams in the Amazon and inter-basin transfers such as the US\$12 billion 'transposição' project in the Nordeste, where water scarcity is seen by the state as a supply problem to be resolved through massive water infrastructure. The state of Ceará also pioneered a decentralised and participatory management approach focused on water as an economic good, integrated water management at the basin level, and water resources planning, through which it gained a reputation "that helped back its demands for supplementary water supply from the São Francisco River".

In China regional water scarcity and acute water pollution are now resulting in growing media coverage and popular outrage (see, for example, Kaiman, 2013). The recognition that the demand for water has to be constrained and that greater care has to be taken to protect existing waters translated into the Ministry of Water Resources' announcement of the 'Most Stringent Standards' or 'Three Red Lines' policy, which set targets for total water use, water use efficiency, and ambient water quality (Crow-Miller et al.). These standards continue the tradition of imposing centralised targets that are to

be met by provincial and lower-level governments, and they have not significantly altered the centrality of mega projects, exemplified by the Three Gorges Dam and the massive South-North Water Transfer Project (SNWTP).

In examining flood detention basins in Northern Italy, Osti suggests that they actually represent a softer approach than the river lining and channelization practices of past flood management. He identifies a search for a multifunctional use of infrastructures that also allows for an increase in biodiversity (small wetland zones) or open-air activities like hiking and biking. A break with the past is the inclusion of experts in biology and ecology for greening the infrastructure.

On balance, as reflected in the renewed stream of dam construction worldwide (Zarfl et al., 2015) and the continued attractiveness of other kinds of water megaprojects, it is apparent that large-scale infrastructure development is here to stay and has remained largely unswayed by the 'ecological turn', or the promotion of demand management or 'soft path' thinking, irrespective of their respective merits and achievements. Yet, the need to justify capital-intensive infrastructure in the face of commitments to sustainability, while borrowing from the conventional grammar of project justifications (see Molle 2008), has generated a few innovative tropes and rhetorical devices. These rhetorical justifications take several forms.

The transposição project in Northeast Brazil is a typical example of a redemption project ('the sertão will turn into a sea', 'the infrastructure will change the face of the semiarid', and 'eradicate the thirst of people in the sertão'). The 'social character' of the project is emphasised by stressing that the diverted water is intended to be used for human and animal consumption and that the transposição is not intended to serve any broader purposes of development (i.e. not meant to help develop export-oriented irrigated agriculture or industrial activities). Repackaging strategies are apparent in the project's four successive name changes, starting with the Project of Diversion of the São Francisco River Waters to the Semiarid Regions of the Pernambuco, Ceará, Paraíba and Rio Grande do Norte States, and ultimately becoming the Project of Integration of the São Francisco River (Roman).

Likewise, in South Africa in 2015, the Water Minister distanced herself from past dam construction projects built mainly for energy and mining industries, emphasising that they will now benefit villages and local communities (Bourblanc). In Mexico, too, the National Water Commission stresses that the Zapotillo Dam is not a stand-alone dam, but rather forms part of an Integral Hydrological System of Works on the Verde River (Sistema Integral Hídrica de Obras del Río Verde), with multiple objectives: avoiding further depletion of the level of Lake Chapala, while at the same time providing 'hydrological security' to the Metropolitan Area of Guadalajara, the city of León and rural areas (McCulligh and Tetrault).

Window dressing is often unconvincing, however. Opponents to the transposição point to the large share of water allocated to irrigation, while opponents to the Garuda Great Seawall – officially known as the National Capital Integrated Coastal Development programme – stress that it is in fact an urban development project masquerading as flood mitigation and that the main cause of flooding (land subsidence resulting from groundwater overdraft) is left unattended.

The narrative of scarcity, a child of natural determinism and Malthusianism often coupled with doomsday scenarios, has long been used to legitimate capital-intensive infrastructural responses to water provision challenges (Swyngedouw, 1999; Mehta, 2001, 2010; Molle et al., 2009a; Crow-Miller, 2015): an unfortunate climatic deficiency is limiting supply and constraining an inexorably growing demand in ways that have to be remedied to allow for growth and poverty alleviation, while avoiding a looming disaster. Associated with a discourse of water plenty or 'excess' applied to a nearby basin, and cemented by a discourse of 'equity', 'national integration', 'hydro-solidarity' or 'reducing interregional disparities', a strong case is built for an interbasin-transfer. This rhetoric is illustrated in this special issue by the cases of the South-North Transfer in China, the transposição in Brazil, the Lesotho

Highlands Water Project in South Africa, the Alto Piura Project in Peru and the Sardar Sarovar Project in India.

Huge economic benefits are invariably promised by such projects and, it is said, cannot be turned down or foregone: hydropower production at the Three-Gorges Dam generated US\$25 billion in revenue in its few years of operation alone, all the while only partially operational (Yang and Lu, 2013). Likewise, the waters of the SNWTP allow the economic status quo in China's political and economic (northern) powerhouse to be maintained, at least for now. In Peru, "the language of exceptionalism surrounding large-scale infrastructure is reflected in the justification of Alto-Piura Project and other large mega-irrigation projects as a key 'stimulating agent for the economy', vitally important to generate regional employment via 'a massive reactivation of the agricultural sector'". For India's water minister, the Interlinking of Rivers Project, which seems to be back on the agenda, has to be constructed merely because it "is a matter of national benefit" (Bagla, 2014).

Another familiar device is TINA (There Is No Alternative), often associated with the idea that infrastructure building is a 'no regrets' process, as everyone agrees that 'something' has to be done about the incongruity of water supply and demand. As expressed by a Dutch expert regarding The Garuda Seawall in Jakarta, "there are only two options, retreat or advance. We either abandon and evacuate north Jakarta, which is a non-starter, or we advance out into the bay with the seawall" (quoted in Sherwell, 2016). This is echoed by the President himself, who emphasised that "It is estimated that all of North Jakarta will sink below sea level by 2030 (...) because of that, the development of the capital's seaside, which has been delayed for so long, is the answer for Jakarta" (ibid). Similar sentiments have been expressed about the SNWTP, with one government official in Beijing noting that "if we don't have enough water then we must find a method to get more. (...) Maybe [the SNWTP] is not the best method, but we must use it. (...) If we don't solve the water problem, the city will die" (quoted in Crow-Miller, 2015).

Megaprojects also play well-known roles in nation-building and in generating symbolic capital for political elites. The Garuda Great Seawall is the visible embodiment of an aspiration to become a modern, 'world class' metropolis on a par with Singapore. The Three Gorges Dam represents a "unique brand of modernity 21st century China has sought to produce for itself, one that uses visions of technological praxis in which the engineer is a 'good god' (Sze, 2015: 86) to inform national identity, economic development, and political legitimacy". It can be interpreted as, "a showcase of China's opening up, China's ability to rely on its own technological capacity without abandoning national independence to outside interests, and its enduring capacity to dominate nature" (Crow-Miller et al.). In Gujarat, the dam, the canal, the pipeline, and modern technology are all rhetorically tied together and linked with an image of Indian Prime Minister Narendra Modi as a benevolent protector for Gujarat, acting under the blessing of Indian independence fighter and statesman Vallabhbhai ('Sardar') Patel, whose statue – the world's tallest – is soon to be erected at the dam site (Luxion). The intended transfer of symbolic power reinforces the hold on power of Mr. Modi, and subsequently that of the high-officials who control the allocation of the water itself as well as contracts for infrastructure operation and maintenance. In addition, the Narmada pipeline project undercuts the independence of Gujarat's minority regions (North Gujarat, Kutch, and Saurashtra) and makes them dependent on the state's willingness to deliver water to them.

New and often creative justifications are constantly being developed for such projects. In Ecuador, resilient coalitions in favour of large-scale infrastructure development have incorporated in their discourses paradigms à la mode such as "the WEF [water, energy, food] Nexus approach, the greening of the economy, climate change resilience, in addition to the '*buen vivir*' ideology" (Warner et al.). The 'hydraulic mission' is now presented as a solution to guarantee water, food and energy security in times

of climate change and the nexus.² Hydropower projects now qualify for top-up funding through the Clean Development Mechanism (CDM) (Mäkinen and Khan, 2010); the World Bank presents dams as climate buffers". Regarding the American West, however, Perry and Praskievicz stress that changing biophysical realities in the face of climate change, increasing urban demand/expansion and the intensification of agriculture are important drivers that cannot be taken lightly. Still, if nothing else, the (re)turn to infrastructure has enriched the repertoire of justifications.

The next question explored through this collection of articles is that of what a (re)turn (or, in some cases, an enduring commitment) to big infrastructure tells us about the governance and wider politics of large-scale infrastructure problems. Unsurprisingly, there is clear evidence of the permanence of the interest groups 'traditionally' attached to capital-intensive infrastructure projects (see Worster, 1985 and Molle et al., 2009b), while the challenges from decentralised management bodies, civil society or dissenting groups remain largely 'under control'. In Brazil, the drought narrative has long been a means for regional and local political elites as well as private companies to attract public funding and aid, under what is called the 'drought industry' (Empinotti, 2007). Climate-driven vulnerability of poor households has been identified as a political opportunity for landed elites, who often extend material aid in exchange for votes. Companies involved in the construction of the transposição have recently been caught up in a corruption scandal.³

In the case of Northern Italy, Osti suggests that flood management (in the form of detention basins) is now "negotiated, planned and implemented by subnational public bodies", and less centrally driven than it once was. Yet, he points to the presence of a "duopoly formed by the strong alliance between construction firms and civil engineering managers. The rewards are not only money but also professional prestige, career advancement, and a sense of mastery over nature". Somewhat differently, in Mexico McCulligh and Tetrault argue that "large-scale water infrastructure projects serve as a vehicle for the realisation of capital through construction contracts and rent-seeking in operating infrastructure". The Mexican state continues to play an important role in promoting such projects and repressing opposition, but it is contracts with private companies that ensure project profitability and help to minimise risk. In Peru, the Alto-Piura Project, and dams and interbasin-tunnels more generally, have been prone to corruption, as revealed in particular by the 'Lava Jato Investigative Commission' that uncovered corruption schemes with Brazilian companies and contractual irregularities with the Obraisa-Astaldi construction company.

In Indonesian, the GGSP is already mired in corruption allegations, before rising from the ground.⁴ More subtly, Colven posits that "drawing on their post-colonial influence, the Dutch have been instrumental in shaping flood mitigation technologies and water governance in Jakarta, with contemporary knowledge transfers and networks of expertise from the Netherlands to Jakarta that promote Dutch engineering expertise, of which the GGSW is a product, even as the same actors promote a very different 'ecological turn' elsewhere". She points to the interest of the Dutch water sector in Indonesia (comprising knowledge institutions, consultancy firms, and technical companies) and how it stands to benefit from the project "through lucrative international contracts".

In the case of China, Crow-Miller et al., identify a techno-political water management regime comprising not only infrastructures and other technologies, but also "ideologies, and networks of institutions, their practices and the capital they are able to mobilise: a regime fundamentally shaped by both past choices and current political-economic conditions". Emerging from and embodying this

² See Water Alternatives Special Issue 'Critical Thinking on the 'New Security Convergence' in Energy, Food, Climate and Water: Is the Nexus Secure ... and for Whom?', www.water-alternatives.org/index.php/tp1-2/1888-vol8/288-issue8-1

³ <http://g1.globo.com/pernambuco/noticia/2015/12/pf-cumpre-mandados-de-busca-e-prisao-sobre-fraudes-no-s-francisco.html>. See also Dias (2016).

⁴ www.indonesia-investments.com/news/news-columns/corruption-in-indonesia-agung-podomoro-land-bribery-case/item7174; and www.thejakartapost.com/academia/2016/04/07/ga-the-problem-with-jakartas-land-reclamation.html

regime, they also point to what has been termed the Chinese Water Machine (see Webber and Han, forthcoming). This machine is an assemblage of corporatised enterprises, government ministries, departments at multiple scales of the governance structure, universities and foreign corporations that together form the "institutional embodiment of China's commitment to large infrastructure" for water management in the contemporary era, a commitment that now increasingly extends beyond its own borders. In Ecuador, for example, as in many other countries in South America, Southeast Asia and Africa, Chinese money and cooperation go "hand in hand with the hiring of Chinese dam construction companies and expertise and little to no conditionalities as to possible socio-environmental effects of these dams" (Warner et al.). Whatever the terms and concept employed [Mexico's 'techno-political network', South Africa's 'policy networks', Italy's 'duopoly', China's 'water machine', or more generally 'iron triangles' (see Molle, 2008)], the financial and political interests associated with capital-intensive infrastructures are constitutive drivers of the re(turn)/permanence of infrastructure development.

In several cases, there are also important historical contingencies and financial connections that suggest we pay due attention to the historical factors that have shaped such hard infrastructural pathways when it comes to water. In the South African case, the post apartheid transformation of the water bureaucracy is significant (Bourblanc). The bureaucracy became increasingly staffed by black South Africans, who by definition were less embedded in the engineering policy network. However, their lack of experience has forced them to rely on the country's engineering consulting firms, which are dominated by the white engineers who left the water bureaucracy. The current fate of big infrastructure projects in this context depends on the ability of the new black water bureaucracy (enrolling a variety of water users and other non-water professionals) to sidestep the white engineering network in favour of more decentralised proposals to focus instead on the demand side. In this case, the debate is not only over policy and securing the consultancies and contracts associated with water projects but also between policy networks that carry with them broader political interests and concerns related to race and the colonial, and post-colonial past. Similarly, the Nairobi case presented by Blomkvist and Nilsson points to the significance of history and the role of colonial attitudes about service delivery to white and non-white populations. The legacy of Dutch colonialism in Indonesia is also central in the Garuda Project.

In other cases, the most important contingencies come in the form of infrastructure itself. Perry and Praskievicz suggest that local path dependencies, demonstrated by the auxiliary supply-side infrastructure projects found across the American West, play an important role in determining water management options for the present and future. Existing infrastructure, they show, can provide an opportunity to expand supply-side approaches to water management without constructing new infrastructure, which minimises the need for additional land inputs and can work within environmental regulation frameworks that often do not allow for the construction of new dams in developing countries. In China, Crow-Miller et al. discuss the legacy of particular types of water management projects from imperial times and point to the technological, social, and institutional lock-ins they have produced as key inheritances shaping water management options today.

But infrastructure is also about sourcing capital. Historically, development banks have been the key providers of funds. But after the World Bank pulled out of the Arun-3 hydropower project in Nepal, for example, half a dozen other projects have been built with other donor and private-sector funding (Gyawali, 2013). The Mekong is a vivid illustration of how alternative donors (foremost China, but also Thailand, Malaysia, etc) have side-lined multilateral funding (Hensengerth, 2015; Hirsch, 2016). Warner et al., also point to the increasing number of projects that are funded privately, or even through 'voluntary contributions' from the population (such as Rogun Dam in Tajikistan, Grand Renaissance Dam in Ethiopia, or the doubling of capacity of the Suez Canal in Egypt). Ecuador (Warner et al.) stands out as an example of the outward thrust of China in search of raw materials in exchange for turn-key projects constructed by Chinese companies (McDonald et al., 2009).

Next, we ask of these papers what they say about changes in the scale at which water is managed within countries. In one sense this is a matter of regional as opposed to national governments – a matter of spatial scale. As economies grow and more capital is accumulated, as concentrations of population and demand grow, so the spatial scale of what counts as a big infrastructure project has been growing too. The 300-km long Mulholland Canal that takes water from California's Sierra Nevada mountains into Los Angeles was once regarded a major feat of water engineering. Now the São Francisco River interbasin transfer project in Brazil is composed of about 500 km of canals, pipes and aqueducts (Roman) and China's South North Water Transfer Project involves two sets of canals, each more than 1,200 kilometres long (Crow-Miller et al.). But it is also a question of social scale - the degree to which civil society actors can influence decisions about water management: whether they can prevent projects that are against their perceived interests, whether they can promote projects that seem important to them. In the end, large-scale infrastructure projects need to be financed, using money outside the capacity of local people to provide, so the voices of local people are rarely decisive in advancing a project. But people's voices may or may not be heard opposing, suggesting modifications or encouraging a project. Do the histories that these papers recount say whether these voices are becoming more powerful or less?

In some places the voices of local people were never significant, and they remain largely ignored and unheard. Such is the case in Nairobi (Blomkvist and Nilsson), where the city's water supply system was originally engineered to provide a European-style water delivery system to satisfy the needs and wants of the colonial elite; the system continues to supply 'formal' water in this way to richer sections of the city's population, largely ignoring the need to supply poorer parts of the city. Likewise in Jakarta, the planned Great Garuda Sea Wall seems to be the project of a geographically and historically contingent techno-political network, formed through political and economic interests, world-class city aspirations of Jakarta's elites, engineering expertise, capital flows, colonial histories, and postcolonial relations between Jakarta and the Netherlands (Colven). Again, in China, the South North Water Transfer (Crow-Miller et al.) is a project of the central government, with support from several northern and central provincial-level governments; people's voices – even the more than 350,000 who were evicted from their homes to make way for the dams and canals – were irrelevant.

In other places, a democratic revolution promised to provide those who previously had no voice with the opportunity to affect policies over water. In South Africa, after the end of apartheid, non-whites gained formal political control over the water bureaucracy and a new language emerged of providing water to all by freeing up water 'saved' through demand management (Bourblanc). Yet these voices were largely frustrated by an alliance of engineers and (supply-side oriented) engineering consulting firms within South Africa, so that a demand-driven approach to water provision never really materialised on the ground. At present, Bourblanc concludes, the newly enfranchised political voices are seeking to create new networks of support and expertise that might undermine the power of the established networks. In one sense, then, those previously excluded now have a voice, but through their elected representatives rather than directly. Also speaking to broader questions of democracy, Osti suggests that the persistence of a rigid and closed-door policy community in Northern Italy that drives the development of detention basin projects is itself an indication of "low-quality democracy" insofar as water management planning remains far from participatory.

In Peru, interbasin transfers are considered as lying beyond the prerogatives of river basins themselves and instead fall under the purview of the central administration (Mills-Novoa and Taboada Hermoza). This justifies the bypassing of the newly formed River Basin Councils which, however, will later have to handle the management complexities, environmental impacts, and user conflicts invariably generated by such megaprojects. A similar situation is observed in Brazil, where the National Council for Water Resources (CNRH), has the power to override the River Basin Committees which only have advisory and consultative functions (Roman). This is how the final decision in favour of the transposição was taken in the CNRH, despite protests by the São Francisco River Basin Committee

(CBHSF) and social movements engaged against the project: indeed, several environmental NGOs and left-wing developmentalist political parties, which were formerly supportive of Lula's policies, have disagreed with the federal government over the transposição.

In other places, local scale voices of opposition to such projects have been loud, although they have often been met with strong repression by the state (Warner et al.). In Ecuador, the civil society, grassroots organisations and NGOs have been increasingly vocal in the defence of their interests and rights in the past 15 years. But contrary to its initial promise to work with indigenous organisations and include them in decision-making, the Correa government eventually pursued a reinvigorated hydraulic mission and fought against grassroots resistance. Opponents to such a mission and the work done in its name are often depicted as anti-developmentalists holding the people back, but as in the case of the Chone Dam, even regional dams may be expediently 'securitised' (Buzan et al., 1998). Likewise, McCulligh and Tetrault show that there has been a relatively strong civil resistance to water projects in Mexico, but also a strong and often violent government repression of environmental activism. At the Zapatillo Dam, for example, the interests of large-scale agricultural producers and industrialists in the León area have trumped those of the smaller scale farmers in the Jalisco highlands. The opposition – an alliance of local communities, NGOs, university groups and religious leaders in nearby Guadalajara – has been met with threats and intimidation from the police and military (McCulligh and Tetrault). Beyond El Zapatillo, the Mexican state has gained a reputation not only for actual violence against water 'activists', but also for enacting structural violence against communities contesting its water development agenda (see, for example, Radonic, 2015). Finally, the Sardar Sarovar Dam has figured as one of India's most controversial projects, opposition to which has amounted to a nearly-three decade long local movement with important international resonance (Luxion). Since 2000, the state of Gujarat has reinvented the dam as a means of providing drinking water to Gujarat's cities and industrial regions through a new round of water-delivery infrastructures. As Luxion notes, the project exemplifies the state's model of development that emphasises the construction of infrastructure, the centralisation of power, and the use of narrative and spectacle as modes of governance – and the vilification of opponents. While Luxion calls this the 'Gujarat model of development' the papers in this issue reveal just how common such a model is.

What these papers collectively reveal is a multi-faceted relation between scale and voice on the one hand and the new round of large water infrastructure projects on the other. Scale has generally (though not always) been increasing, as water is brought from further and further afield to satisfy the demands of new urban and industrial agglomerations and agricultural irrigators. Even in the case of flood control infrastructures, scale is sometimes increasing dramatically, as in Jakarta. With this increase in scale has generally come a shift in power away from regional and up to multi-regional agencies of governance, such as the central state. Sometimes these shifts in scale and power have no effect on the salience of local voices – because in the past they were never heard or generally suppressed anyway. Sometimes the shifts in power and scale have been accompanied by increasing suppression of local voices of opposition. In one case – South Africa – the change in scale has seen a stand-off between representatives of new voices and the infrastructure-focused engineering elite.

While no collection of articles could conclusively answer the questions we set out to address, this group of contributions from around the world offers a rich exploration of important issues about the apparent endurance of big infrastructure projects for water management. It is clear that while we are seeing a return to such projects in many parts of the world, many places never officially departed from such a water management strategy. What we see now, in many cases, is a quiet recommitment to big dams, massive interbasin transfers and flood protection systems, but now couched strategically in discourses about green development, sustainability, and the like. Interestingly, the rhetoric used to 'sell' large-scale infrastructures has ultimately changed little. Climate-change is the most recent scapegoat lending justification for enhanced storage capacity. The need for more security against climate vagaries, and therefore for more storage or inter-basin transfers should not be dismissed or taken lightly. What is

clear, however, is that more storage or supply generally translates into more unchecked demands rather than to a buffering capacity, thus fuelling the next crisis and the next supply augmentation project (Molle, 2008).

These papers also suggest that while governance and politics are centrally important, we would do well to pay greater attention to both the historical contingencies and the financial connections that have helped to shape the water infrastructure projects of today. Noteworthy is the preference for capital-intensive projects over addressing root causes of water mismanagement. With large water infrastructure projects seen as a good investment opportunity, sources of capital are no longer limited to the World Bank and other usual suspects, but have expanded to private financiers and, perhaps most significantly, Chinese banks, which increasingly side-line traditional development banks and their conditionalities.

Finally, it seems that the spatial scale at which water is being managed is becoming larger, and that it has generally involved a shift in the scale at which decisions are made, from regional toward multi-regional or central governments. In many, but by no means all of the cases examined in this special issue, these changes in scale have been accompanied by increasing suppression of local oppositional voices. As these projects work to consolidate and reinforce the power of existing political elites, and deliver significant political and financial rewards to high-level actors, it seems that big infrastructure for water management may be here to stay.

REFERENCES

- Bagla, P. 2014. India plans the grandest of canal networks. *Science Magazine* 11 July 2014, p. 128.
- Bosshard, P. The World Bank is bringing back big, bad dams. *The Guardian*, 16 July 2013, www.theguardian.com/environment/blog/2013/jul/16/world-bank-dams-africa (accessed 2 June 2017)
- Brooks, D.B.; Brandes, O.M. and Gurman, S. (Eds). 2009. *Making the most of the water we have: The soft path approach to water management*. London: Earthscan.
- Bruun, C. 1991. *The water supply of ancient Rome: A study of roman imperial administration*. Helsinki: the Finnish Society of Sciences and Letters.
- Buzan, B.; Waeber, O. and de Wilde, J. 1998. *Security: A new framework for analysis*. London: Harvester Wheatsheaf.
- Crow-Miller, B. 2015. Discourses of deflection: The politics of framing China's South-North Water Transfer Project. *Water Alternatives* 8(2): 173-192.
- Dias, M. 2016. São Francisco river transposition civil work: Challenges to the Brazilian economy. *The International Journal of Business & Management* 4(12): 65-70.
- Eminotti, V.L. 2007. Re-framing participation: The political ecology of water management in the lower São Francisco River Basin, Brazil. PhD thesis, Department of Geography, University of Colorado.
- Gleick, P.H. (Ed). 2002. *The World's Water 2002-2003: The Biennial Report on Freshwater*. Resources Island Press, Washington, DC
- Gyawali, D. 2013. Reflecting on the chasm between water punditry and water politics. *Water Alternatives* 6(2): 177-194.
- Hensengerth, O. 2015. Where is the power? Transnational networks, authority and the dispute over the Xayaburi Dam on the Lower Mekong Mainstream. *Water International* 40(5-6): 911-928.
- Hirsch, P. 2016. The shifting regional geopolitics of Mekong dams. *Political Geography* 51: 63-74.
- Kaiman, J. 5 June 2013. Inside China's 'cancer villages'. *The Guardian*, www.theguardian.com/world/2013/jun/04/china-villages-cancer-deaths (accessed 2 June 2017)
- Larkin, B. 2013. The politics and poetics of infrastructure. *Annual Review of Anthropology* 42: 327-343.
- Mäkinen, K. and Khan, S. 2010. Policy considerations for greenhouse gas emissions from freshwater reservoirs. *Water Alternatives* 3(2): 91-105

- McDonald, K.; Bosshard, P. and Brewer, N. 2009. Exporting dams: China's hydropower industry goes global. *Journal of Environmental Management* 90(2009): S294-S302.
- Mehta, L. 2001. The manufacture of popular perceptions of scarcity: Dams and water-related narratives in Gujarat, India. *World Development* 29(12): 2025-2041.
- Mehta, L. 2010. *The limits to scarcity. Contesting the politics of allocation*. London/Washington, DC: Earthscan.
- Molle, F. 2008. Why enough is never enough: The societal determinants of river basin closure. *International Journal of Water Resources Development* 24(2): 217-226.
- Molle, F.; Floch, P.; Promphaking, B. and Blake, D.J.H. 2009a. 'Greening Isaan': Politics, ideology, and irrigation development in Northeast Thailand. In Molle, F.; Foran, T. and Käkönen, M. (Eds), *Contested waterscapes in the Mekong region: Hydropower, livelihoods and governance*, pp. 253-282. London: Earthscan. <http://bit.ly/2rIUOC3>
- Molle, F.; Mollinga, P.P. and Wester, P. 2009b. Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives* 2(3): 328-349.
- Radonic, L. 2015. Environmental violence, water rights, and (un) due process in Northwestern Mexico. *Latin American Perspectives* 42(5): 27-47.
- Postel, S. and Richter, B. 2003. *Rivers for life: Managing water for people and nature*. Washington, DC: Island Press.
- Sherwell, P. 2016. \$40bn to save Jakarta: the story of the Great Garuda. *The Guardian*, www.theguardian.com/cities/2016/nov/22/jakarta-great-garuda-seawall-sinking (accessed 23 November 2016)
- Swyngedouw, E. 1999. Modernity and hybridity: Nature, Regeneracionismo, and the production of the Spanish waterscape, 1890-1930. *Annals of the Association of American Geographers* 89(3): 443-465.
- Sze, J. 2015. *Fantasy islands: Chinese dreams and ecological fears in an age of climate crisis*. Oakland: University of California Press.
- WCD [World Commission on Dams]. 2000. *Dams and Development*. London: Earthscan.
- Webber, M. and Han, X. Forthcoming. Corporations, governments and socio-environmental policy in China: China's water machine as assemblage. *Annals of the American Association of Geographers*, in press.
- World Bank. 2016. *High and dry. Climate change, water, and the economy*. Washington, DC: The World Bank.
- World Bank. 2006. *Re-engaging with agricultural water management*. Directions in Development, 35520. Washington, DC: World Bank. http://siteresources.worldbank.org/INTARD/Resources/DID_AWM.pdf
- Yang, X. and Lu, X.X. 2013. Ten years of the Three Gorges Dam: A call for policy overhaul. *Environmental Research Letters* 8(4): 1-5.
- Zarfl, C.; Lumsdon, A.E.; Berlekamp, J.; Tydecks, L. and Tockner, K. 2015. A global boom in hydropower dam construction. *Aquatic Sciences* 77(1): 161-170.

THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS *ATTRIBUTION-NONCOMMERCIAL-SHAREALIKE* LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE [HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/LEGALCODE](http://creativecommons.org/licenses/by-nc-sa/3.0/legalcode)

