Future City 6

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Urban Water Trajectories

Springer

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Future City Description

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Introduction

Water is an essential element of cities. It shapes their locations, form, ecology, prosperity and health. The models for providing water supply and sanitation infrastructure and services that have dominated modern urban development are struggling to respond to climate change, water scarcity, environmental values, globalisation, social justice and the changing nature and speed of urbanisation. Conventional arrangements for understanding and managing water in cities are being subverted by a variety of natural, technological, political, economic and social changes. The prognosis for water in cities remains unclear, and multiple visions and discourses are emerging to fill the space left by the relative certainty of twentieth-century urban water and sanitation planning and engineering.

For much of the twentieth century, urban water and sanitation seemed to follow a universal, engineering-led linear trajectory towards an ever-improved provision using centralised, publically owned infrastructure. This idealised trajectory ran in line with broader goals for development and growth. Technocratic administration of water and sanitation systems assumed faith in the capacity for engineered systems to meet an endlessly expanding demand as the basis for good public health and modern citizenship. By the end of the century, several challenges to these assumptions emerged – neoliberalism, environmentalism, globalisation, urbanisation and climate change.

As visions for a single, unifying trajectory of development for urban water and sanitation systems have faltered, multiple accounts of alternative trajectories have emerged. These serve as counter-arguments and critiques of dominant policy and technical discourse and as narratives and visions for alternate futures. Urban water and sanitation trajectories can be observed and constructed by following the experiences of individual citizens and households, particular technologies, policy framings, environmental changes, political ideologies and collective struggles. Cities are shaped through all of these multiple, sometimes conflicting, trajectories operating at different spatial and temporal scales and involving a diverse range of actors.

This book explores the various issues facing cities around the world as they come to terms with multiple water and sanitation challenges. The four parts of the book address key emerging themes of how urban water is discussed. Water has long been

described in terms of urban *transformation*, circulating through the city, and it will remain a key element in shaping and being shaped by urban form, politics, economies and lifestyles (Part I). Water presents public and private utilities, urban planners, engineers and ordinary citizens with a diverse array of *options* for building infrastructures to meet competing demands under conditions of increasing uncertainty (Part II). Water and sanitation are understood as essential urban *services*, but models of provision remain highly contested, with different visions for ownership and management of infrastructure, the scale of provision and the level of service demanded by users (Part III). Water *politics* is a contentious issue in the future of cities, serving different urban interests as power and water seem to flow in the same direction (Part IV).

Transformations

Culture, politics, ecology and infrastructure co-evolve in cities, and water is a central element to these processes of change. Uncontrolled water is often seen as the source of strife and controlled water as the provenance of productivity and prosperity. Understanding how water infrastructures and cultures have emerged through time and in different places reminds us of the dynamic nature of water and cities. Water infrastructures and cultures of the present are the result of specific imperatives and choices in the past, and urban water systems are also likely to change in the future. In this first part of the book, we examine how cities have transformed and are transformed by water.

Taking a long view of water in Amsterdam, Disco (Chap. 1) shows how this city, famous for its canals, evolved in response to changing drivers for managing water. Controlling and separating different water qualities for varying purposes have been a defining feature of the economy, security, culture and built form of the city.

Jones (Chap. 2) presents a shorter snap shot of the history of water in London, focussing on the construction of the Metropolitan Water Board's Laboratory Building and the associated representation of drinking water as the product of advanced science and engineering. The iconic building and the visibility of water scientists in public education campaigns contrast with the present invisibility of water infrastructure in London.

The loss of traditional water management systems in India and other parts of the world is of increasing relevance as cities confront the failure of modern systems in the face of climate change and rapid urbanisation. As discussed by Sundaresan, Allen and Johnson (Chap. 3), incremental changes to governance, economy, society and built environment in Madurai and Bangalore have encroached upon long-standing water management structures, resulting in water pollution, water scarcity and dangerous flooding. The complexity of sociotechnical relationships that form the current systems for urbanisation, environmental management and infrastructure provision resists simplistic political solutions, such as re-enforcing statist infrastructure management or romanticising precolonial 'community' ownership.

The transformation of water in cities and the transformation of cities by water are a dynamic process. Water makes up part of the background of urban form and daily life, except in times of crisis and rapid transformation. It becomes visible as part of deliberate public campaigns or infrastructure construction, such as in the London of the 1940s and Amsterdam in the 1980s, or on its own terms, such as the present day monsoon floods in Bangalore and Madurai.

Histories of water in cities readily assume a mythical form. A history of public health and environmental crises can provide a rationale for the triumph of modern engineering. Alternatively, premodern systems can be romanticised in the face of current water crises. Moving beyond mythologies, detailed accounts of past water systems show how water, cultures, built form and politics change over time and demonstrate the complexity of relationships to be understood and managed in navigating future trajectories.

Options

Future urban water trajectories are shaped by choices made by city leaders, planners, citizens and engineers. There is an increasing array of technical choices available to construct water infrastructure. Greater complexity of decision-making about urban water and sanitation options challenges conventional technocratic, expert-led governance structures. In many places, neoliberal discourse continues to frame the selection of options, but new forms of knowledge and processes of citizen engagement are emerging, changing the institutional as well as technical form of urban water infrastructure.

Sustainable and integrated urban water management, like sustainable development, has few detractors. In principle, managing all the elements of an urban water system as an integrated whole seems likely to improve sustainability and efficiency, goals that are difficult to disagree with. While the principles of sustainable water management have been articulated in theory, policy and practice implementation is patchy. Hurlimann, Wilson and Keele's comparison of water policy-making and climate change adaptation in London and Melbourne (Chap. 4) shows how local environmental and political factors are shaping water planning and governance. Water policies frame the viability of different technical, economic and social options for improving the sustainability and resilience of urban water systems.

As existing water systems face the possibility of water shortages resulting from population growth, increased consumption, climate change and competition from alternative uses, it is inevitable that engineers will propose technical options to increase supply. Water reuse is an important option for households, building owners and cities to alleviate water shortages. However, water reuse can take many forms, from using wastewater for urban agriculture to centralised reuse of wastewater in potable supply. Different technical forms of reuse, and the choice of reuse over alternatives such as demand management, rainwater harvesting or desalination, have diverse implications for water and energy use, regulation, economics and

public acceptability. Wilcox, Bell and Nasiri's analysis of these options (Chap. 5) highlights the relationships between these different elements of water systems, revealing the impossibility of a purely 'technical' solution to water scarcity.

As policy and technical decisions about urban water systems become more complex, the role of the public in decision-making has become increasingly important. As the fallacy of the 'technical solution' to water infrastructure and water supply is ever apparent, new modes of decision-making are needed to deal with trade-offs and value judgements, as well as different forms of knowledge. Scenario-based planning and stakeholder engagement are increasingly familiar in water planning and management, potentially widening the range of interests represented in decision-making. Participatory mapping in Lima, described by Miranda, Pfeffer and Baud (Chap. 6), has been used alongside scenario-building to engage citizens in understanding and managing responses to current and future threats to safe and fair water supply. This represents an incremental shift in discourses of water policy-making, indicating the evolution of water policy to a participatory democratic basis.

Services

When water is defined as a good, it is frequently in relation to its economic value and price. On the other hand, a growing emphasis is being placed on the social value, people's right to water and the need to serve the entire population, regardless of their ability to pay. The recognition of access to water and sanitation as a human right by the United Nations in 2010, and 2015 for sanitation, as a distinct right, and a renewed commitment to universal access through the Sustainable Development Goals indicate an increased priority of water and sanitation in international and national development. Nevertheless, how to deliver on that promise remains a practical and political challenge.

Policy-makers and monitoring agencies often presume that trajectories towards universal access are linear and unidirectional. Once infrastructure is delivered to a household or urban area, policy priorities are assumed to move forward as planned. Assumptions about the speed, direction and adequacy of access to water and sanitation infrastructure and services can mask complex life stories and pathways for particular people. Within and between households and communities, experiences of urban water and sanitation poverty can vary widely. Hofmann's (Chap. 7) depiction of the multiplicity of factors shaping poverty and influencing access to water and sanitation services in Dar es Salaam shows the value of capturing individual experiences in terms of trajectories into and out of water poverty, rather than a homogeneous, linear trend of progressively improved access. Experiences of water and sanitation services by vulnerable women and men can track wider life stories of poverty and marginality, which rarely conform to engineering models and policy assumptions.

Water and sanitation infrastructure and services track broader social, political and economic trends. Just as 'entrepreneurialism' and 'innovative service delivery'

have entered other areas of urban life and the economy, so they have come to feature in policy and delivery of sanitation services worldwide. Keatman (Chap. 8) analyses the role of independent entrepreneurs in delivering sanitation services in Malawi and Tanzania, highlighting opportunities, but also limits to addressing the global sanitation crisis through small and medium enterprise-based business models, particularly with regard to offering feasible solutions for lower-income citizens.

Cochabamba came to international attention at the turn of the twenty-first century, as a result of its 'water wars', when local activism overturned the privatisation of the city's water infrastructure. Walnycki (Chap. 9) tells us 'what happened next', demonstrating the ongoing complexity of achieving equity in urban water provision, whoever owns the infrastructure. People living in marginalised parts of the city still remain underserved compared to wealthier neighbours, and efforts at community management and participation in water infrastructure bring added burden for some. Cochabamba and other similar cases of struggles against privatisation provided some of the impetus for the United Nation's declaration on the human right to water, yet institutional, economic and technical complexity remain when delivering water services to all.

Remunicipalisation of water infrastructure has occurred for different reasons in many cities, countering the trend towards privatisation since the end of the twentieth century. Lobina compares remunicipalisation in Berlin and Buenos Aires (Chap. 10), noting divergent motivations and strategies. In Buenos Aires, water infrastructure was returned to public ownership through administrative reform within a volatile economic climate, while in Berlin, remunicipalisation happened in response to a wider public movement and activism, reflecting a broader movement towards communitarian politics.

These and other cases of changing ownership and management models for infrastructure and delivery of services show that water governance remains dynamic. Water trajectories are influenced but not determined by broader political currents as they are shaped by the multilayered interplay of actors at different levels. The materiality of water and the universality of human needs mean that water is a 'special case', fundamentally resistant to attempts to manifest political and economic ideology in their purist forms. The early twenty-first century has seen a reorientation of water trajectories away from efforts to redefine it as a purely economic good, yet delivery of water and sanitation remain a complex task.

Politics

Water struggles in and around cities are intimately connected with ongoing struggles for water democracy and the right to the city. Influenced by the process of water commodification, a high diversity of public, private and citizen-led practices are emerging – as analysed in Part III – reinforcing or challenging water archipelagos of uneven and unequal entitlements. The chapters in this part examine the political

nature of contested water visions, experiences and practices unfolding in contemporary cities and their potential to transform state-market-citizen relations.

Considering water in terms of wider urban trajectories offers insight into opportunities and constraints to developing more sustainable and equitable processes, forms and outcomes. White (Chap. 11) provides a review of the relationships between water and urban planning and form. Future trajectories of urban water are constrained by past and present urban form, institutions and cultures. How well water systems can adapt to climate and environmental change and growing urban populations partly depends on historical water trajectories and wider debates about urban futures. Transitions to new forms of water infrastructure and services happen as part of longer infrastructural and hydrological trajectories, within dynamic urban *milieus*.

Trends towards privatisation and neoliberal governance of cities since the 1980s have shaped the form of cities and water infrastructure, with uneven distribution of costs and benefits. The consequences play out in different ways in diverse cultural and economic contexts, as Ioris shows (Chap. 12). Comparing the experience of Glasgow and Lima demonstrates how water and urban trajectories have been steered and shaped in similar ways by the politics of privatisation in post-industrial and developing economic contexts.

The long view of the changing form and politics of urban water provision can reveal the connections between access to water services and ideas of citizenship. In her analysis of the changing role of kampungs in Batavia, subsequently Jakarta, Putri's contribution (Chap. 13) shows how water and sanitation service provision reflects definitions of citizenship. The right to these services is part of a wider right to basic infrastructure services, which comes with place-based definitions of urban citizenship. Trajectories of citizenship run alongside trajectories of provision in modernising cities. Changing forms of water governance and infrastructure towards decentralised systems with higher levels of community participation trace alternative trajectories of place-based citizenship to those historically pursued by the colonial and post-colonial state.

Trajectories

The materiality of water provides a unique position from which to view wider urban trajectories. Water is heavy to carry and easily contaminated, and, although renewable, freshwater is a limited resource. It requires energy to treat and transport. While essential to human health and urban life, it is often overlooked in histories, theories and future visions of cities. Urban discourses viewed through water are refracted and occasionally magnified and clarified. Water and sanitation systems respond to the same pressures and trends as the cities they serve, but with more vital and less negotiable consequences.

The contributions to this book map multiple trajectories of urban water and sanitation. Trajectories imply continuity without linearity. Trajectories intersect and

interact and trace movement in different directions at different speeds and scales. Trajectories track the overall direction of movement as well as finer dynamics of chaos and turbulence. They imply change.

This book aims to portray the multiple trajectories of urban water, at different places, times and scales. It aims to reflect and analyse the complexities of water in cities, beyond linear narratives of progress or degradation. Detailed understanding and comparison of particular trajectories in particular cities reveal the choices that are faced and made in bringing water to people, disposing and treating it and making cities. Trajectories are tracked at different scales, from individual lived experiences of water poverty to global trends in political discourse and, at different times, from precolonial and premodern urban histories to future visions and projections.

Trajectories show the movement of politics, technology, infrastructure, societies, institutions and water through time and space in cities. Future trajectories are shaped by current and past conditions, but are the outcome of choices made by urban professionals, governments and citizens. This book seeks to inform and problematise those choices and how they are framed.

Part I
Water Transformations

Water is constantly being transformed due to human physiological demands. We can be dehydrated by a lack of water, drowned by an inundation of water, and made ill by the wrong quality of water. To live, a delicate balance is needed between too little, too much, and good quality water. We are constantly moving to and from water or transforming the external environment to maintain this balance. In cities it is all the more obvious, where failure in supplying water or protecting from inundation can result in human fatalities. Water, people and the environment in cities are transformed so that the right water quality, quantity, and location are maintained for human life and culture. Once these water attributes can be controlled, their transformations are then expanded beyond the metabolic requirements of the human body, stretching into public health, economic transactions, ecosystem health and cultural flows. Citizens and water professionals must also continually operate and maintain this coordinated transformation in order for these capacities to remain. The next chapters demonstrate how these water transformations occur over time in Amsterdam, London, Bangalore and Madurai.

Amsterdam is characterised by its canals. Disco (Chap. 1) traces their history from the first permanent settlement on the shores of the Amstel river around the year 1100 to the environmental, economic, public health, military, and cultural rationales that resulted in an ever more intricate and sophisticated construction of dams, sluices, harbours, dikes, and canals. Each alteration to the city's water metabolism transforms the environment and the dominant value that people imbue water with, whether it is health, trade, military, or aesthetic. The long-time range of this historical approach reveals the trajectory of Amsterdam's water systems. The pre-existing water systems are integral to the context from which new water values arise and every addition modifies and responds to the pre-existing system. Amsterdam's water futures are tied to its water past. Its present canals still have seventeenth century features that are operational today. Its current water trajectories suggest a reinvigoration of waterborne transportation, drawing together the heritage of the canals and current concerns with urban sustainability and regeneration.

Jones (Chap. 2) contrasts the long time frame explored by Disco by investigating a historic moment of change in London's drinking water infrastructure, where the Metropolitan Water Board elevated the science of drinking water within the city to make a concerted effort to alter how drinking water is consumed. Between the mid-1930s to the late-1940s, several water famines escalated a need to change drinking water consumption culture in London to maintain citizen health. The strategies aimed to raise the stature of tap water by educating Londoners about the effort and processes of creating drinking water and making it a more precious, carefully-used daily resource. This was reflected in the design and location of a modern drinking water laboratory in London's inner city; a public relations campaign showing scientists producing drinking water; lectures about water quality; and site visits to waterworks. In the midst of this period, the war and its damage to drinking and wastewater infrastructures brought the necessity of water to the city's metabolism into further prominence. The general public were also generating safe drinking water by using home chlorination kits. This period of exalting the production of municipal drinking water has long since passed. While the quality of drinking water has not decreased, the transformation of raw water into drinking water is once again opaque to ordinary citizens. However, a prolonged drought and forecast water scarcity may once again ignite a new trajectory that re-values drinking water and its provision system.

The final chapter in this section adds two contemporary water management ethnographies in Bangalore and Madurai. Both these Indian cities contain decaying waterways and lakes, once used to store and transfer water stocks for the dry season. Alternative water sources developed in recent decades like municipal supply, tube wells and private water suppliers in these cities of growing population has meant that much of their inhabitants no longer depend on historical blue infrastructure as a source of drinking water. Simultaneously, increasing land value has led to the conversion of these systems into dry land for building. Where this has not occurred, the water systems provide a convenient way for households and industries to dispose of their liquid and solid wastes, causing pollution and decreasing its drinking quality. The fragmentation and deterioration of these cities' blue infrastructure heritage has transformed a once viable management system into a habitat for disease to grow in the dry period, and a lack of protection from flooding during the monsoon season as there is insufficient space to contain the water. Sundaresan, Allen and Johnson (Chap. 3), argue that this change from a water transformation that historically aided human life to one that creates conditions threatening human life and livelihoods is a consequence of altering political relations of governance. Bangalore and Madurai are cities where the water transformation trajectory should aim to save human life but new governance arrangements make this nascent trajectory difficult to achieve.

The authors of these three chapters demonstrate how the delicate balance between too much and too little water, and the quality of water required by human and nature's metabolism, underlies the continuing transformation of water in these urban environments. However, the water trajectories play out in very different ways due to the interrelationships between physiological needs, geographical constraints,

cultural values and socio-economic and political processes. Amsterdam and London tell of water transformations partially successful in maintaining and enriching human lives over certain periods of time; while Bangalore and Madurai illustrate water transformations degraded until they threaten human life, which then inspires new efforts of governance to regain water resource management. Together these cities demonstrate that the history of water transformations in each place alters the possible trajectories of the future because they modify and are modified by water's geographical constraints, cultural values and wider changes shaping the political economy of urban development.

Chapter 1
Dividing the Waters: Urban Growth, City Life and Water Management in Amsterdam 1100–2000

Cornelis Disco

Abstract Taking a long-term view of urban water metabolism in a single city reveals the *regime-like* quality of specific water trajectories and hence their ephemerality. In Amsterdam's long history with water, each successive regime was based on specific values attributed to water and hence was the outcome of latent or overt social conflicts. This relativistic view gives hope that contemporary oppressive or unsustainable water regimes may also not be forever. This study of Amsterdam's water metabolism goes back to the founding of the city around 1100 up to the present. It shows a succession of water regimes based respectively on the core values of safety, commerce, residential segregation, and ecology/tourism. 'Safety' was embodied in a 'division of the waters' between salty and treacherous outer water and fresh and pacified inner water. This value was renegotiated in subsequent regimes until the transformation of Amsterdam's hydrological context in the late nineteenth century put the burden of safety on regional and national sea defences. At the same time new shipping and harbour technologies liberated Amsterdam's inner waters from their commercial yoke and paved the way for their transformation into a major international tourist attraction and urban playground.

1.1 Introduction

It is instructive to look at urban water trajectories in the *longue durée* because a time span of centuries helps to reveal the *regime-like* nature, and hence ephemerality, of what at first sight may seem to be fixed constellations of urban water metabolism.[1] The *longue durée* gives us hope that contemporary urban water trajectories need

[1] I use 'regime' here to indicate a constellation of socio-technical practices that incorporates particular social interests and a specific range of technologies to achieve valued outcomes. The question is always: 'Who has the power?' not 'Who is right?' or 'What is most effective?' The notion has a strong affinity with Thomas Kuhn's (1968) concept of 'paradigm'.

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not be trapped in their own momentum and can – even in the short term – be transformed. The city of Amsterdam is a relevant example because its ubiquitous waters have been viewed in many different ways and put to many different uses over the city's more than 700 years of existence. Tracing the history of water trajectories in Amsterdam from the settlement's inception in the twelfth century up to the present day reveals how regimes of urban water metabolism were shaped and sometimes overthrown by new visions, ecological transformations, pragmatic opportunism, international politics, religious revolutions, economic chances, epidemics, new divisions of affluence, and patterns of residential segregation – to name just a few.

The key dynamic of Amsterdam's water trajectory was a centuries-long 'division of the waters' between salt 'outer water' and fresh 'inner water'. Overlapping regimes took shape around different perceptions and evaluations of the necessity for and the value of maintaining this division – and the precise way it was maintained and ultimately abandoned – under ever-changing historical and hydrological conditions.

The division (in the form of a dam across the Amstel with its contiguous dikes) was originally instituted to keep the city and its surroundings safe from high water. Amsterdam's subsequent water trajectory, involving such disparate concerns as military defence, waterborne commerce, sewerage, drinking water, drainage and city planning was intimately configured around this basic division. In this chapter, it will become clear that these successive configurations of urban water were not simply given by Amsterdam's geographical setting and the subsequent division of waters, but were the outcome of further choices determined by struggles among different social interests – struggles in which specific interests sometimes prevailed for so long that some water regimes came to seem self-evident and self-justifying.

This story goes back to the founding of the city around 1100 and traces the history of Amsterdam's water metabolism up to the present. It shows a succession of water regimes based respectively on the core values of safety, commerce, residential segregation, and ecology/tourism. The story begins with the effects of the construction of a dam in the Amstel in the twelfth century. The subsequent section describes the fate of Amsterdam's waters as the city developed into the commercial metropolis of the seventeenth century. Section 1.4 focuses on the seventeenth century and describes what I call the decadence of Amsterdam's inner waters – in a way a portent of Amsterdam's overall eighteenth century decline. Section 1.5 takes us into the age of steam and tells the story of the revitalisation of Amsterdam's harbour and the effective end of the duality between inner and outer water. The penultimate section describes Amsterdam's present water regime based on tourist packaging and the use of water as an urban playground. Conclusions are drawn in a final section.

1.2 The Dam in the Amstel: 1100–1300

Sometime near the end of the twelfth century migrants from higher grounds to the east began to settle permanently on the muddy shores of the Amstel River where it discharged into the IJ. The latter body of water (pronounced more or less as 'eye' in English) was a fossil river that lost its outlet to the sea and in stages became an elongated (and saline and tidal) bay at the south-western extremity of the Zuiderzee, an inner sea that was itself connected to the North Sea via tidal channels at its north end. The settlement's location at the mouth of the Amstel would ultimately shape Amsterdam's future as a trading city, but for the time being fishing and farming was the main source of livelihood. The situation changed at the outset of the thirteenth century as increasingly frequent storm surges and rising sea levels (not to mention land subsidence resulting from drainage) began to threaten the farming communities located upriver along the Amstel (Van Dam 2007). This prompted the building of a closure dam across the mouth of the river, though it is unclear exactly when and at whose initiative. The dam contained sluice gates that enabled the river to discharge into the IJ but kept high waters and storm surges out. With this barrier to the sea, Amsterdam's die as a trading city was cast.

Though it offered security from high waters and greatly facilitated land traffic, the dam was an obstacle to inland navigation up the Amstel. This profitable business had begun to develop in the thirteenth century after the IJ became increasingly accessible for seagoing vessels from the North Sea thanks to a succession of major storms that scoured out new channels and slowly transformed the freshwater Almere into the unruly and tidal Zuiderzee. However, only relatively small boats called dam-runners were able to navigate the dam's sluice gates. By virtue of this division of the waters, navigation 'through' Amsterdam – i.e. the route from the North Sea/Almere/IJ to the Amstel and thence to the canals and rivers leading to Flanders, France and Germany – now required that cargoes from seagoing vessels be unloaded and transferred to canal barges. Amsterdam's shippers, quays and warehouses became an obligatory point of passage and the city *nolens volens* became a major trading *entrepôt*. To facilitate this, the stretch of river outside the dam was narrowed by landfills and provided with quays for mooring vessels. By 1300, perhaps 125 years after the first inhabitants arrived, Amsterdam had become a town of about 1000 inhabitants grouped around a harbour and a dam in the Amstel. It had domesticated a bit of outer water (its sheltered harbour, the Damrak) and begun to incorporate inner water into its urban fabric (a stretch of Amstel upstream of the dam, called the Rokin, see Fig. 1.1).

At this point in time, managing Amsterdam's modest amount of inner water – i.e. maintaining a constant level and keeping it clean – was a relatively simple affair. The river was able to discharge through the sluice gates at low tide, thus ensuring a more or less constant water level and a supply of clean fresh Amstel water. Faecal and domestic wastes were as yet a minor concern; they were doubtless simply

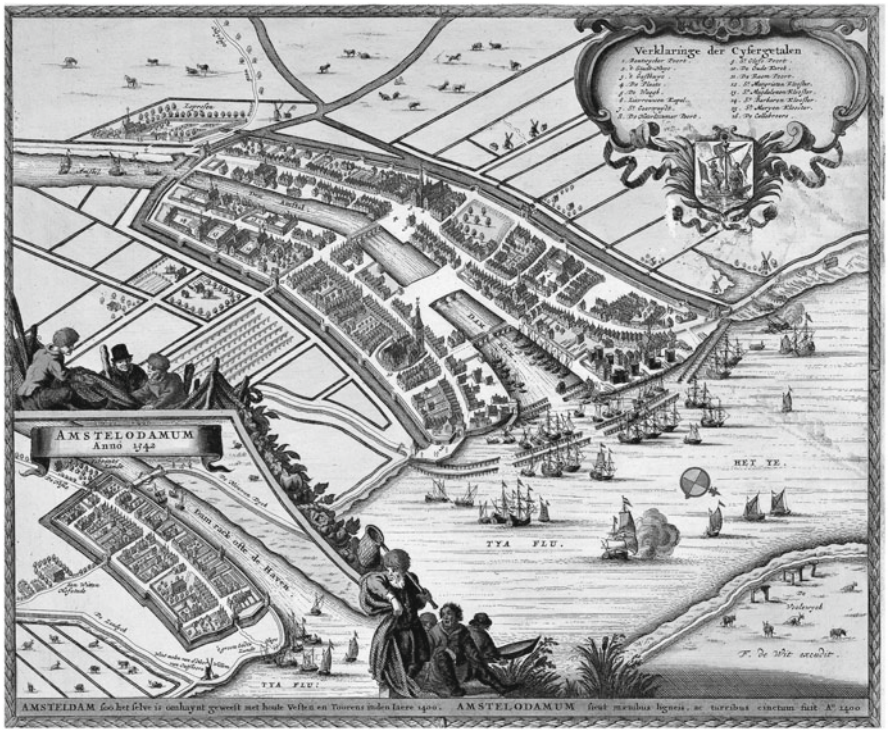

Fig. 1.1 *Amsterdam as it was, enclosed by wooden palisades and towers in the year 1400* (artist unknown). Printed by Frederik de Wit, 1700. The *inset* shows the (presumed) situation in 1342. These are imaginaries of early Amsterdam from the perspective of 1700, based on scant archaeological and archival evidence. Debate on the precise dates and situation is ongoing (Source: Rijksmuseum Amsterdam)

dumped into the river but readily flushed out into the IJ through the sluices in the dam. Clean drinking water was plentiful, certainly upstream of the town, and wells were dug.

1.3 Prosperity and Expansion: 1300–1673

Between 1300 and 1673 Amsterdam expanded far beyond its initial frame as it developed into the early modern world's pre-eminent commercial and maritime centre. While the sea-dikes and the dam remained the keystone of Amsterdam's hydrological structure, urban expansion and the elaboration of canals considerably complicated water management in the city as it also transformed the perception and use of inner water (Mijksenaar 1951).

The original foundation of Amsterdam's seventeenth century 'Golden Age' was the beer trade with Hamburg that had taken off by the mid-fourteenth century. This expanded over the next century to include wood, grain and a host of other commodities from the Baltic regions. As noted, the sea-going vessels that maintained this trade, so-called cogs, were far too large to pass through the dam sluices and navigate up the Amstel. Hence, Amsterdam began to specialize in transhipment, storage and the primary processing of many kinds of goods. Essential to this development was the creation of an inner water frontage in the form of sheltered canal quays and rows of waterfront warehouses. However, this commercial *kidnapping* of the canals was only an opportunistic new use for waters that, with few exceptions, began life as defensive moats.

These moats were dug because by 1300 Amsterdam had become wealthy enough to require military defences in the form of wooden palisades mounted atop raised clay walls. The palisades were fronted by defensive moats dug into the peat marsh. On the west (new) side a portion of the existing drainage canal called the *Boerenwetering* was recruited for this purpose; on the east (old) side a new canal was dug and the excavated earth used for the ramparts. Neither of these canals seemed, at that point, to have been connected to the Amstel and so were still part of the town's 'outer water'.

But this soon changed. By 1385, Amsterdam's *entrepôt* trade was nourishing a growing population and a new expansion of the urban perimeter was deemed necessary. A second line of canals, the present-day *Oudezijds and Nieuwezijds Achterburgwallen*, were laid out parallel to and outside of the older *Voorburgwallen*. The excavated clay was used to elevate the terrain between the *wallen* and to make new earthen ramparts. This expansion marks the first actual incorporation of canals (namely, the 'first generation' of *wallen*) within the city's defensive perimeter and the beginning of the Amstel's artificial delta.

After 1385, Amsterdam's inner waters resembled a three-pronged fork, with the Amstel as the central prong flanked by two canals. The prongs were connected at their upstream ends by short canals perpendicular to the river and joined together again at the downstream IJ-end before passing through sluices in the sea dike. Under this regime, with relatively few canals and a still-modest population, Amsterdam's inner water still appears to have been adequately flushed and in consequence remained quite clean – clean enough, in any case, for the city magistrates to grant the militia exclusive fishing rights in the *burgwallen* in 1394. And clean enough for beer brewers to use the water in the *Oudezijds Voorburgwal* in the last stretch before the sea-dike to brew beer (Hogenes 1997, p. 30).

However, for this to be considered possible doubtless owed more to adequate flushing than to the hygienic discipline of Amsterdam's populace. Though cesspools appear to have existed, a fair amount of human excrement and other refuse must have ended up in the canals. As long as these could be adequately flushed, pollution could be held more or less at bay. The problem was that the more ramified the urban waterway network, i.e. the greater the number of parallel canals incorporated into the Amstel's urban delta, the less water was available per canal for flushing. So there was an inverse correlation between water quality and the elaboration of the

waterway network as successive defensive moats were incorporated into the inner water system as the city expanded.

Indeed, in 1437, a third expansion of the city's territory was deemed necessary, and new moats were again dug (Hogenes 1997, p. 32). Both of the new moats branched off from the Amstel upstream of the *burgwallen* and thus constituted two new channels by which the river discharged into the IJ. This doubtless contributed to the degradation of inner water quality in the course of the fifteenth century. By 1480, in fact, pollution had increased to such an extent that the beer brewers were compelled to have their water shipped in from a nearby lake, the *Haarlemmermeer*. Around the same time, a law was enacted stipulating that privy pots could only be emptied in special depots under the bridges and not into the canals themselves. With this, the Edenic metabolism with inner water was broken for good. From now on, old routines for dealing with waste would be burdened with guilt – though as it seems of an easily suppressible sort.

The former moats (*wallen*) had become elaborations of the IJ and the Amstel into the tissue of the city and would eventually be transformed into a ramified internal navigational and stevedoring network that permeated the entire body of the medieval and early-modern city. Barges fitted with strikable masts could be sailed, rowed or poled to any destination along the Amstel or the *wallen*. This meant that the storage and primary processing of commodities unloaded from seagoing ships was no longer limited to locations along deep-water quays but could be carried out almost anywhere in the city.

The famous bird's-eye view of Amsterdam painted by Cornelis Anthonisz in 1538 (redone by him as a woodcut in 1544) shows the new brick city walls ordained by Hapsburg Emperor Maximillian and completed in 1508 (see Fig. 1.2). The walls and the course of the sea dike through the city are clearly visible as are many of the hydrological features and details of Amsterdam's new stevedoring regime described in the preceding paragraphs.

1.4 More Canals, Pollution and Hydrological Autonomy: 1600–1700

Maximillian's brick walls did not last long. Between 1567 and 1630, Amsterdam's population quadrupled (from 30,000 to 115,000). But it was not until the 'alteration' of 1578, in which Amsterdam joined the Protestant rebellion against Catholic Spain, that a new (Protestant) municipal administration took steps to alleviate overcrowding. By 1585, with other options exhausted, the city fathers had no choice but to tear down the constricting walls and replace them with a much roomier girdle of up-to-date earthen ramparts with bastions.

Once again, moats dug outside the former city walls were incorporated into Amsterdam's inner water to serve as drainage conduits and navigable canals. But this time something novel was added. A new canal was dug just *inside* of the new

Fig. 1.2 *The Famous Merchant City of Amsterdam reproduced with all its Waters*, Cornelis Anthonisz, 1544. Woodcut on 12 blocks. North is toward bottom right (Source: Rijksmuseum Amsterdam)

ramparts in order to drain the new extension and provide it with waterborne transport. This so-called *Herengracht* thereby became the first of Amsterdam's canals with non-military origins.

Less than 30 years later, this turn to civilian inner water was consummated in a radical new venture in which both military and civilian utilitarian considerations took a back seat to the use of urban water as an element of urban *aesthetics* and as an instrument of *social stratification*. This was prompted, as usual, by the need to increase the city's residential capacity as population continued to mount. But now, in the middle of the 'Golden Century', there was also a demand from the city's opulently wealthy class of merchants and bankers for spacious and aesthetically-pleasing residential quarters with large gardens (Taverne 1978). This culminated in what is widely regarded as one of the first and most felicitous instances of early modern city planning, celebrated by Lewis Mumford in these words: 'Nothing so

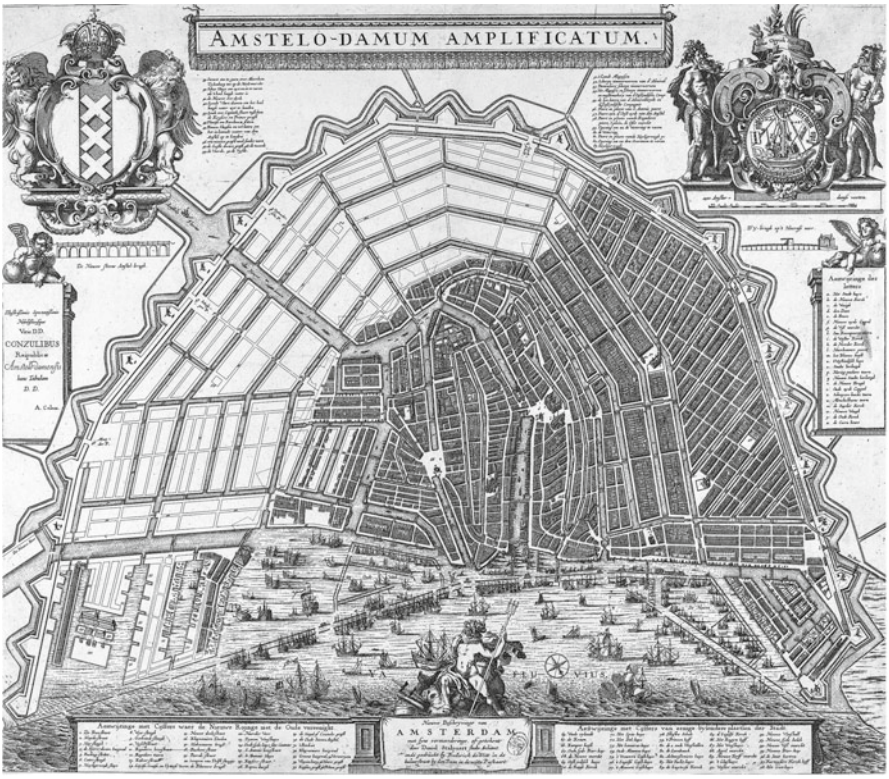

Fig. 1.3 *New Depiction of Amsterdam showing its expansions*, Daniel Stalpaert, 1657. North is toward *bottom right*. The original expansion is visible as the built-up area between the three evenly spaced canals to the right of the map plus the extensive workers' quarter with the skewed canal and street pattern. The new expansions designed by Stalpaert himself as municipal architect are blocked out around the south and east of the old city (Source: Rijksmuseum Amsterdam)

thoroughly and uniformly good as Amsterdam had previously made its way into city design, on the same scale, anywhere' (Mumford 1961, p. 443).

The project ultimately bequeathed Amsterdam the renowned semi-circular canal structure that is now a UNESCO World Heritage site. The initial expansion was a far cry from what we see today. In fact, it was rather more like two slightly angled rectangles with ancillary working class quarters than anything like a circular pattern. But by 1657 the financial and social success of the first project prompted a further extension of the three-canal pattern up to the western shore of the Amstel (see Fig. 1.3).

The great number of new branches now added to Amsterdam's urban delta completely overtaxed the Amstel's ability to flush the system. With every added watercourse, the current grew more sluggish and flushing became less effective. The new expansion on the west side of the city only increased the already existing sanitary problems. Widespread fish mortality in the canals in 1620 was handwriting on

Fig. 1.4 *The Golden Bend in the Herengracht in Amsterdam from the West*, Gerrit Adriaensz Berckheyde, 1672. Berckheyde's draughtsmanlike depiction shows the restrained opulence of the dwellings in this new quarter and the prominence of water in creating what is clearly a post-medieval urban space. The huge gardens behind the houses – an obscene luxury in this very crowded city – are hidden from public view (Source: Rijksmuseum Amsterdam)

the wall. After severe storms in 1621, with dike-breakthroughs near Diemen, the plague broke out in 1622, killing 6000 of the city's 120,000 inhabitants. In 1636, the plague struck again, killing 17,000 out of the population of 150,000.

Pollution and plague were not the only problems. Storm surges were ever more frequent and severe. Amsterdam too was falling prey to the general hydrological deterioration of Holland in the early-modern period (van Dam PJEM 2007). Like all low lands behind dikes, Amsterdam faced not only the threat of high water outside the dikes, but also the challenge of discharging surplus 'inner' water into tidal outer water, especially when, under the influence of storms, the latter failed to fall to normal low tide levels – sometimes for weeks at a time. In 1637, a year after the plague, a northwest storm forced the water in the IJ to such heights that discharge of the swollen Amstel was impossible and Amsterdam's inhabitants had to resort to rowboats to get about. In 1651, two storm surges in rapid succession attacked frontally and breached the city's sea dikes.

Clearly, the very division of the waters was at stake and new defensive measures were in order. Around 1650, the city's sea dike had already been rerouted across the mouth of the Amstel so as to bring the entire projected three-canal semicircle, including the new *Plantage* project, within the primary sea defences. In the 1680s, Amsterdam's mathematician-mayor, Joannes Hudde, appointed a commission of

experts to establish a new standard for dike and lock heights in the city. The commission's high water benchmarks are still visible today on several of the former sea-locks.

But better sea defences could do nothing to alleviate the problem of flooding due to high river stages in the Amstel. On the other hand, when the Amstel was low, flushing the city's canals with infusions of IJ water caused saline and other intrusions into the river. This burdened upstream settlements that depended on the Amstel for irrigation and drinking water. At Hudde's instigation, a new set of locks was built in the Amstel where the river entered the city. Completed in 1673, the locks essentially redefined the upstream Amstel as also 'outer' water and transformed the city into an autonomous hydrological entity. When the locks were closed, high water in the Amstel no longer affected levels in the city's canals. Moreover, by keeping Amsterdam's waters from backing up in the Amstel when the river was low, flushing the canals with IJ water could be vastly more effective.

In 1681, a new plan for flushing the now fully-autonomous inner water of the city was put into effect. The system involved no less than 16 locks and gated culverts scattered throughout the city, plus two windmills for pumping 'exhaust' water into the drainage canals of adjacent polders whence it was ultimately returned to the IJ. *Grosso modo* the procedure was to admit IJ water at high tide through the locks and sluices in the centre of the city and return it to the IJ at low tide through locks on the western and especially the eastern extremities. The system was subject to continual refinements in later years, but remained in force until 1875 when the IJ ceased to be tidal. Flushing the canals was no luxury as witness an ordinance of 1700 forbidding dumping in the canals, including faecal matter from the privies (Wagenaar 1760–1767). That old customs nonetheless die hard is attested by the fact that in 1826 the city's fathers were forced to promulgate an almost identical ordnance.

1.5 Amsterdam in the Age of Steamships, Canals and Railways: 1850–1920

The eighteenth century was unkind to Amsterdam. It ceased to be the first market and storehouse to the world. A seemingly endless series of storms, fires and even earthquakes caused much damage and even threatened the city's survival. One storm-surge in 1775 set all of the city outside the sea dikes under water and was only a mere three or four inches shy of flooding the city altogether (Hogenes 1997, p. 60). To add insult to injury, the sea approaches to Amsterdam had begun to silt up. The sea route to Amsterdam had always been difficult and tortuous, but now heavily laden ships found the route next to impossible. Many merchants found up-and-coming harbour cities like London and Hamburg much more congenial (Mak 1999, p. 151).

It was not until the second half of the nineteenth century that Amsterdam's economic tide began to turn, and as in the thirteenth century it was a transformation in

the hydrological context that provided the impetus. In 1861, work began on a new large-scale seaway leading from Amsterdam's ailing harbour due west to the North Sea at IJmuiden. In 1871, as part of this project, the eastern end of the IJ was also closed off from the Zuiderzee by a dam. From that moment on, the waters of Amsterdam's harbour ceased to resemble traditional 'outer' water, having been deprived of salinity, current, tides and, most dramatically, vulnerability to storm-surges. Amsterdam's harbour had in effect become one big tide-less freshwater dock. Except for the nightly flushing, the canals were now kept open to the IJ and vessels could navigate in and out of the city without the bother of locks. Dangerous 'outer' water in the form of the salty Zuiderzee had now been pushed back two or three kilometres from the city's actual waterfront. The North Sea was certainly closer than it had ever been, but it too was kept at bay some 50 km to the west behind even more formidable barriers and locks.

This new hydrological situation, coinciding with the transition to steam-powered vessels and railway transport, breathed new life into Amsterdam's port. Major investments in harbour facilities on the open IJ were now far less risky and expensive. This came at an opportune moment. The size of seagoing vessels increased dramatically with the turn to steel hulls and steam power while railroads promised to revolutionise stevedoring regimes. Transit traffic rapidly replaced the old warehousing regime. Unloading ships directly into railway wagons required long and sturdy deepwater quays. The existing docks were simply unsuited to the new requirements. Completion of the North Sea Canal thus inaugurated a period of energetic harbour-renewal. Ironically, while the distinction between 'inner water' and 'outer water' was becoming increasingly fuzzy, the distinction between the city and the harbour – and between the activities appropriate to each – was becoming clearer than ever before.

It might be thought that rejoining the waters would bring about improvements in water quality in the city. Nothing was further from the truth. Lacking tides that formerly provided the gradients necessary for flushing, the inner city canals were more than ever clogged with filth and at times smelled execrably, especially in dry summers. Contemporary testimony corroborates this:

> While returning to the boats, we smelt the canals rather strongly. [We were] … glad to reach the sweeter water of the IJ. I believe that advantage is taken of the slight rise and fall of the tide in the IJ to flush the canals, or rather, to cause a slight circulation, and consequent refreshing of the water in them. But I must say I should not care to live in Amsterdam in August (Davies 1886, p. 55)

The deterioration of the canals was a complex result of a rapid increase in the urban population at the advent of industrialisation, increased wastewater due to the adoption of piped-in water, the lack of an independent sewer system, and finally the increasing difficulty of flushing the canal system, especially after the closure of the IJ from the Zuiderzee in 1871 (Hogenes 1997, p. 68). Amsterdam's version of the hygienic offensive that exercised city councils everywhere at the end of the nineteenth century deployed three approaches to alleviating the pollution of the canals: (1) build an effective sewer system to reduce the waste load on the canals,

(2) improve the flushing of the canal system and (3) fill the canals and transform them into new thoroughfares for burgeoning land traffic.

All three of these options were on the agenda after 1870 and provided fodder for interminable controversies (Disco et al. 2001; Buiter 2005). A sewer system was considered frightfully expensive, especially in view of the existence of canals that in the eyes of many effectively performed the same function. Effective flushing had only become more difficult and expensive after the closure of the IJ, and, in view of the fact that by the 1870s the canals had all but lost their commercial function, filling them in became the cheapest solution. Like the surrounding territory, the city itself became much dryer in the second half of the nineteenth century than it had ever been. Land was in, and water was out, though there was a deep current of resistance against what was seen as the modernist desecration of Amsterdam's 'romantic' waterscapes. But the urban elite seemed tired of its old and smelly (and now also unprofitable) canals and more enthusiastic about land-based projects like the Vondelpark, with its English landscaping, the new Artis Zoo in the park-like 'suburb' of the *Plantage*, or any of a number of plans to retrofit the baroque city with Hausmann-like avenues and squares (Mehos 2006; Schreiber 2011).

Nonetheless enough canals remained to justify some deep thinking about improved flushing arrangements. In 1879, a steam-powered pumping station was installed near *Zeeburg*, which every night pumped large quantities of Zuiderzee salt water into the city's canal system. Flushing now proceeded from east to west – a situation that has prevailed to this day. The new regime renewed the introduction of salt water into the city's canals, which meant that the city had to manage its inner water as an autonomous system with carefully controlled inputs and outputs. Although the distinction between inner and outer water remained pregnant, it was no longer a one-dimensional distinction. Inner water was now fresh and salty, stagnant and flowing, and subject to (artificial) changes in level. Outer water could be fresh and salty, tidal and subject to artificial changes in level, pacified as well as treacherous.

1.6 Full Cycle. The Rediscovery of Urban Water: 1970–2000

There had always been those who extolled the beauty of Amsterdam's canals – despite their anything but aesthetic origins (at least of most of them) and their frequent malodorousness. By the 1970s, with the gradual incorporation of the old city into the existing municipal sewer system, the smell had begun to abate considerably and this doubtless contributed to the growing consensus that the canals could actually be the jewels in Amsterdam's crown and ought to be a focus of civic pride. By then, plans like those proposed by Amsterdam's police commissioner in 1964 to transform the *Herengracht*, *Keizersgracht* and *Prinsengracht* into traffic thoroughfares and parking lots had become utter anathema.

The canals were becoming an integral part of urban life again, though in a manner never imagined by their original builders. They began to serve for housing, as

the explosive increase in the number of picturesque houseboats attested. They also contributed in no small part to Amsterdam's growing reputation as an international urban playground, as they provided the city with an anarchic space of freedom from congestion and regulation. Rowboats, canoes, rafts and increasingly all kinds of powerboats began to populate the canals in a kind of festive pantomime of the seventeenth century's bustling commerce. Through it all, the workaday barge trains of the Municipal Sanitation Department, laden with mounds of garbage, came and went as they always had, as a sober reminder of the canals' grave and laborious past. The new appreciation for inner-city water has even generated proposals to re-dig a number of previously filled-in canals.

However, just as in the past, the different uses and values placed on urban water fuels chronic conflicts. Houseboat residents are anything but enthusiastic about the never-ending stream of sightseeing boats, to say nothing of the swarms of noisy pleasure craft that pass within centimetres of their dwellings on summer days. Both citywide and neighbourhood houseboat associations have pressured the authorities to regulate what they consider an unbridled abuse of public space – and with some success (Amsterdam Houseboat Associations 2015). The pleasure crafts are definitely also a thorn in the side of the tour boat operators who now have to manoeuver around 'undisciplined' and sometimes inebriated amateur navigators that prevent them holding to their profitable schedules. The houseboats in turn are regarded with suspicion by an interest group called 'Friends of the Inner City'. This group views living on water as a potential threat to the integrity of the historical canals (Vereniging Vrienden van de Amsterdamse Binnenstad 2015). Oddly the 'Friends' seem to have fewer qualms about parking their equally unsightly cars along the same canals. Automobiles are also an issue when it comes to restoring previously filled-in canals. Restoration inevitably means eliminating parking spaces and many residents would rather be able to park their cars than enjoy the view of yet another canal.

Despite all these conflicts, there is no sign that the transformation of Amsterdam's erstwhile inner water into an urban playground and world-class tourist attraction is a passing fancy. In fact, since the houseboats have also finally been hooked up to the municipal sewer system under duress from the European Water Framework Directive, the canals have even been certified as safe for swimming. In 2012, the first Amsterdam City Swim was organised to raise money to fight *amyotrophic lateral sclerosis* (ALS) disease (Amsterdam City Swim 2015). This two-kilometre swim through the canals has now become an annual event attracting numerous swimmers and spectators. On a related but distinctly different note, since 1996 the canals have also hosted Amsterdam's renowned waterborne annual Gay Pride Parade that has given a rather literal turn to the idea of 'floats'. In 2015, the Gay Pride Festival took a leaf out of the Amsterdam City Swim's book and organised a 'Love Swim' in the Amstel River prior to the Parade (Love Swim 2015).

Ironically, the revitalisation of Amsterdam's canals as the *pièce de résistance* of Amsterdam's touristic renaissance has fuelled visions of re-employing the canals as transport arteries (Nu.nl 2010). Distribution via the canals is now being plugged as a rational and environmentally-friendly alternative for the ever-growing fleet of road vehicles engaged in stocking the city's countless supermarkets, hotels, cafés and

restaurants and in delivering construction materials and online purchases throughout the city. Proponents of canal transport argue that Amsterdam's street network was never designed to bear this volume of traffic while there is room on the canals to spare. Whether this will in fact prove to be the case depends on the facilities the city council is willing to allocate to this 'new' use of the canals.

Meanwhile, the erstwhile 'outer' water of the IJ is also being transformed into what amounts to Amsterdam's biggest canal and is indeed increasingly often put to uses resembling those of the older 'inner' canals. Since harbour activities – with the exception of moorings for seagoing and river cruise ships – were moved to new docklands to the west of the city in the 1980s, the Eastern Docklands and the area around Central Station have been converted into prestigious residential sites larded with cultural facilities like the Dutch Film Museum (Eye) and a Concert Hall with facilities for classical and modern music and a jazz podium. The big scale of construction on both sides of the IJ has indeed given that once-broad expanse of unruly tidal water the aspect of a placid urban canal that, like its 'inner' homologues, is increasingly devoted to pleasure as well as business. A recent example was the coronation celebration for King Willem-Alexander. The Dutch Army Engineer Corps hermetically sealed off a portion of the heavily travelled IJ using large floating caissons lashed together to create a secure 'lake' within which the coronation festivities could take place. The 'lake' was dotted with floats on which representatives of Dutch culture, sport and society were able to present themselves to the royal couple as the latter's vessel passed by each in turn. Impatient freight barges simply had to wait a day or two for the party to finish.

It may seem that with the closure of the IJ in 1876 and the recent cultural metabolism of urban water in Amsterdam, the distinction between 'inner' and 'outer' water has been lost forever – or at least that the dividing line has moved so far from the city that it no longer plays a role in Amsterdam's urban fabric. However, an alert tourist in a sightseeing boat will notice what seem like quaint relics of a distant hydraulic past in the form of big wooden sluice gates (always open) at certain points along the route. These were the points at which the division of waters was negotiated, where water levels were regulated and where ships could pass across the divide. But this alert tourist might be surprised to learn that the seventeenth century fixtures are not just maintained as a tourist *décor*, but are also functionally maintained and periodically tested. They continue to be essential to performing the nightly flushing of the canals by keeping the flushing water from leaking out of the system at unwanted locations. But, they can also be mobilised at a moment's notice to close the old city off from outer water if prolonged rainfall, storm surges at sea, or some distant hydraulic catastrophe threatens with high outer water. So while the divide has disappeared on a quotidian basis and inner and outer water have for all practical purposes merged in Amsterdam, the old division that built the city and kept it safe (though also smelly and disease-ridden) for centuries can still be enacted at any moment.

1.7 Conclusions

What can we now say about Amsterdam's successive water regimes and the dynamics of their rise and fall? The keywords are 'safety', 'riches', 'planning', and 'ecology'. The pursuit of safety produced the original division of the waters as well as the defensive moats that were later included in the city's inner space. By the fourteenth century, a new regime was emerging that enrolled the city's inner and outer waters in the project of mercantile prosperity. This was a tense compromise because safety demanded closure, while commerce demanded permeability and openness. The seventeenth century elaboration on the west side had nothing to do with either safety or prosperity, but was about a new standard of residential quality and urban aesthetics. There was a decadent edge to this regime because by proliferating the urban delta it notoriously sacrificed the quality of inner water to the domestic pleasures of Amsterdam's tiny class of patricians. The final and present regime is based on a reassessment of Amsterdam's urban water as a recreational and tourist resource. It now pays to keep the commercially marginal and utterly safe water clean.

The transitions from one regime to another and the precise way contradictions were negotiated among them depended on a host of factors, some of which I listed in the introduction. As a rule, these were not associated with particular regimes dying of their own contradictions, but were quite exogenous. The 'merchant city' regime, for example, was a pragmatic response to both the changing hydrology of the Almere/Zuiderzee that made Amsterdam accessible from the North Sea as well as the emerging Baltic trade. That said, the 'urban aesthetics' regime was indeed a direct response to the social transformations of the 'merchant city' paradigm, but the final transition to the 'ecological' paradigm again depended on global economic shifts that turned Amsterdam into a commercial backwater and on the city's new hydrological setting after the construction of the North Sea Canal.

On a more abstract level this examination of Amsterdam's water metabolism over the *longue durée* suggests a hypothesis about water and cities that may apply in a great number of other cases. The hypothesis is that urban water metabolisms exhibit both a deep structure that is informed by the specific geo- and hydro-morphology of a given city as well as more ephemeral water regimes that are informed by political-economic ambitions and prevailing perceptions of urban water and its uses. The successive and overlapping water regimes, outcomes of contingent struggles and historically specific opportunities, are always constrained – and sometimes enabled – by the deep structure. In Amsterdam's case, the deep structure is obviously the division of the waters, a *conditio sine qua non* for urban survival in view of Amsterdam's location at the mouth of a river flowing through low-lying peat bogs into a tidal body of water. As long as this hydrological context remained stable, the division of waters prevailed and provided the immediate hydrological context for the institutionalisation of successive urban water regimes.

But as a corollary we must also acknowledge that deep structures, though firmly anchored and of long duration, are not immutable. They derive their compelling force from the geo- and hydro-morphological context but once this changes the compulsion is lifted. In Amsterdam's case, we saw that as soon as the IJ was closed off from the Zuiderzee in 1876 and ceased to be tidal and saline, the division of waters – at least on a quotidian basis – could be and was effectively abandoned. This was seconded by the subsequent closure of the Zuiderzee from the North Sea in 1932, rendering it too tide-less and fresh. The threat of outer water was now delegated to dikes and sluices at a great remove from the city and the division of waters as an urban project became redundant. This in turn paved the way for the emergence of Amsterdam's current eco-touristic water regime.

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Chapter 2
TOXI-CITY: Protecting World-Class Drinking Water

Emma Jones

Abstract In 1938, the UK's first purpose-built laboratories for water quality examination were unveiled in central London as part of the Metropolitan Water Board (MWB) estate. Now a block of luxury flats, this chapter explores the building's conception in the modern, industrial age of urban water production, and its collision with the psyche of water scarcity during natural droughts and the effects of the Second World War on the city. Between 1934 and the post-War era's propaganda about water use/waste, a shift is traced from a MWB public relations strategy focused solely on the *quantity* of water that might be wasted to one that employed a more nuanced, scientific perspective on water *quality* in which the laboratories featured, and therefore drinking water specifically, in such communications. Considering London's water metabolisms of the mid-1930s to the late 1940s, this chapter proposes that the communication about water by the industry during that period is a continuing trope of urban water systems and the interplay between producers and consumers, which we might do well to examine, and challenge, in the context of water as a general product but also as an essential ingredient of our daily diets.

2.1 Introduction

> Historians and social scientists would do well to reintegrate ordinary goods like water into the study of consumer society (Trentmann and Taylor 2006).

Walk along any London street, and you may unknowingly step on a cast iron plate embossed with the acronym 'MWB'. These modest metal plates are in fact entry points to a vast subterranean water infrastructure, one that local turncocks knew by heart as employees of the Metropolitan Water Board: London's municipal water manager from 1903 until 1974. More bombastic architectural remnants of the MWB's reign can be found, even if their use has changed, such as the strikingly

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curvaceous red-brick 'Laboratory Building', as it became known, on Rosebery Avenue in Clerkenwell, just northeast of central London. Now a block of flats, this former municipal building is elegantly recessed from the street and embraces a very civic-looking lawn. From 1938, it housed purpose-built laboratories for the MWB's Department of Water Examination, a leading national and internationally-renowned unit of scientific expertise in water chemistry, microbiology, and treatment (Chevalier 1953; Jones 2013). Yet today, on a side-street off Rosebery Avenue the modest brushed-steel sign that announces 'Laboratory Building' in an elegant Art Deco font is the only clue to its former use. 'A laboratory for what?' a passer-by may well ponder.

Quite apart from the Laboratory Building's functional role in London's water supply, its representation in public relations about water consumption in the context of 'droughts', saw a new trope in the water industry's rhetoric about waste: one in which *quality* was promoted alongside the more prominent issue of *quantity* as a driver for 'behaviour change'. Through the lens of London's water industry of the 1930s and 1940s, and the role of this intriguing building within the discourse about water conservation, my intention is to trace some of the continuities and discontinuities in urban water metabolisms, specifically in producing drinking-grade water (Fig. 2.1).

Fig. 2.1 'The Laboratory Building', Rosebery Avenue, London EC1, 2012 (Photograph by Emma Jones)

The history of drinking water is important to distinguish from general water histories, as I have previously discussed, because of its particular focus on the body and health (Jones 2013). Much has been written about water's role as a drink and key ingredient in the sanitation revolution of the nineteenth century, both academically and in popular non-fiction (for example, Hardy 1984; Halliday 1999; Hamlin 1990; Johnson 2006), while much less material is available for the twentieth century, with some notable exceptions (Burnett 1999; Hassan 1998; Jones 2013; Penner 2013; Salzman 2014). In the twentieth century story of drinking water in London, the MWB was a central driver in the UK's contribution to world water science, in particular for its creation of the country's first Department of Water Examination. Alexander Houston (later Sir) headed its laboratories from 1905 and he was afforded luxurious research time, which led to the publication of evidence, for example, about the impact of time on water storage for natural processes of water purification – still a central tenet of water science the world over (Jones 2013). Houston also introduced systemic chlorination into London's arsenal of water treatment in 1916, when the pressures of war led to treatment economies.

2.2 1930s: The Laboratory Building Is Conceived

The Department of Water Examination operated from makeshift laboratories in a former nineteenth century water company building (Metropolitan Water Board 1939) until the 1930s when the Laboratory Building was built, but sadly not in time for Sir Alexander Houston to enjoy. He died in 1933, but certainly because of his work, and that of his colleagues, London's tap water could be taken for granted as bacteriologically safe during the inter-war era. The first real rupture in the calm of water security during this period was a severe drought in 1921.[1] In response, the MWB encouraged its customers to voluntarily reduce their consumption by having, for example, more modest baths of five inches deep (Taylor et al. 2009). Later, the need for the MWB to ramp up its public relations on the topic of water consumption was further stimulated by subsequent droughts, officially announced in 1934, 1944, and also in 1949. 'Drought' is now a somewhat contested term for its implicit suggestion that the causes for water shortages are entirely natural rather than systemic, or indeed socio-technical (Swyngedouw 2004; Taylor et al. 2009)[2] – droughts were perhaps more appropriately known as 'famines' in late nineteenth century London.

[1] Although there were drought periods in 1911, and 1929, the 1920–1921, and 1933–1934 drought events are recorded as being more serious (Chevalier 1953, p. 160–61). For more information on how these droughts affected places in Britain other than London, see also Taylor et al. (2009).

[2] Droughts, and particularly those occurring in large cities, cannot be viewed as wholly natural phenomena divorced from water management. Urban water's production and distribution, so dependent on industrial infrastructure and central management, as other water researchers have pointed out, makes 'drought' in these contexts as much an outcome of the system as the availability of the raw material: a 'socio-technical' process (Swyngedouw 2004, p. 47; Taylor et al. 2009, p. 569–70).

In 1934, water's on-tap reliability in London, and indeed elsewhere in the country, became less certain again when the effects of the previously dry summer were compounded by another season of low rainfall. London's water reserves were seriously depleted. At first, the Metropolitan Water Board requested that its customers – circa seven million in total – voluntarily reduce their water consumption, like in 1921, but this time with guidance on how to water their gardens more sparingly, and instruction on the use of antiseptics in the toilet so that flushing could be minimised (Taylor et al. 2009). This was swiftly followed by an enforceable ban on the use of hosepipes and sprinklers for domestic gardens, public parks and for washing cars. *The Times* collaborated with the Board in its efforts to encourage behaviour change: a 20 % reduction of water consumption was a target for these imposed restrictions on 'non-essential' uses of water. Nationally, the drought aroused public interest and debate about water supplies (Hassan 1998). During the MWB's 1934 publicity campaign, the waste prevention message was communicated liberally: '[P]ublicity and notices were displayed in public vehicles, buildings, and hotels and on cinema screens' (Chevalier 1953). An article published during the mid-1930s publicity drive to inform the public about London's water production suggests that the MWB's strategy was to guilt-trip consumers into more thoughtful water use by dazzling them with aerial photographs of reservoirs, dams and mighty water pumps, collectively depicting the effort and expense involved in capturing and transporting river and groundwater to their taps (Ray 1934).

The 1934 crisis also coloured where the MWB should locate the building it was commissioning for the Department of Water Examination: central command was needed for crises management and so it was agreed that the Laboratory Building would flank the existing administration headquarters, which was already grandly occupying a swathe of Rosebery Avenue on the estate of the former New River Company that had been in situ since the early seventeenth century. By 1920, the MWB's central office had absorbed the New River's famous Round Pond under its building. The central headquarters, now also flats, has been described 'as prestigious headquarters on the grandest municipal scale, almost rivalling County Hall' – home of the former London County Council (Forshaw 2001). The visibility of London's water management was therefore writ large in Clerkenwell, visibly central to the metabolism of everyday inner city urban life.[3]

2.3 On the Drawing Board

The architect John Murray Easton, whom the Metropolitan Water Board recruited to design the new laboratories in 1936 formed one third of the highly-regarded architectural practice Easton, Robertson and Hall.[4] In selecting Easton as the

[3] Clerkenwell is in the London Borough of Islington.

[4] John Murray Easton (1889–1975) was President of Royal Institute of British Architecture (RIBA) in 1939, and was awarded the RIBA Royal Gold Medal for Architecture in 1955, as was his partner Sir Howard Morley Robertson (1888–1963) in 1949; biographical files are available at the RIBA Library, London.

Fig. 2.2 'Opening of the Metropolitan Water Board's New Laboratories', 1938 (Source: London Metropolitan Archives, City of London: Thames Water Predecessors Archive (Metropolitan Water Board), ACC/2558/MW/C/14/103)

lead designer, the Board was sensibly placing trust in an architect with a proven track record of delivering specialist buildings for science, such as Cambridge University's zoological laboratories and School of Anatomy (Annual Report of the Director of Water Examination 1936; Department of Zoology, University of Cambridge 2014). He was also an eminent figure in Britain's architectural *avant-garde*, consequently the laboratory was poised to be a thoroughly modern building, both architecturally and scientifically. However, these modernist values were not shared by all public figures in the inter-war era (Mayer 2000). Even partners in the architect's own practice dissociated their work from the more experimental modernist architects of the era, preferring their buildings to be labelled as 'moderate' modern (Robertson 1932) (Fig. 2.2).

Functionality, however, united all designers on the modernist spectrum, and for this laboratory to house experts and be productive there were many practical challenges for Easton and his colleagues to consider. For example, the inner city location on the main thoroughfare of Rosebery Avenue, which linked Islington and Holborn, meant movement, noise and pollution from road traffic. It was a situation which may have been tolerable for administrators but for the delicate arts of measuring chemicals; tasting; smelling, and studying the biological and chemical minutiae of water samples, the location was far from ideal. Therefore, to give the laboratories

some sanctuary, the building was to be set as far back as possible from the road, and an extra design safeguard were vibration-proof lab benches. The MWB's financiers had evidently agreed on the wisdom of investing in a high-quality and performance building. To make way for the lab, a water treatment filter bed was decommissioned to allow space for a generous landscape garden to operate decoratively and as a sonic and olfactory buffer. A large fountain in the garden that would be illuminated at night was another signal that there was no intention beyond the practical necessity for some distance from the hub-bub to make the building a shrinking violet. Indeed, the striking opaque glass frontage wrapping around the building's interior staircase that can be seen in the photographs in this chapter was an equally strong visual beacon to attract public attention to this municipal space of water science rather than to keep it under wraps.

Easton had to meet the considerable expectations of the Department's staff for improving lab conditions. The Deputy Director of Water Examination, Mr Byles recounted his frustrations and those of his colleagues with their existing premises:

> …the Biologist had his laboratory on the third floor, but he had to come down to the first floor to do certain experiments, which required a reasonably lofty room; to the wine cellar in the basement for micro-photographic work, because only there was the building reasonably free from vibration and then back to the darkroom on the third floor to develop his photographs (Metropolitan Water Board 1939).

Resolving such detailed user specifications was no doubt tantalising for Easton and his colleagues, in what would be a building that was all about use and the user: the biology team, for example, dealt with up to 2000 test tubes to process 120 water samples daily.

Part of the design process involved a trans-Atlantic trip to consult water science colleagues in the United States of America (USA) and Canada (Harold 1936). The investment underscored the MWB's intention for this to be a flagship building nationally, but also internationally on the world stage of water science. For the USA trip, the Rockefeller Foundation provided a letter of introduction as a passport to must-see water people and facilities, with advice from senior public health administrators. This transatlantic dialogue presents an example of the ongoing international mutualism of the hygiene revolution that had grown initially out of the decades-long battle against cholera (Howard-Jones 1975). The USA forged ahead with chlorination in the first decades of the twentieth century, along with sanitary allies in Europe. During this period, water production became an ever more sophisticated, and increasingly standardised industrial process, albeit in industrialised societies. The strength of this specialisation by the inter-war period is one reason why the desire to create a separate departmental building was both a practical necessity and of symbolic importance in elevating what was still a relatively new science.

The final building, although adjacent to the administrative headquarters, in its quirky embrace of bricks, was an entirely separate unit physically and aesthetically. A third larger than the former laboratories, it had four storeys although two of these were most prominent as the uppermost storey was recessed to allow a flat roof space

for outdoor experiments (see the white-coated figures just visible in the 1938 photograph of the laboratories), and the final storey was a basement. Despite its modest stature, the building's impressively engineered shape and glazing certainly made it a visually distinctive purpose-built space. As one of the 1938 inaugural photographs of the building shows, two rows of steel-framed windows made up most of the ground and first floor façades with high-tech reinforced glass for sound-proofing. Chemistry was the focus of the top floor, with one laboratory spanning two thirds of that space, the Chief Chemist's quarters and the 'chemical store'. In an appreciation of the new building for the Board's internal magazine, the good north light on the top storey was noted as being 'essential, as many of the tests depend upon colour matching or noting colour changes' (Metropolitan Water Board 1939). The first floor was designed for the bacteriological end of operations, with two large laboratories, 'sorting incubators' and 'media filter/media store'. Given the concern about air pollution from the road affecting experiments, this portion of the building also had sophisticated air conditioning technology. On the ground floor, a key feature was the incorporation of a spacious 'library and lecture room' for the inevitable pilgrims: at a 1936 meeting at the MWB it was recorded that 'the hospitality of the Board's Laboratories has been extended to numerous visitors and professional staff not only of organisations belonging to Britain and the Dominions, but also to foreign countries, and the names of many of these rank high in the annals of science associated with water supply' (Metropolitan Water Board 1939).

The building's first official visitors in October 1938 were the Minister for Health, who was greeted with a guard of honour, and the Mayor of Finsbury Borough Council. The latter represented a local authority known to promote the socially progressive architecture and values that were also embodied in the Finsbury Health Centre for preventive medicine that was concurrently inaugurated that month, and somewhat upstaged the MWB's new laboratories in the architectural press. Even so, the building did not fail to make an impression or a large-scale photographic splash on the pages of the main architectural journals of the day, albeit with the same details rather lazily rehashed from the MWB's press release. The journal *Building* at least offered some opinion, congratulating the plan's 'extreme simplicity' and the project's 'excellence in brickwork' (Anon 1938).

2.4 Water Stress

The lecture theatre provided a space for disseminating scientific knowledge to visitors, reflecting the implicit need for communication about water: both professional knowledge dissemination and, increasingly during the ensuing years, general public education. When World War Two broke out in London, water infrastructure would become more visible and more widely discussed, at least in the public domain, than in peacetime. The MWB went on a publicity drive to ensure that each Londoner was versed in home water sterilisation techniques, on one occasion using a radio broadcast with instructions from the Director of Water Examination on do-it-yourself

chlorination – Milton became a must-have product (Jones 2013). The issue of waste prevention was, of course, vital because of reserves needed for fire-fighting on a major scale. A series of posters promoted this message, some featuring 'Tommy Tap', a cartoon-faced faucet (Metropolitan Water Board 1939–1950):

> 'YOUR HELP IS URGENTLY REQUIRED. YOU SAVE WATER, BRITAIN SAVES FUEL.'
>
> 'EVERY DROP OF WATER YOU USE HAS TO BE PUMPED. EVERY PUMP IS DRIVEN BY COAL OR OIL. SAVE COAL, OIL AND USE AS LITTLE HOT OR COLD WATER AS YOU POSSIBLY CAN.'
>
> 'THOSE WHO WASTE WATER HELP THE ENEMY. THOSE WHO SAVE WATER HELP BRITAIN.'

Water quality also had to be prominent in the minds of Londoners due to the dangers of sanitation breaking down during the Blitz when London's subterranean infrastructure was often lacerated, or under threat. In the Post War demand for water to rebuild and regenerate London, and particularly following an official drought emergency in 1944, the MWB's public relations strategy became more sustained to elicit a general appreciation for, as the organisation's own corporate historian put it, the 'need for economy in the use of water' (Chevalier 1953). Visits to waterworks to enthuse officials from local authorities and health professionals about the water industry, such as nurses, were encouraged, a travelling exhibition was mounted, and a film documentary was even commissioned (Figs. 2.3 and 2.4).

Fig. 2.3 'Emergency Supplies, Edward Street, Canning Town, [London] E16', 1944 (Source: London Metropolitan Archives, City of London: Thames Water Predecessors Archive (Metropolitan Water Board), ACC/2558/MW/C/14/112)

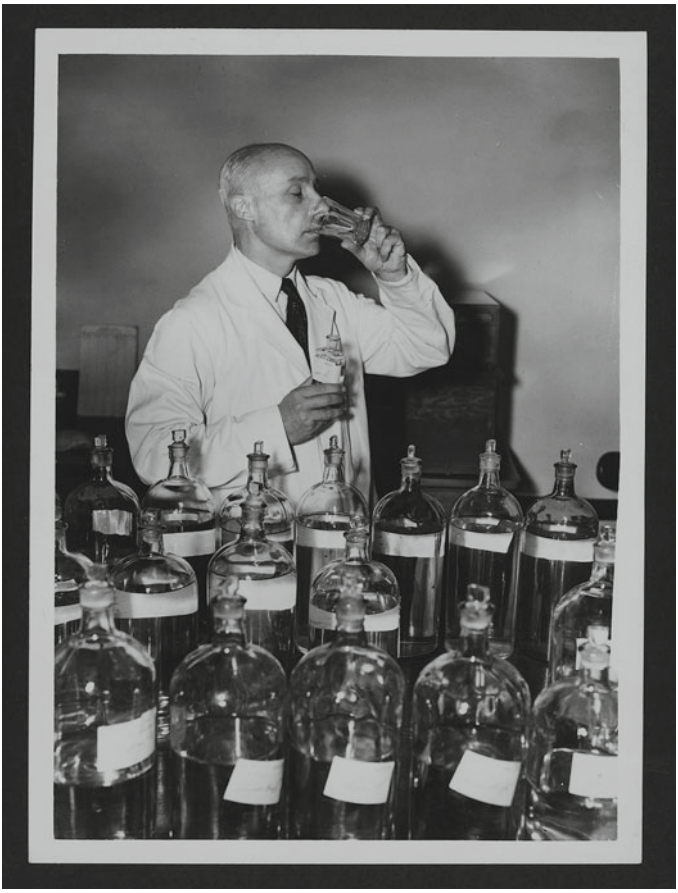

Fig. 2.4 'Metropolitan Water Board Anti-Waste Campaign: Mr S. Barwick', *c.*1940–1944 (Source: London Metropolitan Archives, City of London: Thames Water Predecessors Archive (Metropolitan Water Board), ACC/2558/MW/C/14/113)

Within the Post War public relations campaign, the Department of Water Examination's laboratories had two starring roles. The first was in a series of photographs documenting the labour of water examination and research scientists at work: sterilising media culture, at lab benches awash with test tube samples, sucking up fluid with pipettes, and performing the all-important taste tests with a standard glass of water. This was all under the auspices of the grandly-titled 'Metropolitan Water Board Anti-Waste Campaign'. One photograph introduced 'Mr S. Barwick, [who] has a very unusual job. He is a water-taster, and tastes fifty samples a day at the Water Board's Laboratories'.

These intriguing vignettes of scientists-at-work certainly show the MWB's intention to present a more nuanced narrative about water quality within the rhetoric of water conservation. They invite the viewer into the laboratory to virtually experience

Fig. 2.5 'Metropolitan Water Board Anti-Waste Campaign: Inoculating samples of water to detect the presence of any undesirable organisms', *c.*1940–1944; London Metropolitan Archives, City of London: Thames Water Predecessors Archive (Metropolitan Water Board), ACC/2558/MW/C/14/113

drinking water production and in contrast to the rather patrician voice of the 1930s water industry and of the earlier years of the War. Microbiology was also represented in a far more sophisticated mode than had been deployed, for example, in a 1935 supplement on 'London's Water Supply' that had only one article on water quality in a several-page spread of technological prowess, merely depicting the scientific aspect of London's water production and examination via photographs of two petri dishes: one riddled with bacteria, and the other spotless (Harold 1936). In a decade, the representation of science by the MWB had transformed. The fact that water examination had also gained a modern building allowed it a new stage for performing within such modern, sophisticated modes of communication (Fig. 2.5).

When I first came across the Anti-Waste Campaign photographs, I was surprised by their candid revelation of what I had hoped to find while looking for evidence of the humans involved with the science of London's drinking water production in the 2000s, yet I found little contemporary material. These revealing photographic documents of scientists going about their daily work were refreshingly unguarded. Rather than unconsciously knowing that some anonymous white-coated person is testing and researching our water quality, here we see a real person holding a petri dish, tasting a sample of water on their own tongue, actually driving home to an audience the visceral reality of the labour that is involved in the production of drinking water. If anything, in revealing the precise science, they are also a reminder of the possibility of human error.

Prioritising this *quality* as well as *quantity* message as a public relations strategy recurred in the laboratories' second starring role of the 1940s, in the film 'Every Drop to Drink' (Metropolitan Water Board 1948). In 1947, the MWB's Chairman wrote that the intention for the film commission was to 'spread a knowledge of the Board's undertaking together with a certain amount of propaganda – which could be suitably camouflaged – to try and get people to use as little water as possible.'[5]

The 19 min result laid on that message thickly in a didactic tone, while also serving up a succinct portrait of the MWB's work in the short documentary. One section of the film that showed the might of water pumps choreographed in the edit to a full orchestral score was a clear nod to the social-realism style of Russian film-makers then in vogue (Boon 2000, p. 110). However, the film's coverage of such engineering prowess did not dominate the narrative: equal emphasis was given to water quality. The drinking water theme was clear in the opening lines: '6.5 million Londoners have a formidable thirst. Over 300 million gallons of water is provided for them every day, for food and drink, for industry, transport, cleanliness and health.' This commentary went over footage of children refreshing themselves from a public drinking fountain, a toddler drinking a glass of water beside the kitchen tap, then a man glugging from a pint of beer (water being the all-important raw material in the latter, I assume). The visual absence of representations of water's use for industry and sanitation revealed the carefully mediated frame on how the MWB wanted its product to be viewed by the audience: as an essential nutrient rather than a key ingredient for the taboo topic of everyday sanitation.

Following the film's potted history of the nineteenth century, and a lingering shot of the MWB's administrative headquarters, the camera turns to showcase the 'magnificently-equipped laboratory' with several scenes of scientists at work. Similarly to the anti-waste photographs in content, we see the daily cast of the laboratories on their production lines: the delivery of water samples from a suited man – fresh from a Morris Minor car that workers travelled to and from the reservoirs in – and straight onto the lab benches to several white-coated colleagues on the test-tube production line; a chorus of pipettes in action; samples in petri dishes being moved on a trolley into the 'bacterial incubator' unit; the monitoring of

[5] Letter of H. F. Cronin, Chairman of the Metropolitan Water Board's Works and Stores Committee, 17 November, 1947, London Metropolitan Archives, reference ACC2558/MW/C/8/213/001.

chlorination machinery, and again, Mr Barwick the water-taster-extraordinaire performs. As he sips from a glass, the commentary explains, 'an expert with an unusually sensitive palate tests samples of water every day to see whether it is over-chlorinated, flat, or just right.'

The documentary's final couple of minutes offer some light relief from its stiff tone, depicting a more sumptuous enjoyment of water recreationally: a diver plunges into a river; some rowers drift past the lens; a group of people loll by a riverbank; and there is a lingering hold as a sprinkler pivots around a large lawn. The narrator reminds us that this pleasure in 'rural' water is 'justly celebrated' before an abrupt cut to a bustling urban lido full of young people frolicking in the swimming pool; women in chunky bikinis march past the camera and a portly man is shown purposefully carrying a deckchair to the poolside. The scene gives an impressionistic portrait of just a few of the Londoners enjoying their leisure time at the lido, that epitome of the interwar architectural and cultural zeitgeist in Britain, just like the public drinking fountain at its side that children scamper to and drink from in the film's parting shot – both civic amenities are, of course, brought to you courtesy of chlorinated municipal water.

The documentary was premiered in 1948 at the Tivoli cinema on the Strand in London, then it was screened in schools and other institutions, apparently extensively, including at the Foreign Office and the Central Office of Information. In 1949, the film was also shown to delegates at the United Nations Scientific Conference on the Conservation and Utilisation of Resources, incidentally a year when another drought struck London (Chevalier 1953, p. 329). And further international profile for the MWB came the following decade when it represented Britain at the World Health Organization's meeting to set the first International Standards for Drinking Water in Geneva.

2.5 Conclusion

London's 'world-class' water quality is certainly one connecting point between the 1930s, 1940s, and the present. The move to actively promote water quality as an incentive for wiser water use in the 1940s by bringing the consumer into the laboratory was a bold one: how many critical questions might it also have raised about the water industry's methods, stoking consumer fears about chemicals for example in the brave new world? In a way, the industry was almost encouraging consumers to fetishise their water in order to not take it for granted, to be awestruck by a simple glass of healthy water produced in the city. Fetishising water quality today is something we much more readily associate with bottled water when particular brands of mineral or spring water are elevated by advertisers above tap water. Water quality is not only fetishised by the consumer who chooses Evian over tap water, but also in the professional, scientific spheres, which further advanced in the second half of the twentieth century with disciplines such as molecular biology, environmental toxicology, and then with the spectre of bioterrorism to boot. The specialisms

surrounding water science have only grown, becoming more complex and consequently much more publicly inaccessible and distant from most tap water drinkers. Unlike the Laboratory Building's era, London lacks any public buildings relating to our water supply with a privatised industry. Its facilities are gated communities, which are located on the periphery of the city, often for good practical water abstraction, treatment, and security reasons but this geography certainly makes it difficult to see the water industry's role in your daily life, apart from virtually.

While the contemporary water industry is keen to assure consumers of the stringent legal/regulatory hoops that it must leap through to produce world-class tap water, unlike the 1940s' media campaigns, our lack of access to any real window on the daily work of flesh and blood scientists, and engineers, is a worrying omission in the industry's communication to consumers. Perhaps this is because too much consideration of drinking water examination and production might lead to uncomfortable debates about why tap water is employed for uses for which potable quality is unnecessary, and consequently the topic of greywater technologies? Employing alternative or 'soft' technologies and/or re-plumbing cities to divide grey and drinking water supplies are propositions that are all too often swiftly rebutted by large technologies, with associated slick public relations campaigns, even though in European Union countries, for example, there is a mandate to protect places of 'drinking' water abstraction under the terms of the Water Framework Directive (2000/60/EC).[6] These regulations make even more of a mockery of flushing drinking water down the loo, however wise it, of course, is to prevent water pollution and reduce the environmental and labour costs of drinking water treatment.

Public relations within the water conservation debate, if light touch in the 1940s, now play an ever more sophisticated role in the water industry, which, like most modern businesses, has its dedicated communications departments. As well as such departments' customer services role, they also mediate much of the information we receive about our urban water metabolisms and *they* also instruct *us* on how we should be reducing our water consumption, often greenwashing the real issues in the water conservation debate with novel water-saving tips. Then, as now, critiques of the systemic flaws designed into London's water industry, and wastewater, infrastructure and treatment as it modernised, and the philosophies underpinning these technologies and practices, were avoided by focusing on the consumer's rather than the industry's role in waste prevention, and, in that respect at least, little has changed.

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[6] See Article 7: Waters used for the abstraction of drinking water.

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Chapter 3
Reading Urban Futures Through Their Blue Infrastructure: Wetland Networks in Bangalore and Madurai, India

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Abstract By examining the transforming geography of water systems through its interactions with everyday life and the governance in Madurai and Bangalore in South India, we argue that making sense of the risks and vulnerabilities associated with the blue infrastructure in these cities needs to be understood as the consequence of transforming political relations of governance rather than from the notion of an indifferent and incapacitated state or the disappearance of traditional community management institutions. It is our contention that governing complex ecological assets demands an equally complex relationship between a wide range of social actors in diverse locations of power and capacity embedded within emerging political relations and realities.

3.1 Introduction

Urban settlements morphology is generally understood to have developed through productive relationships between land and water in ways that render water as almost mystical and essentialist compared to how socio-political relations have shaped that morphology. Challenging such essentialist portrayals, in his recent book 'Fabric of space', Gandy (2014) argues that studying water can reveal 'an intersecting set of processes, practices and meanings that cuts across existing disciplinary boundaries.' Further he notes, 'water lies at the intersection of landscape, infrastructure, crossing between visible and invisible domains of urban space' (p. 1–2). Similarly, Castán Broto et al. (2012) note how a critical perspective on urban metabolism opens up

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new ways of conceptualizing the interactions between socio-political relations, flow of resources and producing the urban experience.

Entering through the changing geography of water systems or 'blue infrastructure', and in particular the interactions between blue infrastructure, everyday life, and transforming political relations of governance in the cities of Madurai and Bangalore in South India, we examine the invisible domains of flows and interactions that produce the urban space.[1] In doing so, we highlight the shortcomings of dualist conceptualisations of state-society interaction, as well as the need to recognise the interrelations and flows between the visible and invisible domains of urban space at diverse scales while explaining the risks and vulnerabilities associated with obliterating the blue infrastructure of these cities.

We argue that these risks and vulnerabilities need to be understood as the outcome of changing political relations of governance rather than from the notion of an indifferent and incapacitated state or disappearing traditional community management institutions. The idea of 'state' separated from 'community' not only prevents making sense of ground reality, but also forecloses any useful and imaginative solutions. The governance of complex ecological assets demands a less straightforward relationship between a wide range of social actors in diverse locations of power and capacity. The discussion builds upon fieldwork conducted in Bangalore and Madurai – respectively located in the states of Karnataka and Tamil Nadu – between 2008 and 2013 (Sundaresan 2014; Sundaresan et al. 2014a).

3.2 The Historical Configuration and Geography of Water Systems in Urban South India

As noted by Mosse (2006a) complex water systems evolved in southern Tamil since Pandya and Chola times (ca. 750–1300), as precursors of the riverine canal irrigation developed in the eleventh century.[2] Formed of intricately interconnected lakes, rivers, seasonal streams and regional drainage valleys, the geography of water systems historically shaped the key ecological infrastructure that supported human habitation in the urbanising agrarian regions of South India. For centuries, this blue infrastructure was integrally associated with groundwater recharge, drainage, microclimate, water quality, public health, food security and livelihoods and enabled a diversity of socio-economic and cultural practices. The rainwater harvesting infrastructure was also an integral part of human settlements morphology and metabolism in most of urban and rural India – whether in the desert regions of the west, or hills of the north east, dry regions of south central or flood plains of south India (Agarwal and Narain 1997; Shah 2008).

[1] The authors would like to acknowledge that this article draws from the field work conducted in Madurai during 2013 for an action research project named Future proofing Indian Cities collaborating with Atkins and DHAN Foundation in Madurai.

[2] Also see Heitzman (1997), Stein (1980).

About 159,000 lakes (locally called 'tanks') are known to exist in South India, of which the share of Karnataka and Tamil Nadu are about 38,000 and 39,000 respectively (Vaidyanathan 2001). Many of these tanks were built to irrigate agricultural lands and as a drinking water source for villages and urban centres. This blue infrastructure enabled people to successfully manage the extremes of heavy monsoon and dry spells throughout the year; mitigating flooding and retaining water through the cascades formed by the tank networks connected by canals,[3] seasonal rivulets, and rivers linked to the larger level drainage valleys. Water that moved through this network recharged groundwater sources, irrigated agricultural lands, provided drinking water, enabled rituals, ablution, and supported local cattle and fishing economies as well as the microclimate for vegetation and shaped the landscape.

These networks were central to the social political cultural and economic life of agrarian South India. In Karnataka and Tamil Nadu, studies show that many of these water systems were built during the expansion of Vijayanagara Empire (throughout the fourteenth and sixteenth centuries) by local chieftains and dominant warrior classes, as part of the strategies adopted to grow their territory and revenue base. (Davison-Jenkins 2001; Mosse 1997). These sophisticated systems also contributed to place-making as the key base for economic, ecological and cultural infrastructure (Baindur 2014). Even though changes to this blue infrastructure are as old as its history, the scale of transformations driven by contemporary urbanisation and the challenges posed for their survival are unprecedented.

3.3 Taming Institutional Practices in Urban Water Management: The Official and Non-official Production of Risk and Vulnerability

Since the mid-twentieth century, urbanisation transformed the social and political relations embedded in these networks for centuries. The agrarian community's settlement morphology paved way for new social relations, management institutions, aspirations and associations with the landscape resulting in devastating consequences for the wetlands infrastructure. Within the urban boundary of Bangalore, several studies document that 400–600 tanks existed untill the 1980s; out of which only about 200 survive now (Thippaiah 2009; D'Souza and Nagendra 2011; Nagendra and Ostrom 2014). In Madurai City (less than one-tenth of the Bangalore urban area), only 19 of the 33 major irrigation tanks and innumerable smaller tanks built during the turn of the century continue to exist today (Sreenivasan and Kanagavalli 2014). While the regional drainage valleys and the tank network form the hydrological landscape of Bangalore, in Madurai the tank and channel networks are integrally connected to two historically-significant rivers named *Krithumal* and *Vaigai*.

[3] Known as *Rajkalves* in urban Bangalore and *channels* in Madurai.

3.3.1 Bangalore

Established in AD 1537, Bangalore has grown to about 750 km^2 and 10 million people (in 2015), through several immigration waves and the urbanisation of surrounding villages. Since the *Sangam* period (from the third century BC), Madurai remains an important South Indian city, counting just over one million in 2011. This discussion contrasts the blue infrastructure trajectories of these two cities over time.

In June 2009, we met a friend on the banks of a large lake[4] in the middle of Bangalore City to discuss the transforming ecology of the city's water systems. Monsoon season had begun, so heavy rain was imminent. Walking around, the friend explained the lake's specific workings – where the water flows in and out through the link canals or '*rajkalves*', the catchment and overflow, the details of its bund engineering, the impact of changing land uses around it, the impact of new embankments and so on. A sudden heavy downpour interrupted our conversation and forced us to take shelter for an hour in a nearby teashop. We continued chatting over cups of warm tea for about an hour till the shop owner interrupted and asked us to step outside so that he could rearrange the wooden furniture to protect it from any imminent floods.

Returning outside, the lake had rapidly broken its banks. Within half an hour, the water level on the road rose to about two feet and the traffic came to a standstill, apart from some buses and large cars that could get through. The sidewalks, storm water drains, manholes, tarmac, embankment, and the lake merged as one large thick body of grey-coloured water masking many traps. We could see the strong flow of current running into the lake and the large open adjacent drain. The walkway and driveway suddenly became an unfamiliar terrain and arrested everyone under the shelters. Half an hour later, the rain subsided and urban life began limping again as if performing a regular ritual of wading through the innumerable floating plastic water bottles. We were asked to watch out for the five-to-seven feet deep open gutter concealed by receding waters. Our friend remarked: 'This is exactly the transforming ecology of lakes in Bangalore.'

The meaning of this remark was only to be reflected in the following day's newspaper report about a 6-year-old boy named Abhishek who was drowned in one of the *rajkalves* while walking with his mother near Lingarajapuram, central Bangalore. The army and the officials from the city's elected local body Bruhat Bengaluru Mahanagara Palike (BBMP) spent a week searching for his body, in the lakes, canals and the drains within 10 km of the accident. Finally, the BBMP commissioner gave up and announced 100,000 rupees as relief to the family. The boy's body was never found.

Abhishek was neither the first nor the last hapless person to be swallowed alive by these killer storm-water drains in Bangalore. On a similar rainy day in May 2009,

[4] Tanks in Bangalore are popularly known increasingly as lakes, hence the latter term is adopted throughout the chapter.

60-year-old Venkateshwarlu drowned when he was dragged away by the powerful current of an open storm water drain in central Bangalore. In its petition to the High Court of Karnataka, the civic society platform Namma Bangaluru Foundation (2014) highlights more of these hapless events. Eight-year-old Geetha Lakshmi, 67-year-old Pukhraj Jain, 3-year-old Rihan, and 12-year-old Yeshwant were all swallowed alive by the killer *rajkalves*.

For more than a decade, severe flooding has become normal in much of Bangalore, along with consequences like disease outbreak, displacement and water scarcity. There are areas of the city that flood every time it rains and new neighbourhoods find their place onto the flood map time and again. The lake network in Bangalore does not act as an effective rainwater harvesting system anymore because many lakes and the canal network have been reclaimed, encroached or damaged by their legitimate custodians and other public and private actors.

Many government agencies have safeguarded Bangalore's lake network over the past 50 years. Every organisation transformed the city's blue infrastructure in different ways. For example, the bunds were broken by the BBMP during the malaria eradication programme. Bangalore Development Authority (BDA) built housing layouts, bus stands, markets and public institutions reclaiming the lakes. Private developers encroached or successfully claimed legal ownership and built apartments. The Lake Development Authority (LDA) privatised some lakes and private caretakers isolated these from the network to make their recreational parks viable. Moreover, Bangalore Water Supply and Sewerage Board (BWSSB), as well as many individual entities, disposed large amounts of sewage directly into the lakes without any effective treatment. In short, the network was gradually disrupted through multiple governmental and private decisions that redefined the city's water metabolism.

Consequently, during monsoon season, rainwater does not cascade effectively through the lake network anymore and in the summer most lakes are dry or became sewage pits. Once a city of lakes, Bangalore is now a water stressed city. Water demand in Bangalore is taken care of by the BWSSB's supply from a river 100 kms away, but also by thousands of household tube wells and informal small scale private water suppliers.[5] Disease outbreaks from groundwater pollution and mosquito breeding have become recurrent; the wetlands network – one of the key city assets – has become one of its worst nightmares. Even though the impact is widely distributed, many informal settlements located on the edges of the lakes or canal embankments and other low-lying areas of the city are the most vulnerable. Abhishek's death and therefore the *killing water* in Bangalore is a specific kind of interaction between different elements of the integrated ensemble of Bangalore's blue infrastructure.

[5] *Water Tankies* – as they are called – obtain their water from peri-urban tube wells.

3.3.2 Madurai

During our fieldwork in Madurai between July and December 2013, we encountered a severely damaged wetlands infrastructure similar to Bangalore's. The blue infrastructure network in Madurai is an interconnected system of water supply and wastewater infrastructure, groundwater, flood plains, and the lakes/tanks network but aligned topographically with the *Vaigai and Kruthumal* rivers. Similar to Bangalore, water supply in the city is piped from a source that is 70 km away from the city (Vaigai project) and covers only 52% of the population (Sundaresan et al. 2014a, b). The remaining people depend on thousands of individual bore wells and private local suppliers, fast depleting the groundwater level without any effective recharging system. The underground sewage network covers roughly 50% of the city, but only 15 MLD of wastewater is discharged into the two treatment plants. The rest is disposed into the canals and lakes by individual entities and the municipal corporation's pumping stations. Moreover, the sewage network is old, out of gradient, over-burdened and broken in many places, meaning most manholes frequently overflow into the lakes, channel and river networks.

Like in Bangalore, many lakes in Madurai are encroached upon, or reclaimed for bus stands, markets, office buildings, public institutions and residential colonies by private, public and semi-public entities that act as their custodians. Moreover, solid waste is disposed of all along water bodies and canal networks. Unlike Bangalore, only a few state institutions are involved in managing Madurai's blue infrastructure. The Public Works Department (PWD) was responsible for this. However, about a decade ago, responsibility for maintaining those network components without an *ayacut* or irrigation system was transferred to the Municipal Corporation, which is also in charge of service delivery and waste management. As discussed below, the wetlands network trajectory in Madurai is very similar to Bangalore.

While exploring this trajectory, we first met Selvi at the Dhidir Nagar slum behind the main Periyar bus stand in the centre of Madurai. She was standing in the queue to fill her plastic *kudam* (water pot) from a community water tap located next to a manhole submerged in sewage, solid waste and wastewater that sprawled in front of us for at least 50 ft. This was part of the *Kruthumal* river: that untill five decades ago was a fresh water river with 11 months of continuous flow with an original bed width of 20–50 ft and its bank adorned with deeply fragrant *Thalampoo* plants (Fig. 3.1).

Selvi's house is located right at the river bank – overlooking the sprawling river of waste. She told us that about 30–40 years ago she used to bathe there. At the time, her house was a small shack; her family was very poor, they did not have electricity and were under constant threat of eviction. But, she said, 'we had access to clean water from the river, clean air and we could sleep inside or outside.' Three or four decades later, their slum was regularised, they rebuilt their house and she earns a decent sum every month, her household has electricity, a TV, a washing machine and other basic modern comforts. However, she said, 'now, we have neither clean air nor clean water and we can neither sleep inside nor outside. Mosquitoes and foul

Fig. 3.1 Kruthumal River at Dhidir Nagar, Madurai (Photograph by Adriana Allen)

smells swarm us everywhere. We have many ceiling fans in the house – but it doesn't help. We spend a lot of money to go to the doctor every month. Recently a child got drowned in this waste.' Their drinking water supply is mixed with foul smelling sewage. In monsoons, to conduct their daily lives they have to wade through the knee deep foul water that enters their houses and streets.

Selvi's story calls for some history. Originating from the foothills of Nagamali hills in the western outskirts of Madurai city, the Kruthumal River flows for about 73 km. It used to feed more than 700 tanks (Sundaresan et al. 2014a, b), agricultural fields and catered for bathing, washing as well as regulating flood and recharged groundwater levels before flowing into the Ramanad Lake. The ancient city of Madurai developed around the Meenakshi Temple as a small urban settlement between the northern banks of Kruthumal and southern banks of Vaigai, which both played a significant role as a historic, cultural, ecological and economic infrastructure. Several villages, temples, cremation yards and markets next to the river, that have now become part of the city, remind us of the morphological significance of this infrastructure. Inside the city, the Kruthumal flows 15 km from east to west connecting many tanks and channels along its way.

Over the past three to four decades, land use changes at the foothills of Nagamalai and the residential conversion of adjacent agricultural lands, disruptions to the wetlands network, particularly to its connections with other channels, tanks and Vaigai river, contributed among other factors to the Kruthumal drying up. Inside the city, encroachments radically reduced its width to less than 10 ft in many places. Concurrently, individual households from surrounding residential neighbourhoods, public and semi-public institutions, commercial establishments and industries currently dispose their solid and liquid waste into the river (Mahadevan and Krishnaswamy 1984). Municipal corporation engineers pump raw sewage into the

Fig. 3.2 The remains of Kruthumal River, Madurai (Photograph by Jayaraj Sundaresan)

river and its feeder channels from their pumping stations. To deal with the subsequent pressure built-up, they then break open the manholes near water-channels to let the sewage flow into the river. Similarly, septic tank emptying companies regularly dispose raw sewage in large quantities into the river. Meat and fish selling units, dead animal corpses and waste from cattle farms, rice mills, garage and metal works are disposed in abundant quantities there (Fig. 3.2).

Consequently, inside the city, the river has become a swamp of solid waste, heavy metals and sewage. In many parts, wastewater from the river (as well as from other channels) is blocked and pumped to grow greens and vegetables.

The remaining wastewater from the river finally reaches the *Samanatham Tank* located southeast of the city, before it moves on further to irrigate the agricultural lands. One of the farmers downstream told us, 'many years ago we used to petition to the authorities not to redirect water from this river into Nilayur Channel [one of the channels to which the river is linked to] so that the river brings us water that can irrigate our fields downstream. Now we petition to the authorities to somehow stop any downstream flow of this river because it brings poison into our fields that seriously damages our crops.' Furthermore, using funding from the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) 2005–2014, India's largest Urban Renewal Programme, the Madurai Municipal Corporation covered the embankment and the bed with reinforced concrete for most of its length within the city, converting a river into a concrete paved canal. The improper gradient and cross section of

Figs. 3.3 and 3.4 Gold ash filtering, cattle rearing and abattoirs supported by the polluted waters from Kruthumal River, Madurai (Photographs by Jayaraj Sundaresan)

this intervention further contributed to silt accumulation, weed and vegetation growth resulting in stagnant polluted water and flooding.

Within the city, the river passes through 16 wards inhabited by middle/working class neighbourhoods as well as 18 informal settlements. Along with housing, a wide range of economic activities along its edges interact with the river corridor – metal works, urban agriculture, gold ash filtering, cattle sheds, abattoirs, garages and so on -actively consume and contribute to the river's wastewater (Figs. 3.3 and 3.4).

Once a significant ecological, cultural and heritage infrastructure, the Kruthumal has become a sewage channel that just carries the dirt of Madurai's urban life. While the middle class neighbourhoods located along the river suffer from the foul smell, polluted groundwater, mosquitoes and the threat of communicable diseases. About 25,000 people living in informal settlements suffer the most due to their active dependency and proximity to this water body. Even though the whole city contributes to its pollution, significant impacts are felt by the informal settlements adjacent to the channel. Mosquitoes invade public space in the evenings. Frequent fever, including dengue, chronic cough and skin infections are widespread among dwellers in the informal settlements; increasing their expenditure on health, mosquito repellents and electricity.

Our brief description of interactions between the Kruthumal and urban life is only one among similar descriptions waiting to be written about each of the more than 60 tanks and about 14 water channels that make up the rest of Madurai's blue infrastructure. Similarly, there are many more instances to be documented about the mutually antagonistic relationships between nature and the city created by the insidious transformation of the blue infrastructure in Bangalore. Bangalore and Madurai are not exceptional when it comes to similar cumulative processes of taming nature in the name of progress, as experienced across many other cities in the Global South (Allen et al. 2015). It is precisely for this reason that the often-invisible trajectories

of obliterated urban waterscapes call for a renewed understanding of how and why blue infrastructure is routinely misconceived and spoliated depriving cities and citizens of a vital lifeline.

3.4 Emerging Social Coalitions and Negotiation of Institutional Relations

In their public interest litigation, the Namma Bangalore Foundation asked for action to be taken against the local authority for its indifference to everyday accidents caused by how casually the blue infrastructure of Bangalore is managed. According to them, the reason for this state of affairs is the inefficiency of the local state in taking care of these extensive, complex and vital infrastructure systems to ensure safe human habitation. Evident in their petition is the assumption that there can exist a capable state separate from society that can discipline ordinary social and political actors from actively participating in encroachments, reclamation, waste disposal and so on.

Equally simplistic is the romantic view that local communities used to manage these resources more efficiently in the past and traditional community management institutions worked more equitably and appropriately compared to post-independence state institutions (Shanmughan et al. 2007). Therefore, challenging the leviathan state and the narrow interested market, the renewed orthodoxy emphasises local community institutions as the future of urban commons.

However, the stories shared in the previous section about the gradual deterioration of the blue infrastructure of Bangalore and Madurai are not simply the result of a state that devours the ecological assets within its own jurisdiction, or the outcome of a subversive society concealing its act from the state's gaze. All the gradual interventions described were done in the open and often rendered as rational decisions and desirable changes. The solid waste and sewage suction contractors dispose waste into the water channels to save their transport costs. Local engineers break open the over flowing drains to cater for higher housing densities than those initially planned for in the city's master plan. Home buyers move in knowing that there is no effective sewage network. Local residents encroach the canal with the active support of local engineers and the contractor-engineer-politician network enjoys the rents from concreting the river. The developer-real estate broker-politician-engineer-resident-banks-designer-contractor network mutually benefits out of rents from reclaiming the lakes for housing. Complex networks that are behind the hundreds of acres of vegetable production using sewage farms are not easily traceable. There are developers known as tank-men,[6] construction waste contractors specialised in

[6] This is a popular term used to designate those who know how to convert a tank into housing through the most appropriate legal, engineering, economic, political and marketing means.

Fig. 3.5 Sankey Tank, one of the many components on Bangalore's ecological infrastructure. Built in 1882 to meet the water supply demands of Bangalore, restored in the twentieth century as a recreational area (Photograph by Adriana Allen)

reclaiming lakes, lawyers who know to successfully litigate and convert lake ownership; and the list goes on.[7]

An adequate description of the innumerable ways in which an ever-growing web of institutional and individual agents in different locations of power in social, political and government spheres come together to tame the waterscapes of Madurai and Bangalore would require many more pages to be told. The pressure on land for development is immense in urban areas. The potentials to increase ground rent is well beyond the capabilities of one actor to defend, therefore the water bodies face multiple development pressures. A senior officer from the Madurai Planning Department told us that they are not even able to control urban land use change nor urban density based on the master plan due to widespread noncompliance; therefore developing and implementing an ecological master plan is 'beyond our mortal self'. Neither a romantic community nor a leviathan state could be seen during our fieldwork but a complex, dynamic and robust network of political relations leading to a state of collective (in)capacity that produces risk and vulnerability.

Unlike Madurai, in the last decades the number of local collectives striving to save specific lakes and the lakes networks has increased in Bangalore. The past 30 years reveal the formation of a complex network of events and actors struggling to save the lakes and tanks (Fig. 3.5). Spanning across public, private and civil society domains they produce events, documents and court rulings, building on each other's activities, forging political relationships against the aforementioned disruptive

[7] For a detailed analysis of how changes in land use planning transform the blue infrastructure of Bangalore over the years, see Sundaresan (2014).

networks. The cumulative experience from the current state of Bangalore's blue infrastructure revealed to ordinary citizens that a service providing, resource managing all powerful state is perhaps non-existent and that the governance of lakes does not exist in isolation from the political relations forged in the everyday socio-political world. With this realisation many people from diverse social and political backgrounds have become actively engaged in reclaiming the governance of lakes. This transforming political relationship between the state and society constitutes a crucial moment in the history of the lake system in Bangalore, with similar stories replicated elsewhere across the urban Global South.

Below we shall try to trace briefly some significant events in the past 30 years that resulted into a multi-level networked actors, discourse and a momentum to save the wetlands in Bangalore: after the 1985 Bangalore Master Plan recommended that *Hebbal Lake* be developed into a National Park, the government appointed a committee to study the state of the lakes and recommend measures for its conservation. The committee identified the extensive damage inflicted over time to the wetlands system and proposed that the government should prohibit all land use conversion and encroachment of lakes by developing them instead as regional parks, mini forests, picnic spots or water bodies as feasible. In 1988, the government accepted the committee's recommendations, however the conversion and encroachment continued unabated. In 1995, an environmentalist pointed out through a Public Interest Litigation the continuing damage done to the wetlands system with the active involvement of government agencies and requested the court to direct the government to adopt urgent measures. In 2002, to coordinate the National Lakes Conservation Programme as well as an Indo Norwegian lakes rejuvenation programme, the government constituted a Lake Development Authority (LDA) as a non-profit society.

Two years later, the LDA leased out some lakes to private corporations and developers to protect them. Furthermore, in 2005 for the first time, the Bangalore Master Plan mapped and proposed zoning measures to protect the complete wetlands network. However, this resulted in a complex litigation between the Chief Planner and the developers lobby, which eventually the former lost. All this happened while encroachments and reclamation continued unabated, as documented in a 2007 government report on the state of encroachment of public lands. Therefore, in 2008, a local activist non-governmental organisation (NGO) called the 'Environment Support Group' filed a Public Interest Litigation in the High Court challenging the privatisation of the lakes as well the ongoing public and private activities that were damaging the wetlands system (ESG 2010). The High Court appointed a committee to study the ground realities and prepare an action plan and in 2011 issued orders to the government to take urgent measures to protect the lakes (Patil 2011).

Successive court rulings, government reports and institutional frameworks of 15 years yielded little result by themselves. Therefore, at the turn of the century, many local collectives emerged in Bangalore to save its blue infrastructure, some of which formed trusts and similar entities to work actively towards lake restoration.

This movement was recently strengthened by a new 'Save Bangalore Lakes Trust', formed in an attempt to bring together all the individual lakes collectives. Currently, their activities are limited to raising public awareness, digital archiving, advocacy, and developing specific measures to bring more citizens into lake activism.

These activists networks were formed out of the realisation that court orders, government reports, programmes and directives alone cannot ensure the protection of lakes without the active and public struggle of ordinary citizens against the long standing networks that have insidiously and consistently obliterated the wetlands system and which include members from within and outside the government that have quietly privatised public assets through a range of complex mechanisms (Sundaresan 2011).

3.5 Urban Water Futures Reconsidered

Using a sociological historical approach Mosse (2006a, b) argues that dynamic political relationships between local and trans-local power structures produced, sustained and transformed the irrigation tanks in South India during colonial as well as pre-colonial times. He contends that 'the form of these water systems – locally autonomous sources interlinked to complex regional systems – was a function of political systems within which they were first developed and then extended….[the local chiefs] who made and interlinked local irrigation tanks, building political constituencies while strongly guarding their autonomy from ruling sovereign landlords, and ensuring that the water control system was itself highly decentralized' (2008, p. 940). The colonial government did not understand this variegated and widely embedded geography of power relations, so wherever the tank systems were in decline they attempted to revive them by inventing a local community that instead accelerated its decline. Consequently, Mosse proposes that 'If tank systems declined under colonial rule, then, it was the result of this isolation of resource management from the wider political relations through which it had been organised and not, as is widely believed, because of an erosion of the autonomous functioning of village management systems' (1999, p. 315).

Learning from the history and from our analysis of the present, the continuous decline of the blue infrastructure systems of Bangalore and Madurai is due to a reductionist approach and the expectation that a powerful state *can* manage such an extensively networked system of interactions and flows, without involving a dense web of diverse actors and processes that interact across the social political, geographic and hydrological spheres. The nascent revival of the lake system in Bangalore has emerged precisely out of the confluence of variegated social actors at diverse geographical scales building on each other's strengths and capacities. Urban socio-ecological assets are formed of extensive networks of complex relationships, their governance therefore requires equally complex and dynamic processes with the capacity to link networked actors in diverse levels of capabilities.

In the case of Bangalore rather than government reports, court orders or institutional interventions alone, a complex set of events and interactions between social and state actors that lasted for at least 30 years has led to the current momentum of lake revival efforts. This has involved a network of ordinary citizens, legal practitioners, NGOs, government officers, institutions and reports, court orders, master plans, national and international programmes, environmental ideology, nostalgia and innumerable litigations that can be understood as a collective activist network challenging, cooperating, contesting, provoking, lobbying and so on, using an artillery of legal, governmental and political means (Sundaresan 2011). Among this network, environmentalists, confrontational NGOs, able lawyers, altruist funders, retired middle class residents, and government officers among others have supplied information and support, judges who rule in favour of environmental preservation, academics who examine the transformation of lakes and wetlands, citizens who operate as city-wide collectives, digital experts, designers, local and regional newspapers that published special stories in their magazines and local blogs. This thick network is formed of socio-political relations that transcend the separation of state from society to rediscover and restore the blue infrastructure as urban commons.

In Madurai, this thick network is limited to a few public petitions and related court judgments, a few concerned but not very aggressive activist groups, a recent but almost dormant Public Interest Litigation against the Municipal Corporation and a recently started public awareness campaign called 'Madurai's water walks',[8] which seeks to extend the identification of heritage to ecological assets like water tanks (Sundaresan et al. 2014b). Forging a new form of governance network that integrates public and private actors to safeguard the blue infrastructure in Madurai is incipient but still has a long way in counteracting the processes that continue to undermine it.

The tales of Bangalore and Madurai suggest that the future water trajectories of these cities depend on the inception of a form of cascading governance that sees the future through the past and moves beyond the notion of state capacity alone towards a collective capacity for struggle against the actions and decisions that produce the 'killing waters'. As Mosse reminds us, '[w]ater systems are not only shaped by, but also themselves shape, social and political relations; [in that sense] water makes history' (2008, p. 941). Reading a city through the history and metabolism of its water systems, allows us to understand the widespread levels of unspoken complicity among state engineers and planners, private contractors, real estate developers and ordinary citizens alike that make the gradual obliteration of water possible and with it the obliteration of urban life. Such reading might forge new contemporary forms of governing the commons, variegated, networked, decentred, heterogeneous, political and fundamentally capable of imagining and of activating substantially different societal decisions and urban water trajectories.

[8] Activated by the authors during their field work in November 2013, in collaboration with DHAN foundation.

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Part II
Water Options

For much of the twentieth century it seemed as if global urban water infrastructure was headed along a singular trajectory towards providing drinking water and water based sanitation services universally through centralised systems, owned by the state. Since the 1980s this unifying, modern ideal has been challenged from many directions. Neoliberal economics and policy created a greater role for the private sector in water infrastructure, including full privatisation in some jurisdictions. Growing urban populations have created an increasing demand for water and the infrastructure to deliver it. In many cities, water demand is higher than the water available in supply catchments. In rapidly growing cities, even where water is available, investment in infrastructure has not kept up with urbanisation, creating inequalities of access to services and health outcomes. Climate change presents a fundamental challenge to water infrastructure provision, changing patterns of precipitation and water availability, and increasing the risks of extreme events.

In the twenty-first century, cities are pursuing diverse water trajectories. Faced with specific hydrological, climate, environmental, economic, political and social conditions, they have choices to make in determining the form of water infrastructure and governance. Whereas providing urban water infrastructure may once have followed a more-or-less universal template, cities are making specific choices reflecting local conditions and international trends in technology, economics and policy. This section addresses some of the options available in building urban water trajectories, and methods for selecting the most appropriate for specific city contexts.

Sustainable Urban Water Management (SUWM) has become a catchall objective for engineering and policy-making in the sector in recent decades. Managing all forms of water in a city as a single system seems like a logical step forward in improving sustainability and efficiency. However, integration has proven difficult to achieve in practice. Incorporating climate risk into policies and plans further complicates sustainability and resilience objectives. Hurlimann, Wilson and Keele (Chap. 4) develop a framework for evaluating how SUWM is incorporated into urban water policies, including climate change adaptation and mitigation. They apply this framework to urban water policies in London and Melbourne, and reveal

a disconnection between academic discourse about sustainability and its implementation in policy and practice. Hydrological, political and institutional factors shape the way urban water policy is formulated, but these case studies show the persistence of neoliberal 'triple bottom line' framings of sustainability, underpinned by an imperative for growth, in the water sector.

Water reuse is an important option for improving the integration and sustainability of urban water systems. The chapter by Wilcox, Bell and Nasiri (Chap. 5) presents a typology of urban water reuse options based on system scale, strategy, end use, and relationship with existing water resources. The emergence of different forms of water reuse in cities highlights the growing diversity and complexity of water infrastructure provision worldwide. Water reuse systems vary from direct reuse of treated wastewater for potable supply in Namibia and the drought stricken south west of the US, to simply redirecting water used for showering and toilet flushing in an individual bathroom. This presents an array of options for policymakers, infrastructure owners and householders to choose from. Choices are constrained by public acceptability, regulatory uncertainty, cost, energy intensity and technology maturity. The case of water reuse highlights the complexity of decisions in choosing technology for urban water infrastructure in the coming decades, in contrast with conventional modes of provision.

The increasing complexity of decisions facing water managers and infrastructure providers is leading to new forms of policy and decision-making. Expert-led decision-making based on the continual expansion of infrastructure to supply growing demand is no longer capable of addressing the challenges of provision. Miranda, Pfeffer and Baud (Chap. 6) argue that the choice between options for water infrastructure cannot be made on the basis of technical or economic efficiency alone. In Lima, Peru, new technologies of community mapping have enabled stakeholders and residents to participate in determining the future of water supply infrastructure. Through a series of policy developments and research projects, different forms of knowledge can be seen to influence deliberation over options for improving the equity of access and resilience to climate change. Whilst the dominant policy discourse is consistent with a neoliberal framing of water as an economic good, these new approaches to knowledge production demonstrate changes in practice and the conditions for decision-making.

Urban water trajectories emerge as the outcome of a series of technical and political choices. Technological change, the improved scientific characterisation of water resources and climate, urbanisation, demographic transitions, social conditions and economic development are amongst the broad range of factors influencing the selection of options and the effectiveness of outcomes. Characterising the options available for urban water systems, and identifying alternative means for choosing which options to pursue, are important elements in determining a city's future water trajectories. As the case studies in this section show, it is likely that the socio-technical form of water infrastructure in cities will follow divergent pathways, reflecting local culture, society, politics and hydrology.

Chapter 4
Framing Sustainable Urban Water Management: A Critical Analysis of Theory and Practice

Anna Hurlimann, Elizabeth Wilson, and Svenja Keele

Abstract Achieving 'sustainable urban water management' (SUWM) is a growing goal for many cities globally, particularly in the face of existing and emerging water threats. Water policy reveals particular ways of framing problems and possible actions. By understanding the components of sustainability, we analyse how key water policies for two major cities frame SUWM. London and Melbourne face significant future water threats, and have tried to address these through strategic water policy. However, they have different approaches to water policy, and different climatic and built-form contexts. Hence, we review the water policy context shaping London and Melbourne, and analyse to what extent their strategic water policy addresses SUWM. Our study shows that the water policy documents analysed do not define SUWM. Despite this, they addressed a number of components of sustainability, strongly focusing on economics and spatial planning, but there were notable gaps such as climate change, uncertainty and complexity. We draw upon the broader water policy context of each city to discuss these differences within the documents. Our results indicate that a broader and more holistic conceptualisation of sustainable urban water management would be beneficial in both policy contexts. Doing so will help achieve this important goal, particularly in light of current and future water threats, including climate change.

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4.1 Introduction

Achieving 'sustainable urban water management' (SUWM) is increasingly important to many cities given current and future water threats. Implementing effective policy is a valuable component of achieving these aims. Public policy theory contends that problems are identified and framed in a contingent and cyclical way (Hill 2013). Governments and society articulate and structure a response to public issues (Massey and Huitema 2013), including urban water management challenges and threats, but public policy inevitably reflects an interface between management goals and the real world (Laves and Choy 2012). As such, public policy frames water problems and offers particular solutions to them. Cities are major consumers of resources such as energy and water, yet are also places with potential for creative innovation. Melbourne and London have taken steps to address climate change and adopt an alternative approach to water management in public policy (Bulkeley 2013; Hodson and Marvin 2010). Both are first world cities, with different contexts driving their water policy, which makes for an interesting comparative case study.

Recently, the effect of climate change on water security has received more attention across nations. The impacts for water resources vary globally, often significantly threatening traditional sources and methods of urban water supply. These include disrupted precipitation patterns, leading to an increase in the number of extreme rainfall events, and periods of drought in many locations (IPCC 2014a). It is anticipated that these changes will increase consumer demand for water, cause extensive damage to infrastructure and redundancy of system components, and require existing supply sources to be expanded. They have posed and will pose more threats to the well-being of the human-environment systems, which rely on these built and natural water supply systems.

Responding to these experienced and anticipated threats, alternative approaches to water management have been called for in literature. These include the well-established concepts of 'integrated water management' (e.g. Mitchell 2006), and SUWM (e.g. Gleick 1998; Pahl-Wostl 2002). How these important concepts are defined, their ability to respond to these challenges, and their translation into public policy has received limited critical attention. This is an important consideration, given that the way in which SUWM is defined and framed could have a significant impact on achieving this goal (Rein and Schon 1996; Vink et al. 2013). Yet, as Brown et al. (2006) assert, while SUWM is used in various policy documents, it is rarely defined, and thus its policy implications are not specified.

This chapter presents an analytical framework to assess SUWM and examines the coverage of SUWM in two strategic water policy examples – London and Melbourne. The comparative case study offers an in-depth understanding of how SUWM is implemented and addressed in these two different water policy contexts. The analytical framework provides an important tool to compare extant policy with SUWM goals stated in literature, in an in-depth and consistent way.[1]

[1] A seed grant from the Faculty of Architecture Building and Planning at the University of Melbourne, provided funding for this research. Financial support of Hurlimann's sabbatical was

4.2 Components of Sustainability Applied to the Urban Water Management Sector

A centralised and technocratic approach to supplying water has been a dominant paradigm for over a century, particularly in developed nations. However, its appropriateness is increasingly being questioned. Integrated Urban Water Management (IUWM) is an alternative to the traditional water paradigm (Mitchell 2006). But its origins and definition are often contradictory between sources. As characterised by Mitchell (2006), IUWM emphasises demand and supply-side management, the use of non-traditional water resources, the idea of fit for purpose water quality, and decentralisation. It integrates planning, management and stakeholder participation across institutions and planning horizons (Closas et al. 2012). At times, it also includes water supply planning with spatial planning, yet there is little published research detailing how integration might occur, or analysing this in an empirical context. Implementing IUWM can be challenging due to the 'new ground' being charted, and the lack of precedents to follow (Mitchell 2006). Additionally, it is limited by several factors such as a hierarchical and market-based governance paradigm, and industry conservatism (Farrelly and Brown 2011).

The idea of SUWM has received increasing attention in academic literature and encompasses IUWM. Van de Meene et al. (2011) define SUWM as 'integrated infrastructure and biophysical systems, which consider social, economic, environmental and political contexts, provision of water for ecological and human uses, and a long term perspective' (p. 1117). It can have a philosophical and technical component (Brown 2008).

Despite efforts to achieve an alternative and more sustainable approach to urban water supply management, there has been limited impact. Evidence indicates that water resources are currently over-exploited in many regions of the world. Current water use patterns are already unsustainable resulting in risks to human welfare, and damage to ecosystems and wetlands (Brown 2013). The difficulties in achieving more sustainable water supply management are even greater in the context of climate change, and the need to mitigate and adapt to this.

Addressing sustainability and climate change requires paying attention to the long and short term, and ways of handling uncertainty and multiple forms of knowledge. If plans to address sustainability do not address the threat of climate change, it will be impossible to achieve sustainability given the major impact it is predicted to have on society (IPCC 2014a). Literature from the field of sustainability theory, SUWM, IUWM and climate change indicates several important considerations to progress to sustainability. We have summarised these in Table 4.1, referring to examples from applicable literature. The literature in this table is presented chronologically as it emerged into public debate, starting with the sustainability themes commonly interpreted as emerging from the World Commission on Environment

received from the University of Melbourne, hosted by Oxford Brookes University during which this research was conceived. Dr Sonia Graham provided research assistance.

Table 4.1 Key components of sustainability applicable to the urban water management sector

Sustainability components	Example link to literature	Key considerations
Social	WCED (1987), Yencken and Wilkinson (2001), Dempsey et al. (2011)	Maintain/improve human and societal wellbeing; considering factors such as education, health, housing, governance, and eliminating poverty
Economic	WCED (1987), Daly (1991). Diesendorf (1997)	Maintain/improve financial security, household income, economic diversification, full-cost accounting
Environmental	WCED (1987), Goodland (1995), Diesendorf (1997)	Protect/improve the natural environment: regenerating biodiversity, maintaining natural capital and ecosystem services, living within limits of the biosphere, respecting the rights of non-humans
Intergenerational equity	WCED (1987)	Respecting our obligation to future generations and their right to inherit a world meeting their needs; planning for the future; long term benefits
Intragenerational equity	WCED (1987)	Equitable distribution of resources and risks; equity of access to opportunity; poverty reduction, justice
Cultural	Yencken and Wilkinson (2001)	Maintain/advance: 'distinctive customs, achievements, products, outlook and belief systems of a particular group or society' (p. 351)
Transdisciplinarity	Kates et al. (2001), Brandt et al. (2013)	Decision-making that integrates different scientific knowledge bases with other knowledge systems, including indigenous knowledge; invites community participation; respects a plurality of views
Scale	Kates et al. (2001), Goodland (1995)	Decision-making that recognises systems operating across multiple scales; issues that cross boundaries; promote locally-specific solutions. Can consider time scales
Uncertainty	Kates et al. (2001); Goodland (1995)	Decision-making that explicitly recognises risk and uncertainty, incomplete knowledge, unknowns and multiple futures; and adopts the Precautionary Principle
Integration/ diversity	Brown and Farrelly (2009), Closas et al. (2012), Carter (2007), Mitchell (2006), Yencken and Wilkinson (2001), WCED (1987)	Holistic decision-making that integrates multiple sustainability considerations, multiple needs or a range of solutions, including through spatial planning processes where relevant
Complexity	Kates et al. (2001)	Explicit consideration of multiple interactions between system components and unanticipated consequences

(continued)

Table 4.1 (continued)

Sustainability components	Example link to literature	Key considerations
Water source hierarchy	Dobbie et al. (2013), Lloyd et al. (2012), Wong and Brown (2009)	Diversity of water supply options, water source fit for purpose; low impact water use
Climate change mitigation	IPCC (2014b)	Reducing anthropogenic greenhouse gas emissions and/or increasing sequestration to prevent dangerous changes to global and local climate
Climate change adaptation	IPCC (2014a)	Adjusting human systems in response to actual or expected climatic change, to moderate harm

and Development's (WCED 1987) report *Our Common Future* and the triple bottom line approach (Elkington 1997). They expand to include sustainability components advanced by Kates et al. (2001), who argued that to achieve sustainability we must address the fundamental nature of the relationship between humans and the environment, and do it in an innovative way. Table 4.1 provides the framework to analyse the strategic water policies for London and Melbourne.

4.3 Policy Comparison

We compared policies in Melbourne and London using strategic water policy documents of each city, current at the time of analysis. For Melbourne, *Melbourne's Water Future* (Government of Victoria 2013a); and for London, *Securing London's Water Future* (Mayor of London 2011b). We also considered the broader policy context (see Table 4.2). We aimed to establish whether each city is addressing the challenge of SUWM and future water threats, compare policy documents, and draw inferences about their differences. Using a comparative case study is an appropriate method to explore points of difference in select cases (Yin 2014), and is supported by Lodge (2007, p. 276) who argues, 'small-n qualitative case studies have a role to play in advancing our understanding of public policy.'

London and Melbourne are first world cities, with shared heritage permeating culture, and legal systems. They have semi-privatised water supply systems with a government regulatory function and privatised 'utility' providers. London reflects the recent strongly neoliberal turn in UK political economy towards infrastructure (Marshall 2014), but has its own strategic powers. Melbourne has experienced major governmental changes, affecting its water portfolio. In terms of urban form, London is roughly one fourth the size of Melbourne, yet its population is double (Government of Victoria 2014; Greater London Authority 2015). Climatically, London is cooler and wetter than Melbourne, with less variable rainfall (Australian Bureau of Statistics 2015; Meterology Office 2014). Melbourne has a more variable

Table 4.2 Water policy context across three levels of government: Melbourne – London comparison

Governance	London	Melbourne
International	1991 European Communities Urban Wastewater Directive 91/271/EEC	
	1998 EU Drinking Water Directive 98/83/EC	
	2006 EU Bathing Waters Directive 2006/7/EC	
	2000 EU Water Framework Directive 2000/60/EC	
	2007 EU Floods Directive 2007/60/EC	
National	2003 *Water Act* 2003	1994 Council of Australian Governments (COAG) *Water Resource Policy*
	2007 UK Government, Water Resources Management Plan Regulations	2000 COAG National Water Plan for Salinity and Water Quality
	2011 Department for Environment Food and Rural Affairs, Water White Paper: *Water for Life*	2004 COAG Intergovernmental Agreement on a National Water Initiative
	2012 Environment Agency et al. Water Resources Planning Guideline	2007 Water Act 2007
		2007 National Water Commission National Groundwater Action Plan
		2007 Prime Minister of Australia, National Water Security Plan for Cities and Towns
		2008 Minister for Climate Change and Water, National Urban Water and Desalination Plan
		2009 National Water Initiative, Review of Water Restrictions
		2009 COAG, National Urban Water Planning Principles
		2010 National Water Initiative, Pricing Principles
		2012 National Water Initiative, Policy Guidelines for Water Planning and Management
		2015 Department of the Environment, Review of the National Urban Water Planning Principles

(continued)

Table 4.2 (continued)

Governance	London	Melbourne
Region/state	2009 Environment Agency Thames River Basin Management Plan	2001 Government of Victoria, Planning for the Future of our Water Resources
	2011 Mayor of London, Securing London's Water Future[a]	2002 Government of Victoria, Water Recycling Action Plan
	2014 Thames Water Final Water Resources Management Plan 2015–2040	2004 Government of Victoria, Securing Our Water Future Together – White Paper
	2014 Environment Agency. The London Catchment Management: Consultation	2007 Government of Victoria, Our Water Our Future: The Next Stage of the Government's Water Plan
	2014 Mayor of London, London Infrastructure 2050: A Consultation	2013 Government of Victoria, Living Melbourne, Living Victoria: Implementation Plan
		2013 Government of Victoria, Melbourne's Water Future[a]

[a]Policies analysed

climate and greater water storage capacity. However, both cities depend on a centralised supply of water. Given these key physical differences, their vulnerability to climate change, and adaptability, may be different; however, as described in Sect. 4.4, they both take the issue of climate change seriously.

There are differences in the policy context for each city (as detailed in Table 4.2). They have multiple local governments – 32 boroughs for London and 31 local government authorities for Melbourne. While London has the Greater London Authority (GLA), Melbourne has the Metropolitan Planning Authority, which has a different role to the GLA. London has international policy context for water planning through the European Union (EU), yet Melbourne does not. As seen from Table 4.2, the EU policy frameworks were important. The 1991 Urban Wastewater Directive was a starting point for broader water policy change in Europe. The 1994 Council of Australian Government (COAG) water reform was key to the water industry in Australia (McKay 2005), resulting in significant changes to account for broader social, environmental and cultural concerns – and hence a starting point for greater consideration/framing of sustainability in water policy.

The strategic water policies chosen for the unit of analysis were considered appropriate comparisons given their scale of focus (metropolitan), their non-statutory weight, and their formulation by locally-elected democratic bodies. Each policy was analysed: (1) for the guiding policy vision; (2) the underlying water management approach; and (3) the broad strategy. The purpose was to evaluate how each policy addressed the components of SUWM (Table 4.1) in each instance. We added spatial planning to the considerations in Table 4.1, because it contributes to SUWM, particularly in terms of integration and managing complexity. Spatial planning addresses the 'activities of economic and service sectors (such as housing,

energy, economic development, transport, water, waste, social welfare and health) that have spatial or land use consequences in their wider social and environmental context' (Wilson and Piper 2010, p. 10). It also considers the social and environmental context within which decisions are made and implemented in the short, medium and long term. Table 4.1 was used as an analytical tool – a strategy undertaken in numerous fields of policy analysis (le Gouais and Wach 2013; Schneider et al. 2015). Each component was assessed according to three categories: 'superficial' if the component was only briefly mentioned; 'some detail' if the component was elaborated on to an extent, and 'very detailed' if there was substantial detail provided. The analysis was undertaken by two researchers for each city. Where discrepancies occurred, they were discussed and resolved.

4.4 SUWM in London and Melbourne

London reveals how the components of SUWM play out in practice, and the tensions between them. It is a global centre of finance and culture, with population projected to grow 37 % by 2050 (Mayor of London 2014a). Reports show it is highly exposed to the impacts of climate change, located in a region already suffering water stress (Mayor of London 2011a) and vulnerable to fluvial, tidal and urban (surface water) flood-risk, with dangers of water pollution exacerbated by ageing infrastructure. Londoners have a higher per capita consumption (at 160 l/d) than the UK average (of some 140–150 l/d), and there are very low levels of water-metering.

For over 10 years, the London government has taken the issue of climate change and water resources seriously, despite having no statutory powers over water supply management. Since 2000, it has had its own strategic planning powers in the form of the Greater London Assembly and an elected Mayor, and the two incumbents (Ken Livingstone, a former Labour Mayor, and Boris Johnson, a Conservative) have acknowledged the importance of integrating climate change responses, the relationship between mitigation and adaptation, and integrating water management with other interventions such as spatial planning. But their capacity to act depends on the powers of other agencies at different scales, from the European Union, the UK Climate Change Act 2008 and the regulation of water resources by the Environment Agency, to the 32 London Boroughs, with land use planning but no water resource powers. The European Water Framework Directive (see Table 4.2) requires a sustainability reduction in the abstraction of water to restore good environmental conditions. Moreover, water and sewerage services in the UK are privatised, although each company has to prepare a 25-year Water Resource Management Plan for government approval. London is served by five water companies, the principal one being Thames Water.

The *Climate Change Adaptation Strategy* (Mayor of London 2011b), *Water Strategy* (Mayor of London 2011c) and *London Infrastructure Plan 2050: a Consultation* (Mayor of London 2014a) highlight the seriousness of the water issues

facing London. The Infrastructure Plan foresees a water shortfall of 26 % by 2050. Thames Water constructed a desalination plant (commissioned in 2012) as an emergency supply to be operated during drought. The city still needs to reduce its demand such as through retro-fitting existing properties, and will need to secure further resources. It is keen to support behaviour change through awareness-raising and higher levels of metering, and potable reuse of wastewater is currently presented as the preferred option meeting shortfall between supply and demand from the 2020s (Bell 2013). In this context, a supporting document to the Infrastructure Plan 2050 (Mayor of London 2014b, p. 24) argues forcefully for integrated and sustainable water management.

The results of our analysis of *Securing London's Water Future* (London's water strategy) against the analytical framework (Table 4.1) can be found in Table 4.3. The policy seeks to 'future-proof' London in the face of a growing population, increased standards of living and a changing climate that threatens water supply and exacerbates risks from flooding/erosion.

The strategy does not use or define the term 'sustainable urban water management.' However, its aims are clearly placed within sustainability rhetoric: 'one of the primary reasons for preparing this water strategy is to move towards greater sustainability in London' (p. 25–26).

Achieving sustainable development must be supported by 'clear objectives and targets' around efficiency, reduced pollution, flood risk management, and greenhouse gas reduction (p. 26–27). The strategy outlines a vision (1), objectives (3) and actions (20) for water management in London. It envisions a 'secure supply of water that is affordable, safeguards the environment and a water infrastructure fit for a world-class city' (p. 13). To achieve this, the strategy articulates three complementary visions: (1) a fairer charging system to increase water efficiency; (2) better management of rainwater through creative approaches to flood risk and substitution for non-potable uses; and (3) seeing wastewater as a resource, rather than a by-product, and one that represents important climate change mitigation opportunities.

Table 4.3 reveals that six sustainability components are addressed in the 'vision and objectives' at a superficial level: environmental; social; intra-generational equity; multiple scales; integration/diversity and water hierarchy. Additionally, three components are addressed in some detail: economic, climate change mitigation; and spatial planning. It makes implicit connections to spatial planning through references to flood risk management and infrastructure.

The water management approach of the policy document reveals that it addresses nine of the sustainability components in a superficial manner, but the other six components are not addressed. The policy is underpinned by an integrated water management approach that: 'promotes the co-ordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems' (p. 21).

The broader strategy articulates this approach beyond the components already addressed in the policy vision, and more explicitly makes links to spatial planning

Table 4.3 Comparing metropolitan water strategies in London and Melbourne against components of sustainability

	London			Melbourne		
Component of sustainability	Policy vision Vision; objectives; preface and intro	Water management approach (Ch: 1.3; 1.7)	Broader strategy (Ch 2–5)	Policy vision (p. 1)	Water management approach (section 2)	Broader strategy (sections 1, 3 and 4)
Economic	2	1	3	1	0	3
Environmental	1	1	2	1	2	2
Social	1	1	2	2	0	2
Cultural	0	0	0	0	0	1
Inter-generational Equity	0	1	1	0	0	1
Intra-generational Equity	1	1	2	0	0	0
Climate Change Mitigation	2	1	2	0	0	0
Climate Change Adaptation	0	1	1	0	0	1
Transdisciplinarity	0	0	1	0	1	2
Multiple Scales	1	0	1	0	2	1
Uncertainty	0	0	0	0	0	2
Integration/ diversity	1	1	1	1	2	2
Complexity	0	0	1	0	0	1
Water hierarchy	1	0	2	0	0	1
Spatial Planning	2	1	3	0	2	3

Legend: not addressed = 0; superficial = 1; some detail = 2; very detailed = 3

and detailed economic considerations. As detailed in Table 4.3, there are two components not addressed at all in the strategy: cultural and uncertainty.

As the capital of Victoria in south-eastern Australia, Melbourne provides an equally illuminating yet contrasting example of SUWM. With a population of 4.3 million projected to grow to 7.7 million by 2050 (Department of Transport Planning and Local Infrastructure 2014), water is an important aspect of the urban structure and identity as a coastal city built around Port Phillip Bay and its beaches. The city's central business district is near the Yarra River.

Melbourne's urban water system is newer and designed to cope with a variable climate so has significantly larger surface water storage volumes (Dingle and Rasmussen 1991). It is considered to be highly susceptible to fluvial, tidal and urban (surface water) flood-risk and overall drying and ongoing water stress (Grant et al. 2013). Its broader region recently emerged from the decade-long Millennium Drought (1997–2009), which resulted in widespread socio-economic and environmental impacts (Grant et al. 2013). This period saw substantial changes to water-

related policy, infrastructure and behaviour. Significant water restrictions were enacted that saw Melbourne's average daily per capita water consumption drop from 458 L/person to 246 L/person over this period (Grant et al. 2013). Consumption dropped to under 150 L per person at the drought's peak, and has increased to 160 L/person/day in 2013/2014 (Melbourne Water 2014).

The sitting Labor Government invested in constructing a desalination plant to augment critically low dams, and in a long distance pipeline to bring water in from regional areas. The plant ran for a short time in 2012 to complete tests, but has been on 'stand-by' mode since (Melbourne Water 2015). The drought period also stimulated the widespread roll-out of localised rainwater tanks, the uptake of greywater recycling systems and conversion to low water-use gardens, and household level water conservation and reuse initiatives (Hurlimann 2011). These household-level actions were made easier by the city's extensive water metering and pay-by-usage billing arrangements.

City-wide water strategy is set by the State Government and implemented by the urban water management authority (Melbourne Water), two catchment management authorities, three water retail corporations, 31 local governments, and various regulatory bodies such as the Environment Protection Authority. Despite changes from a Labor Government (1999–2010) to a Liberal-National Government (2010–2014) and back to a Labor Government in November 2014, the city recognises the importance of and risks to the urban water system, and adopts a networked governance approach to water management (Ferguson et al. 2013).

The Victorian Labor Government passed the *Climate Change Act 2010* requiring government decision-makers to take account of climate change (mitigation and adaptation) as well as adopt a triple bottom line (TBL) approach (Elkington 1997) integrating short and long term interests in preparing any number of water-related strategies and decisions. The incoming conservative Liberal-National Government reviewed and revised the Act in 2011, but went on to fulfil the Act's requirements to publish Victoria's first Climate Change Adaptation Plan (Government of Victoria 2013b), which previewed a new reform agenda in the water sector. This agenda was articulated in more detail in the recently published *Melbourne's Water Future* (Government of Victoria 2013a) and supporting practical guidelines.

Melbourne's Water Future does not use or define the term 'sustainable urban water management', and the terms 'sustainable development' and 'sustainability' are rarely mentioned. The word 'sustainable' is used on a number of occasions as an undefined adjective. The strategy does articulate a vision, which makes reference to 'sustainable communities,' and while resilience is mentioned, this is not specific to climate change (p. 3). The vision is supported by seven outcome areas that are in need of priority attention (p. 32–33). Each of these objectives is supported by a series of stated initiatives (p. 34–84).

The water management approach guiding the policy is articulated in section 2 – a 'whole-of-water-cycle management' approach. It is defined by a one-page graphic and text box (p. 15). This explains that the term is the 'preferred description for what is known in the industry as integrated water cycle management' (p. 15). The

detailed explanation addresses many components of sustainability defined in Table 4.1, including multiple scales and spatial planning.

Melbourne and London's key strategic water policy documents address the supply, use/demand, wastewater and waterways components of the water system; the interconnections between governance and the environment; the interests of multiple stakeholders. However, as revealed in Table 4.3, such an integrated approach does not adopt all the components of sustainability established in the analytical framework.

Both documents similarly recognise that population growth, urban change, lifestyle and climate change are main drivers for their policy initiatives. Their visions emphasise the improved social and environmental benefits from the water system, yet give primacy to economic and infrastructure 'solutions' to achieving these goals. The two strategies are framed as future oriented – yet neither addresses uncertainty or complexity in an extensive manner, and they poorly address inter-generational equity. With regards to framing a sustainable water future, both policies accept a strong 'growth' scenario, shying away from a strong demand management frame (more strongly in Melbourne).

The strategies of both cities lean towards institutional and private sector stakeholders, favouring expertise and robust/standard decision-making frameworks – recognising other knowledge systems or (varied and/or competing) cultural values is almost completely absent. The 'community' is largely framed as a single entity, and the emphasis is on 'inform' and 'engage' rather than true transdisciplinary governance or decision-making. Linked with this is a reluctance to acknowledge the limitations of scientific knowledge. This resembles findings by Miller et al. (2014) in their analysis of an earlier water policy document for Melbourne (Government of Victoria 2006). While this could be a definitional problem, it has an implication for the framing of SUWM, and hence the resultant policy solutions which may arise.

London places a far greater emphasis on climate change than Melbourne, in particular relating to mitigation. The broader influence of international level policies may be instrumental here: international networks for municipal climate change action, such as the C40 Cities network, of which London was a founder member, have been shown to be important (Kern and Bulkeley 2009). London also places a greater emphasis on intra-generational equity in the sense of fairness and affordability. Melbourne's reference to this is more on the broadly liberal agenda of competition reducing overall prices.

London's strategy from 2011 was focused largely on metering/billing and design/infrastructure solutions (although policy develops, and the later Infrastructure Plan 2050 (Mayor of London 2014b) more explicitly identifies a need for new resources). This is logical given the difference between infrastructure age, and water leakage differences in these two cities. Such initiatives were largely implemented in Melbourne as a result of the COAG water reforms (see Table 4.2). In comparison, its strategy is focused largely on liberalisation addressing support and knowledge-sharing.

4.5 Conclusions

This chapter has contributed to a critical focus on the uptake of alternative approaches to urban water management. It reveals how two first world cities are articulating and responding to more complex and urgent water challenges in their water management policy discourses. Integration and sustainability have clearly been incorporated into how London and Melbourne authorities have shaped contemporary water policy. Where London seeks to 'future-proof' itself as a 'world class city', Melbourne pursues 'resilience' for a more 'liveable community'. Comparing the cities indicates there has been re-framing of sustainability discourses to reflect important local historical, political and other contextual drivers for policy. A legacy of flooding in London and of drought in Melbourne exemplify the ongoing impact of water history in urban policy memory, whilst key political issues for both cities include the impact of policy directives at higher levels of governance (London's EU Water Framework Directive and Melbourne's COAG water reforms) and very different political treatment of climate change as an urgent driver of water policy. This indicates that the unique context of each city is likely to shape its water management approach.

Questions still remain about the extent to which these narratives are largely political rhetoric and window-dressing rather than a deeper shift in water management policy and practice. Our policy analysis reveals that economic, spatial planning (development) and integration aspects of sustainability remain the most comprehensively addressed in water policy documents, arguably consistent with pro-growth and liberalisation agendas. Therefore, a continuing disconnection exists between academic and professional discourses about sustainable development and SUWM, and their integration into policy in London and Melbourne. Re-considering the way that SUWM is framed in theory and practice, with greater attention to components other than TBL, will help achieve sustainability, and a robust approach to current and future urban water threats. To reach SUWM under conditions of climate change and future threats, a holistic and encompassing definition of sustainability must be considered and addressed. This must move from the traditionally-defined TBL approaches, to encompass equally important considerations of culture, intergenerational and intra-generational equity, transdisciplinarity, scale, uncertainty, complexity, integration and climate change adaptation and mitigation. There is a need for greater attention clearly articulating the components of SUWM and ways of achieving this goal, with a more holistic view of sustainability in mind.

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Chapter 5
Water Reuse Trajectories

Jonathan Wilcox, Sarah Bell, and Fuzhan Nasiri

Abstract Water reuse is an obvious and important response to water scarcity in cities. It takes many forms – potable and non-potable, centralised and decentralised, direct and indirect, and planned and unplanned. How different forms of reuse emerge and stabilise depends on technical, economic, social, environmental and political factors, and specific local conditions. This chapter reviews trends in potable and non-potable reuse, including international examples of urban water reuse. The analysis shows that public acceptance, regulation, proven technology and support for innovation are needed to provide the conditions for water reuse systems to function. The diversity of approaches to water reuse in cities indicates that urban water infrastructure is diverging from the twentieth century ideal of a centralised, universal supply of potable water. The different forms of water reuse present specific challenges for regulating and governing water infrastructure that require reform of existing arrangements and new institutions and management strategies.

5.1 Introduction

For most of the twentieth century the development of urban water and sanitation infrastructure pursued an ideal model of centralised provision of drinking water and water-borne sanitation services (Graham and Marvin 2001). Universal, affordable access to potable water is a fundamental principle of good public health. Continuous water supply has also enabled modern lifestyles, gardens and standards of cleanliness that consume much more water than required to meet basic health needs (Shove 2003). Meeting the growing demand for water in cities is a major challenge

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for engineering, urban planning and governance. Conventional fresh water resources are renewable but limited, and in many parts of the world are unable to meet increasing urban demand.

Reusing water is an obvious and important measure for narrowing the gap between supply and demand. Water reuse takes many different forms, from simply using dishwashing water on kitchen pot plants, to recycling effluent from sewage treatment works for drinking water. Various techniques and systems for water reuse have different implications for cost, social acceptability, quality, energy consumption and governance. Reusing water at varying scales for different purposes introduces additional complexity into water infrastructure systems compared to conventional drinking water and sewerage systems (Bell 2012).

This chapter presents a typology of water reuse options, characterised according to scale (centralised or decentralised), strategy (planned or unplanned), end use (potable or non-potable) and the relationship to existing water resources (direct or indirect). The analysis highlights the socio-technical character of different types of reuse. As new technologies and infrastructures emerge to meet growing demand for water, they interact with and drive change in governance, social and economic systems.

5.2 Scale and Quality

Water reuse requires the existence of both a water supply system and a source of wastewater. The system which connects the two defines its form. There are typically four binary categories of water reuse systems: planned or unplanned, direct and indirect, potable and non-potable, and centralised and decentralised. Planned systems are those where a formal decision has been made to implement water reuse. Direct systems have no environmental buffer between discharging treated wastewater and the water supply system. Indirect reuse discharges treated wastewater into surface or groundwater sources, mixing it with conventional water resources, before abstracting it for reuse. Potable systems are used for drinking, food preparation and personal hygiene. Non-potable systems provide water for toilet flushing, irrigation, fire suppression and other low-risk uses. Centralised systems are organised at a municipal level, while decentralised systems operate on a building or neighbourhood scale.

In practice, few combinations of the four categories exist as the overall system form is dictated by the required water quality and the most appropriate scale at which to achieve this. Local economic, political, social and technological factors combine to determine the most appropriate form. Generally, system scale grows with increases in final water quality requirements.

Potable reuse systems can be both planned or unplanned, and direct or indirect. The level of water quality required for potable applications typically favours centralised systems to minimise risk to public health and achieve higher economic and energy efficiency required for high quality drinking water.

Non-potable systems are generally planned, direct and decentralised. The decision to use water for non-potable applications is inherently planned, an environmental barrier is not necessary to reach an appropriate level of water quality, and treatment can be achieved at smaller scales. System scale ranges from instant – sink to flush – to neighbourhood scale collection, storage and distribution. Examples of large scale non-potable reuse schemes are typically in industrial, environmental and agricultural, rather than domestic, applications.

The source of wastewater is a key factor in determining the cost, energy efficiency and scale of reuse. Energy use and cost increase with the amount of impurities that need to be removed – low-quality source water and high-quality final water requirements both lead to higher energy use. Most centralised reuse schemes are based on treating and redistributing municipal wastewater. Municipal wastewater is highly contaminated, and high levels of treatment, therefore energy and cost, are required prior to reuse.

5.3 Unplanned Indirect Potable Reuse

Unplanned Indirect Potable Reuse (IPR) is the most common form of water reuse. It occurs wherever a water supply abstraction point exists downstream of a wastewater treatment discharge and the scheme is not formally recognised as being water reuse. It is common in urbanised catchments. In water stressed catchments, wastewater discharge can significantly contribute to river flows, enabling abstraction of water downstream whilst maintaining ecological functions.

In contexts where wastewater discharge and water supply quality is monitored and regulated, these are governed by the conventional standards for wastewater and water quality. Research into the treatment requirements for IPR and Planned Direct Potable Reuse (DPR) is becoming increasingly relevant for unplanned reuse as abstraction for potable applications regularly occurs from polluted water sources. In the future, it is possible that planned and unplanned potable reuse will be subject to the same regulatory scrutiny, public acceptance complications, and technological and infrastructural expense as the distinction between the two becomes blurred.

5.4 Planned Indirect Potable Reuse

Planned IPR schemes augment conventional sources of water in aquifers, rivers and reservoirs with treated wastewater to abstract higher volumes than would otherwise be sustainable. In IPR schemes, wastewater is usually treated to a much higher standard than is required for discharge to the environment. In addition to conventional sewage treatment, water for planned reuse in most cases is treated using membrane technologies. Technologies for tertiary wastewater treatment for potable reuse

include reverse osmosis, micro-filtration, ultra-filtration and membrane bioreactors.

The most common treatment train for potable reuse systems is recognised by the California Department of Public Health (CDPH) as being microfiltration, reverse osmosis and an advanced oxidation process (CDPH 2011). The widespread implementation of this system is restricted by high capital, operational and maintenance costs, high energy consumption, limits on levels of water recovery, and effluent discharge. In response, a number of alternatives are emerging globally (Gerrity et al. 2013) such as ultraviolet disinfection, membrane bioreactors, chlorination, ozonation and biological activated carbon.

Membrane treatment technologies that are commonly used for potable reuse are expensive and energy intensive compared to conventional methods. Reverse osmosis is the same technique used in desalination, the most energy intensive method currently used to produce drinking water. Energy requirements for treating wastewater to potable standards can be a significant factor undermining the sustainability of potable reuse compared with other options (Cooley and Wilkinson 2012). However, in many cases potable reuse treatment trains are more cost effective and less energy intensive than alternatives such as water supply transfer schemes and desalination (Leverenz et al. 2011).

Regulation of IPR is well developed in the US, due to the development of schemes in Florida and California. Around half of US states have statutory requirements for IPR, and others use US Environmental Protection Agency (EPA) guidelines to assess individual cases (US NRC 2012; EPA 2004). California's regulation of its groundwater replenishment schemes is especially strong, addressing both reuse in general and groundwater recharge standards in particular (CDPH 2009, 2011).

The 'environmental buffer' provides additional informal treatment to the already highly treated wastewater, and enables mixing and dilution with conventional supply sources. Dilution with surface water and groundwater can cause the water quality to deteriorate if the treatment train achieves a particularly high standard, but have been thought to increase public acceptability of potable reuse.

Potable reuse of wastewater has proven to be controversial in recent decades. Indirect reuse is thought as more acceptable to the public than direct reuse. Mixing highly-treated wastewater with conventional water sources and the treatment provided by natural systems is thought to allay concerns about health risks associated with potable water reuse. Using treated wastewater to augment existing resources rather than directly reusing it as drinking water is also thought to reduce the 'yuck factor' associated with potable reuse, which is used to describe seemingly irrational public concern at drinking treated wastewater.

Nonetheless, public opposition to water reuse has been a significant factor in the failure of proposed projects and has delayed the implementation of others. The city of Toowoomba in Australia voted against IPR as a new source of water in a referendum in 2006 (Hurlimann and Dolnicar 2010). Public concerns focussed mostly on health risks and the 'experimental' nature of Australia's first IPR scheme. Implementing IPR in San Diego during the 1990s and 2000s was delayed due to

public opposition, including concerns about environmental justice, with poorer neighbourhoods protesting about receiving more reused water than wealthier parts of the city.

Controversy about IPR has highlighted gaps in modern governance regimes for water infrastructure (Bell and Aitken 2008). The conventional expert-led management of water supply systems has been unable to adequately account for public interest and concerns about new sources of water. Responses have varied around the world. In Toowoomba, the referendum created an adversarial debate. A simple yes/no vote mitigated against meaningful public engagement in the decision-making process and debate about risks and benefits of the proposed scheme (Bell et al. 2011). Many schemes, particularly in California, have adopted a Decide-Announce-Defend (DAD) approach to implementation, in which engineering decisions are made without consulting the public, and sophisticated communication strategies deployed to convince the public of the benefits of IPR and counter concerns about risks.

Colebatch (2006) argues that decisions about IPR should be taken in a wider context of public consultation and engagement about water resources management and infrastructure. Rather than being presented as IPR as the preferred engineering solution to water shortages, the public should be engaged more widely in decision-making. A more deliberative approach to engaging the public in decisions about water reuse was proposed as an alternative expert led processes (Russell et al. 2008). Greater attention to public acceptability was a feature of recent proposals for IPR in Perth and London, including the use of deliberative methods of engagement (Aitken et al. 2014; Hills et al. 2013). Early results indicate that addressing social concerns about potable reuse from the outset of research and planning into new schemes reduces opposition and increases acceptance.

5.5 Planned Direct Potable Reuse

Planned Direct Potable Reuse (DPR) is the least common form of water reuse. In such schemes, treated wastewater is introduced directly into the drinking water system, without any environmental buffer between the wastewater treatment effluent discharge and water supply abstraction. DPR can consist of either a direct connection of the wastewater treatment discharge into the water supply distribution system or at the abstraction point for water supply treatment just before the normal drinking water treatment process. As in IPR, wastewater is subject to advanced treatment, usually membrane filtration. DPR must find alternative ways to provide the system security and public confidence that an environmental barrier provides.

The most famous example of DPR is in Windhoek, Namibia where the blending of treated wastewater with raw water sources has been available since 1968 to provide a more resilient supply in drought situations (Du Pisani 2006; Lahnsteiner and Lempert 2007; Menge 2007). The system includes extensive control and testing of the wastewater source to minimise the impact of industrial discharge and identify

spikes in contaminants (Du Pisani 2006), and a treatment train designed to remove various contaminant classes consisting of chemical coagulation, sand filtration, ozonation, biological activated carbon, granular activated carbon, ultrafiltration, chlorination and sodium hydroxide stabilisation (Du Pisani 2006; Tchobanoglous et al. 2011). Extensive control and monitoring act as an alternative to an environmental or engineered buffer by providing sufficient time for quality testing, analysis and decision-making (Gerrity et al. 2013).

Two systems have recently been implemented in the US at Cloudcroft, New Mexico which uses a similar treatment train to Windhoek, and Big Spring, Texas which uses the traditional Californian model of microfiltration, reverse osmosis and advanced oxidation (Gerrity et al. 2013; Crook 2010; Khan 2014; Leverenz et al. 2011; NWRI 2010; Tchobanoglous et al. 2011). Further DPR systems are proposed for California as a solution to ongoing drought and water shortages (WRRF and WRCA 2014). Public acceptance of these schemes under extreme drought conditions has challenged previously held assumptions that DPR would be likely to face strong opposition due to concerns about health and the 'yuck factor' associated with the idea of 'drinking sewage'.

DPR technology is between two and three times as energy efficient as desalination (Poussade et al. 2011; Tchobanoglous et al. 2011). It can be cheaper than IPR by avoiding pumping water to and from an environmental buffer. DPR can also be cheaper than centralised non-potable reuse as it avoids the need for a dual-reticulation network (Leverenz et al. 2011).

There are four barriers to the widespread implementation of DPR: the development of national regulation and global guidance; further research into the associated public health risks created by removing an environmental barrier; further development of cost and energy efficient treatment; and a change in the public perception of the risks associated with DPR.

5.6 Non-potable Reuse

Non-potable reuse (NPR) has the possible advantage over potable reuse of less stringent end-use water quality standards, reducing the requirement for treatment. However, NPR requires a separate distribution network to the conventional potable system. This is a constraint on the scale of NPR schemes. Within a bathroom NPR can be as simple as redirecting shower outflow to fill a toilet cistern or irrigate the garden. NPR at a building or bigger scale requires more extensive plumbing systems, which practically duplicate the existing potable network.

Reuse of municipal wastewater for non-potable end uses should require less treatment than for potable use, but this can vary depending on the system configuration and risk management strategies. NPR schemes can also be based on local reuse of greywater, which is water from showers, washing machines, bathtubs, hand basins and low-risk industrial processes. NPR of greywater usually occurs on a household or building scale, with minimal requirements for treatment. However, the

reduced cost of treatment for non-potable use must be balanced against the cost of building and operating a 'dual reticulation' system to distribute both potable and non-potable water as separate supplies.

Centralised NPR is perhaps the second least common form of water reuse after DPR. Its implementation requires considerably more planning, regulation and oversight than other forms as it requires the adoption or retrospective implementation of a dual reticulation network. Decentralised non-potable water supply systems can utilise a variety of water sources such as rainwater, storm-water, greywater and locally reclaimed wastewater (Moglia et al. 2011a) depending on the water quality requirements of the local context.

Non-potable urban reuse is a well-established practice in Japan due to policy requirements for dual reticulation networks in new buildings above 3000 m^2 in many urban areas (Asano et al. 1996). Perhaps the largest example of NPR is the 1979 Fukoaka City reclamation plant which supplies 9600 m^3/day for toilet flushing, park irrigation and commercial buildings (Funamizu et al. 2008). The system was implemented following an extreme drought in 1978 and uses a treatment train consisting of chemical coagulation and sedimentation, ozonation, granular filtration, and chlorination. This treatment train is comparable to those in potable applications. NPR applications are not limited to buildings and are typically used for landscape irrigation and garden watering.

Australia has led in researching and implementing decentralised NPR systems as a means to a diverse water supply to provide system reliability and flexibility (Cook et al. 2009; Moglia et al. 2011a; Sharma et al. 2008; Tjandraatmadja et al. 2005). In 2009, the Queensland government introduced mandatory on-site water reuse devices for new build homes, in addition to fitting water efficient appliances, to enable them to save 70,000 l of mains water per year (DIP 2009; Mankad 2012).

There is now a recognised need to develop regulation and practice guidelines for constructing and using NPR (Moglia et al. 2011b; Sharma et al. 2010). Moglia et al. (2011b) suggest that there is a need for: governance development, operation and management models, engineering design codes, installation guidelines, risk assessments, and technology selection methods to support decentralised water reuse. In addition, they also suggest that adaptive governance mechanisms should be implemented to capture knowledge. These include performance monitoring, identifying key success factors, ongoing stakeholder discussion, the development of a multi-perspective complexity understanding, flexible institutional mechanisms to promote the industry, and intelligent and responsive policy-making in addition to industrial engagement (Moglia et al. 2011b).

Limited information from district NPR schemes suggest that they are not yet as economically or environmentally efficient as the combined footprint of traditional water supply and wastewater infrastructure (Verrecht et al. 2012). Initial estimates suggest that providing a dual reticulation network is more expensive than the treatment costs associated with treating wastewater to a high standard for potable reuse (Tchobanoglous et al. 2011). Results from BedZED, a zero-carbon housing development in London, (Verrecht et al. 2012) show that balances between public acceptance and water quality, staff, maintenance and capital costs, treatment efficiency

gains and storage costs, and storm-water, rainwater and wastewater integration have not been optimised.

Non-potable reuse of municipal wastewater at the Queen Elizabeth Olympic Park in London is considerably more expensive than conventional water and wastewater treatment. The reused water is intended for use in non-potable applications but the risk management strategy employed to avoid public health problems in the event of a misconnection or misuse of the water requires treatment to effectively potable standards. In this case the management of risk undermines the potential sustainability benefits of non-potable reuse by increasing the intensity and cost of treatment.

5.7 Socio-Technical Trajectories

Water reuse schemes in various forms are currently considered alternative, rather than mainstream options for water infrastructure. Our review of water reuse options shows that the key factors shaping the implementation of water reuse in cities around the world include public acceptance, regulation, technology and economic subsidy.

5.7.1 Public Acceptance

The public perception of any water reuse scheme is integral to its success. Public acceptability of water reuse is particularly of concern for potable reuse. Effective public engagement in water resources decision-making can increase the acceptability of reuse. Recent experience in the United States also shows that acute water shortages are conducive to public acceptability of reuse, including DPR.

Without public support, schemes may be underutilised or abandoned as has been demonstrated in Toowomba. The main public concerns are the perceived public health risk, system failure, maintenance requirements, service parity with the incumbent system, water quality, and the environment (Dolnicar and Hurlimann 2010; Moglia et al. 2011a; Southern Water 2012). Objection to the use of reclaimed water increase as the application moves closer to the body (Dolnicar and Hurlimann 2010).

Community involvement in the development of a scheme can take three forms: participation – where the community is actively involved in the development of a scheme they will adopt; influenced design – where the requirements and wishes of the community are considered by the system designers; and no alternative – where the system designers present the scheme as the only option to solve water scarcity (Bell 2012; Dolnicar and Hurlimann 2010). Higher levels of participation in water

reuse and water resource decisions can make planning more complex and time consuming, but have been shown to underpin more robust decision-making and lead to higher levels of acceptance.

5.7.2 Regulation

The provision of national regulation and guidelines standards may enhance public confidence in water reuse as an alternative form of water supply. End use standards for potable and non-potable water should allow for flexibility in devising treatment trains in different applications. The establishment of any regulation and standards needs to find a balance between ensuring public health and avoiding an overly conservative standard which acts as a barrier to the implementation of water reuse schemes or requires energy and chemically intensive treatment (Nellor and Larson 2010). The development of guidelines and regulation is critical to the widespread implementation of water reuse schemes (Sharma et al. 2010).

5.7.3 Technology

Proven technology improves public confidence in water supply quality security and allows designers to implement systems, which are less energy intensive and more cost effective whilst having an appropriate level of process resilience. An increase in the technical capacity of water industry and its contractors and consultants in construction and maintenance of water reuse systems will be required for their widespread implementation (Moglia et al. 2011b). At present, inefficiencies associated with unfamiliarity are mitigated against through redundant process capacity providing system resilience to incoming contaminants and process failure (Gerrity et al. 2013).

Various treatment trains have been successfully implemented globally for both potable and non-potable applications. Reverse osmosis combined with micro/ultrafiltration is perhaps the most established and proven treatment train for potable applications (Thames Water 2013). Advances in online-monitoring will allow systems to be closely observed and process failure to be detected sufficiently quickly. Currently microbiological tests do not facilitate sufficiently quick pathogen identification for the removal of engineered or environmental barriers (Gerrity et al. 2013). This improvement will effectively optimise treatment trains – making them more energy efficient and cost competitive with alternative forms of water supply. Further monitoring of raw and effluent water quality is required to fully determine the design requirement and reliability of potable systems (Thames Water 2013).

5.7.4 Innovation Support

Water reuse utilises technology and infrastructural arrangements which have not yet reached maturity. As a consequence, schemes may need to be implemented in protected market environments to allow water reuse to be competitive with traditional forms of water supply. To enable schemes to be economically feasible heavy subsidisation is often required (Hochstrat et al. 2007).

Water reuse is usually more expensive than conventional supply. However, under conditions of water scarcity, water reuse may be costlier than other alternative water sources such as desalination and inter-basin transfers (Iglesias et al. 2010).

The water industry is conducive to the creation of protected markets to support developing technologies due to its monopolistic nature (Geels 2002). The lack of funding available for the trial of innovative technology and infrastructural arrangements is regarded to be a widespread barrier to implementing water reuse schemes (Bixio et al. 2008).

5.8 Conclusion

Water reuse offers a solution to water scarcity through the augmentation of existing water supplies to meet growing demand. Numerous water reuse examples exist globally with various applications, system scales, technologies and regulation. The determination of the optimum form of water supply will rely upon local economic, social and environmental conditions such as the cost of a marginal increase in water supply from existing or alternative sources; the availability and cost of energy for the treatment of wastewater; the required water quality for end use; the capital cost of installing a water reuse treatment system suitable for its applications; public acceptability and regulation.

Constraints on conventional supplies are an unavoidable physical challenge to the predominance of the twentieth century model of universal, continuous provision of drinking water to cities (Bell 2015). The diversity of water reuse technologies and strategies exemplifies the complexity of trajectories of emerging water infrastructure systems. Balancing security of supply, public health risk, cost, environmental impacts and social acceptability in different options for water reuse demonstrates a shift away from universal, centralised provision. Water reuse systems are being deployed to meet demand in particular, local circumstances.

The emergence of alternative water reuse strategies demonstrates the interactions between the local and universal, as well as the need for social, political and economic reform alongside technological innovation in the context of environmental change. Alternative water sources and infrastructures do not exist as isolated, universal technological solutions to water scarcity, but are central to trajectories of development and reform in urban water systems.

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Chapter 6
Unfolding Urban Geographies of Water-Related Vulnerability and Inequalities: Recognising Risks in Knowledge Building in Lima, Peru

Liliana Miranda Sara, Karin Pfeffer, and Isa Baud

Abstract This chapter analyses how different discourses influence knowledge-building processes in terms of their main concerns, water sector boundaries, and types of information considered legitimate, in the context of Lima. It shows how these processes are embedded in urban configurations, and how the legitimacy of mapping processes needs to be negotiated across boundaries. We analyse how iterative mapping processes within three *concertación* (*Concertación*' has no proper translation into English. We have discussed the concept elsewhere (Miranda and Hordijk 1998). It refers to the process of reaching agreements for joint action through dialogue and deliberation.) processes in Lima reveal uneven geographies of water-related vulnerabilities and inequalities, and presenting the outcomes of the cross-boundary processes of social construction for generating, analysing, and exchanging knowledge on water vulnerabilities. Three research and policy-building projects in Lima reflect how mappings of 'water-related vulnerabilities and risks' are socially constructed. Firstly, maps draw on different discourses and framings, data inputs and classifications at multiple spatial scales. Secondly, they visualise spatial inequalities and link multiple dimensions to one geographic locality, building a more integrated understanding of the dynamics and spatial differentiation of Lima's 'waterscape', combining human and natural processes. As a result, it becomes easier to discuss the legitimacy of different types of knowledge among various actors. Thirdly, maps facilitate 'exchange on priorities, conflicts and synergies', providing inputs into negotiation processes between actors in water gov-

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ernance configurations. Although mapping produces new types of knowledge, it is necessary to ensure that the results are incorporated into policy-making and implemented for wider acceptance.

6.1 Introduction

As the global population becomes urbanised, the growth of large cities in low- and middle-income countries is intensifying water challenges. Such challenges are related to extreme inequalities in providing and consuming drinking water and sanitation for urban populations, the need to deal with future risks and uncertainties around water availability, and vulnerabilities related to climate change scenarios. These challenges are exacerbated when cities are in low-elevation coastal zones, where the effects of climate-related extreme weather patterns are expected to be felt most strongly (McGranahan et al. 2007; IPCC 2014). Lima, Peru is a strong case, as the city combines extreme water scarcity (<9 mm/year) and inequalities in drinking water provision with high risk levels related to climate variability (Miranda Sara and Baud 2014). Also, there are extreme inequalities in drinking water distribution between and within central and outlying areas.

Consequently, local and national governance institutions must assess such risks and devise strategies to make cities more resilient against future stresses and shocks. The water crisis is seen by several authors as foremost a governance crisis (UNESCO 2006; Castro 2007; Bakker 2010). Institutional networks dealing with water provision and water-related risks can be complex, fragmented and not used to collaborating, which limits their knowledge exchange (Jameson 2014; Filippi et al. 2014). Therefore, it is necessary to better understand the city's different institutional perceptions and discourses concerning water-related risks and how up-to-date information and knowledge concerning water issues is built up.

Actors have different discourses, perceptions and knowledge of water and climate change, which they use within their urban governance configurations. Miranda Sara et al. (2011) have identified four main discourses around water and water-related issues, based on how relations between nature and society are recognised.[1] These approaches characterise different water trajectories in terms of sources, flows and uses. They also recognise various types of knowledge and value them differently, as shown by the issues included, and the sectoral and physical boundaries they set to a water governance configuration. We embed the notion of discourses within our *concept of urban governance configuration* to capture the links between actor perceptions, knowledge building processes and power relations, and the way they influence the governance of water-related vulnerabilities, risks and inequalities. The concept distinguishes the dominant discourses and framings around water and water-related issues, the actors and coalitions involved, the processes and methodologies of producing spatial knowledge on water-related issues, the material and

[1] This is water as an economic, a human right and social, a socio-ecological good, and a technical sector.

spatial scales at which issues are dealt with, data inputs and classifications (together mapping processes), and the outcomes with respect to practices (Baud et al. 2014).

The purpose of this chapter is to analyse how different discourses influence knowledge-building processes in terms of their main concerns, boundaries set on the water sector, and the types of information collected recognised as legitimate. We show how these processes are embedded in an urban configuration, where the legitimacy of mapping processes needs to be negotiated across existing boundaries. We look at how iterative mapping processes within three *concertación*[2] processes in Lima reveal uneven geographies of water-related vulnerabilities and inequalities in and around the city, presenting the outcomes of the cross-boundary social construction of knowledge for generating, analysing, and exchanging knowledge on water vulnerabilities (*concertación*); moving from sectoral to integrated spatial planning.

Mapping different types of knowledge is valuable to understand water-related risks and inform adaptation strategies. Including key actors and local community-based information in knowledge building processes (mapping) is crucial as it often provides insights that are not usually acquired through expert-led knowledge building (Pfeffer et al. 2013; Allen et al. 2015; Deakin 2009). Combining different sources of information in *spatial representations* can be used as a strategic resource for local deliberative processes. Such mapping helps understand water-related vulnerabilities and trajectories across boundaries, linked to one geographical location within the water hydrological cycle processes. It also creates new understandings as part of interactive and iterative knowledge-building mapping processes (Kitchin and Dodge 2007; Allen et al. 2015; Pfeffer et al. 2011; Muguruza Minaya et al. 2012; Lambert and Allen forthcoming). However, maps remain the outcome of subjective decisions, influenced by the social, political and cultural contexts (Pfeffer et al. 2015).

The first section briefly describes the various perceptions on water-related vulnerabilities and risks, obtained through 39 in-depth interviews held with key-actors such as SEDAPAL,[3] MML, SUNASS,[4] researchers, non-governmental organisations (NGOs) and community-based organisations (CBOs). The second section describes the mapping processes of three projects through which climate change scenarios were created to design plausible future scenarios of the water situation in Lima. These were complemented with focus group discussions, meetings and workshops with community leaders, residents and key-actors.[5] The outcomes laid down in maps indicate likely future patterns of water-related vulnerabilities and risks.

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[2] '*Concertación*' has no proper translation into English. We have discussed the concept elsewhere (Miranda and Hordijk 1998). It refers to the process of reaching agreements for joint action through dialogue and deliberation.

[3] Para-statal water company that supplies and distributes drinking water for Lima, www.sedapal.gob.pe.

[4] The water regulator institution in Peru, www.sunass.gob.pe.

[5] Together these consisted of more than 50 workshops, seminars, fora, and focus group discussions. In addition, the first author (as FORO director) was also the team leader in developing the Climate Change (CC) adaptation strategy of Lima and actively participated in the Concerted Development Plan of Lima with the MML.

6.2 Water-Related Risks and Inequalities in the Context of Metropolitan Lima: Current Trends and Future Uncertainties

Metropolitan Lima is a coastal city on the Pacific Ocean (Fig. 6.1). It consists of about 85,525 urbanised hectares[6] and more than 17,000 agricultural hectares under pressure from urban expansion.[7] Lima is the capital city of Peru, with 8.5 million inhabitants (INEI 2013), one-third of Peru's population. It contains more than two-thirds of national industrial production, financial management and trade, and concentrates the highest number of urban poor people in Peru (Miranda Sara et al. 2013).

The city and its surrounding areas source their water from four basins; three originating in the Andes Mountains and dropping 3500 m to the coastal desert and Pacific Ocean and one being part of Amazon River basin, namely the Mantaro river basin. Although the fourth river basin is part of another basin, its water is partially transferred to the western Lima basin to augment the city's water supply and energy through large-scale infrastructure projects (five hydropower plants contributing 60 % of the country's electricity). Groundwater extraction is 10 % above the replenishment level regularly and goes up to 30 % in emergencies. Water is treated, distributed and wastewater released to the Pacific Ocean. It is quite difficult for key actors to understand and quantify these combined manmade and natural dynamics of Lima's hydrological cycle, as the information remains diffused and confidential (Zwarteveen and Boelens 2014).

Lima is extremely vulnerable to water scarcity, as river water is currently insufficient to meet the increasing demand for drinking water. Only 1.7 % of rainwater flows towards the Pacific side where 63 % of Peru's population lives (National Authority of Water 2014). The country's perennial rivers are in danger from glacial melting, which is expected to generate a temporary increase in flows, followed by a drastic decrease in the volume and regularity of water resources afterwards (Calvo 2010). There is a growth in frequency, intensity, and variability of extreme and recurring climate events, ranging from heavy rain associated with El Niño and droughts to the La Niña phenomenon (ENSO).[8] The expected rise in temperature (2 °C minimum) and rising sea level will exacerbate existing vulnerabilities (MINAM et al. 2010). These factors have led to permanent tensions, competition and conflicts between different water users.

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[6] Instituto Metropolitano de Planificación (IMP), MML Concerted Development Regional Plan, 2013.

[7] This area is characterised by a natural system with a mix of biotic and non-biotic elements that support essential ecological processes, including the green coast, island and islets, wetlands, sand deserts and the *tillandsias* plant vegetation, rivers, coastal ridges and mountains.

[8] The major effects of El Niño are caused by rising seawater temperatures. This creates high evaporation, which moves beyond the Andes and causes persistent and extreme rainfall, registered since 1911. These have important socio-economic effects on activities like agriculture, communication networks, services and living, which in turn impact the national gross domestic product (GDP), and has a direct effect on Lima's climate (there is a direct relation between the increase of sea temperature and the climate).

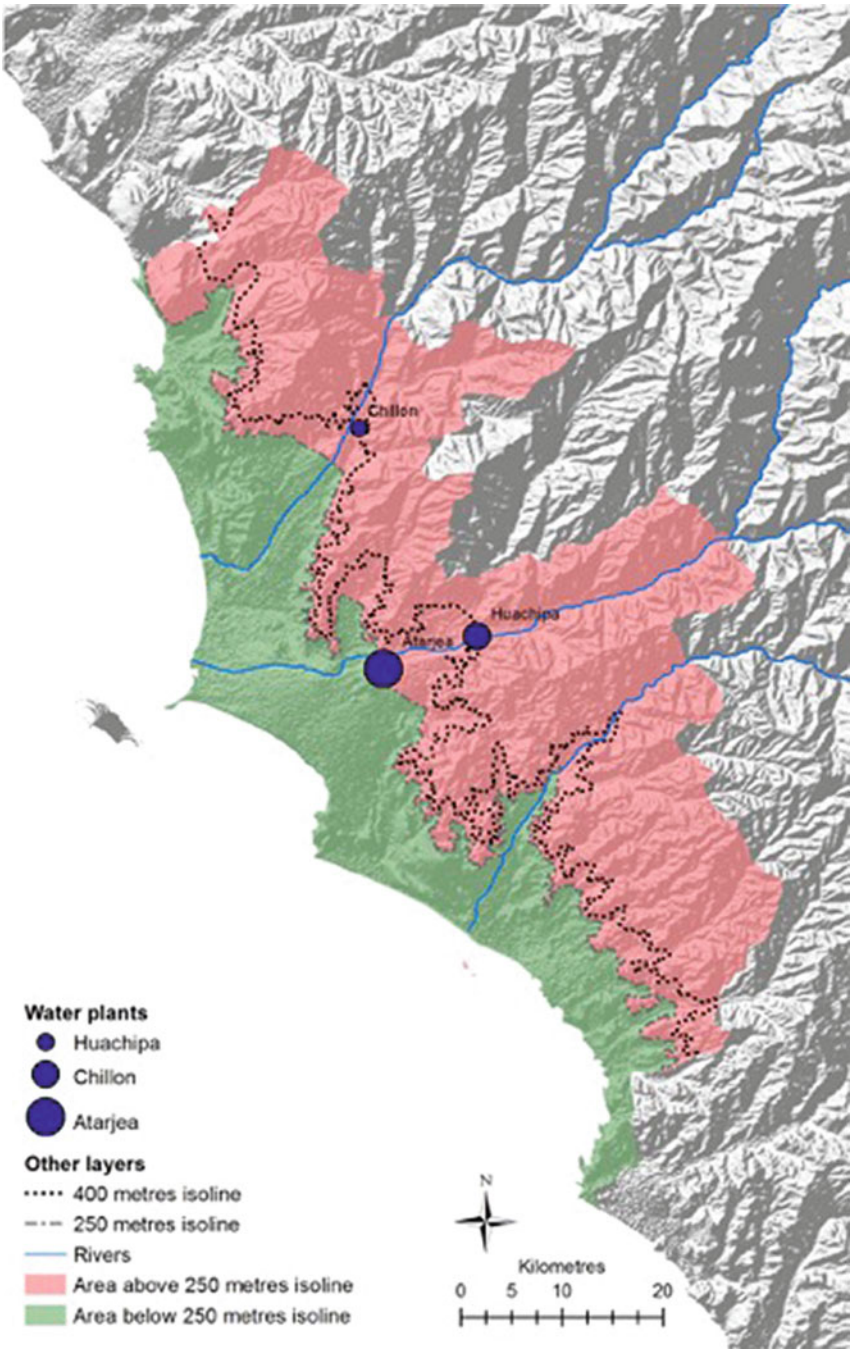

Fig. 6.1 Lima's topography and unequal water distribution: creating vulnerability (Source: SRTM, INEI 2007, Chance2Sustain field data 2013)

Drinking water distribution in the city is quite unequal. SEDAPAL, which determines drinking water distribution for Lima metropolitan area, is owned by the national Ministry of Economy via the National Fund of Public Companies (FONAFE)[9] and ruled by the Ministry of Housing. The city government has no say in its own water distribution. According to the household data of the last census (INEI 2007), 73.5 % of dwellings have access to water connections, and another 7.4 % of households have outside water connections or public standpoints. SEDAPAL[10] reported in 2013, that about 13 % of houses don't have water connections (i.e. more than 1.1 million inhabitants) and nearly 1.2 million receive rationed water for less than 3 h a day (SEDAPAL 2014).

The city is divided into water 'sectors' (the official unit of water provision by SEDAPAL) of about 2 km^2 each. Water allocation to these 'sectors' varies from less than 50 to more than 460 l per person per day.[11] SEDAPAL provides much more water to those households who, as they say, pay full costs and to commercial and industrial connections.[12] Households without domestic water connections depend on private water tankers, which cost more and provide water of lower quality. A person without a water connection pays approximately 3.74 USD per m^3, whereas people in non-subsidised residential zones in Lima pay on average 0.83 USD per m^3 [13] Mines pay only 0.08 USD per m^3.[14]

6.3 Lima's Water Governance Configuration

The actors and institutions involved in water-related activities in Peru are very diverse and often in competition. They work with limited information and usually make little effort to share available data. With restricted resources, their decisions on investment and implementation are rarely coordinated, though improving.

Although governance structures in Peru are usually highly centralised, with power and financial allocations concentrated in the national ministries, water governance institutions are fragmented in terms of their mandates, powers, and the areas they cover (Fig. 6.2) (Miranda and Baud forthcoming). Nationally, the National Water Authority (Autoridad del Agua - ANA) determines water rights for the coun-

[9] This organisation is the National Fund for Financing State Enterprise Activity, which exists since 1999.

[10] Cespedes, José (Sedapal) 'Gestión del Ciclo del Agua', presentation in Ecological Infrastructure Course, FCPV, ILPOE, LiWa, 2013.

[11] Based on data from SEDAPAL and the 2007 INEI census.

[12] This seems to be related to the subsidised tariff, which a large number of inhabitants of Lima receive, yet which SEDAPAL claims does not give full cost recovery.

[13] The costs estimated were provided in Nuevo Soles and converted to US Dollars on August 5, 2015.

[14] See Supreme Decree http://www.munizlaw.com/normas/2014/Diciembre/28-12-14/D.S.%20N%C2%BA%20024-2014-MINAGRI.pdf. Accessed 6 March 2016.

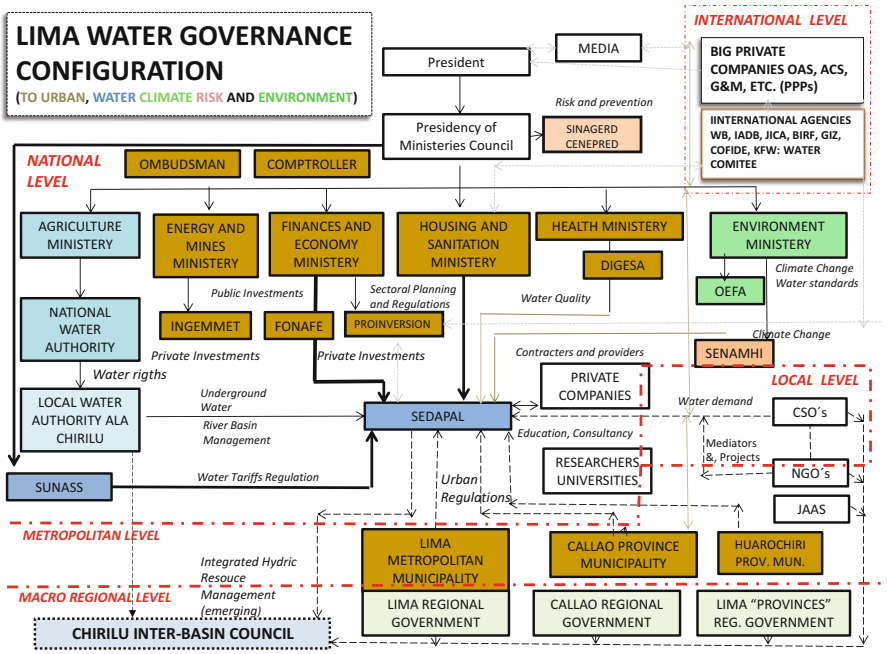

Fig. 6.2 Lima water governance configuration (Source: Miranda and Baud (forthcoming))

try under the Ministry of Agriculture. As the regions within Peru have very different levels of water availability, this authority is important in determining regional allocation. At the river basin level, a new council is being set up, in which regional governments and the city government of Lima play a decisive role. This council does not include nor connect with the river basin council in the Andes, from which almost 25 % of the Lima water is sourced. However, neither the river-basin councils nor the regional governments have the mandate to set tariffs, allocation nor distribution levels, which are the sole purview of ANA.

Lima metropolitan city has numerous authorities whose varied discourses and mandates are superimposed on the same areas. The focus of these authorities also varies: it includes hydrological resources, drinking water and sanitation services, flood risk and climate change management. Although few actors can develop an overview of this complex governance configuration, they decide on the city's development, utilising their own framings for current issues and little coordination concerning future water-related issues. The context of uncertainty includes the long-term issues recognised in water-related climate scenarios and the current context of water governance, where changing political representation risks discontinuity in on-going processes.

The dynamics of these configurations are driven by discursive coalitions, which influence the legitimacy and ability by their dominant discourses, concepts and arguments, which may be incorporated into policy development and decision-

making (Hajer 2006; Broto et al. 2012; Miranda Sara and Baud forthcoming). Within the water governance network in Lima, organisational practices and strategic actions within a wider political context were identified to trace dominant discourse coalitions and their 'representatives' or 'champions'. The way they interact, include or exclude certain actors and build up their relationships in the water governance arena are referred to as an 'urban configuration' (Baud et al. 2014). Such configurations are the means for discourse dissemination and provide legitimisation for policy design and implementation.

The Lima's actors using the dominant discourse of water as an economic good are the Economy Ministry (FONAFE), the regulatory institutions SUNASS, ANA, big private companies, influential international agencies, and technical universities. Their thinking dominates policy development and decision-making, excludes participatory processes, and maintains the power of traditional power holders. The discourse of water as an economic good is linked to the discourse of Integrated Water Resource Management (IWRM). However, their focus on sectoral and centralised urban water management systems persists, with an emphasis on large-scale infrastructure projects decided at the highest political level, and implemented through Public Private Partnerships, whose contracts have little transparency and are generally contested. This configuration's discourse is not yet supported by in-depth spatial knowledge building in Lima.

The actors promoting a sectoral (with an infrastructure focus) discourse are SEDAPAL, the Housing Ministry, construction companies and civic society organisations. Although SEDAPAL is the most visible entity in this water governance configuration, it remains under FONAFE's control. SEDAPAL produces internal information and worked with the LiWA project to develop knowledge on future trends. It explicitly excluded other partners from access to such information; particularly civic organisations.

Some actors also utilise water as a human right discourse in their discussions. These include community-based organisations (CBOs), civil society organisations (CSOs), NGOs, municipalities, regional governments, SEDAPAL union, some researchers and universities. Whereas the socio-ecological perspective focusing on nature-society relations remains weakly represented (some municipal departments, environmental NGOs, youth organisations, peasants, some researchers and universities).

Generally, organisations responsible for generating information to measure city-wide vulnerability, adaptation capacities and socio-economic trends belong to national government ministries and not municipalities. However, these national and local institutions lack the budgets to expand and update information. Some information is scattered among various actors or not acknowledged, weakening local governments' role. Examples include the cadastral offices at municipalities, which draw maps at block scale and by district, but do not produce risk maps (which are mainly done by INDECI,[15] drawn only at district scale, and not the surrounding territory).

[15] Civil Defence National Institute, see http://sinpad.indeci.gob.pe/PortalSINPAD/Default.aspx?ItemId=74. Accessed 31 August 2015.

Similarly, river basin and water flow maps are produced by ANA (maps drawn at macro-regional scale) which both are difficult for municipalities to access. Maps also do not match each other, so that capacity for risk perception for wider territories and water flows becomes inaccurate or non-existent. The effect is that no organisation is mandated to integrate and save information concerning the whole hydrological cycle, including fresh water (rain, surface, atmosphere and underground), drinking water provision, distribution, sanitation, river basins, humidity and the ocean. Therefore, the effects of extended water sourcing, unequal distribution and quality of water supply between industries and residents, and within Lima itself, are largely unknown and rarely a point of argument.

The city's water governance configuration is complex and fragmented. However, several projects, which include interactive knowledge-producing processes, are supporting actors in the governance configuration to deal with future challenges. The LiWa project producing climate change scenarios was the combined effort of several German universities, the water company SEDAPAL, the Municipality of Lima (MML) and the FORO.[16] The second project was the Chance2Sustain project on sustainable city challenges, based on a consortium of research groups from eight countries, including the FORO.[17] The third project was the work done by the Technical Group for the development of the Lima Metropolitan Climate Change Strategy – within the environmental commission of the Metropolitan Municipality of Lima (MML) (Miranda Sara and Baud 2014).[18] These projects have built current and future knowledge on water scarcity and vulnerability related to climate change using different discourses and sources of data. Following the discussion on *concertative* decision-making processes in Lima through these three projects described in Miranda Sara and Baud (2014), this chapter traces the genealogy of mapping in the course of these projects (in which the authors participated in over the last 6 years). They are described in the next section and draw together relevant actors with their different discourses about water, to reach a certain level of consensus in defining the drivers of future trends laid down in recently developed scenarios.

[16] LiWa stands for Sustainable Water and Wastewater Management in Urban Growth Centres Coping with Climate Change - Concepts for Lima Metropolitana (Peru), a German sponsored research project of several German universities where the water company SEDAPAL, Cities for Life Foro as well as MML were actively involved. http://www.lima-water.de/es/index.html. Accessed 5 March 2016.

[17] Chance2Sustain is the acronym for the research project 'Urban Chances, City Growth and the Sustainability Challenge'; funded by the EU Seventh Framework Programme. The Technical Group for the development of the LMCCS wrote the Strategy Paper, which was subsequently submitted to the MML, and accepted by the Council.

[18] The MML project sponsored by AVINA and developed by Cities for Life Forum was participatory and developed through deliberations with the Climate Change Technical Commission of the Environmental Commission of Lima Metropolitan Municipality, the Strategy was approved by MML in 2014.

6.4 Mapping and Knowledge Building Processes and Water-Related Risks in Lima

This is how mapping took place to build knowledge within three projects based on various *concertación* processes. The LiWA project produced non-spatial climate change scenarios, outlining the potential effects of specific drivers on Lima's future water situation. The Chance2Sustain project created a series of maps analysing the different scenarios, which were used in the MML's third project for iterative consultation and policy development to outline the implications of future water-related risks patterns.

Firstly, the LiWa project gathered actors from international technical academic networks in the public and private sector to identify and analyse the drivers of socio-economic and environmental change in Lima. A model, provided by LiWa partners, was applied to compose three plausible climate scenarios based on the drivers of change, described below in Table 6.1 (Miranda Sara and Baud 2014).[19]

Secondly, the Chance2Sustain project's *concertación* process included a wider range of actors from the inter-institutional network FORO, international academic institutions, Peruvian NGOs, informal settlement communities and the water governance network (cf. Miranda Sara and Baud 2014). These actors discussed how water governance is framed and the discourses used when the topic is approached. Community perspectives on water-related vulnerability were acknowledged within a multi-scalar spatial approach, and were used to model the vulnerabilities in Lima's water governance network.

Table 6.1 Three plausible water-related climate change scenarios for Lima in 2040

Scenario 1	Scenario 2 (Combination of 1 and 3)	Scenario 3
Higher frequency of 'El Niño' (ENSO), almost permanent	Higher frequency of 'El Niño' (ENSO), alternate conditions of scenarios 1 and 3	Climate gets colder, similar to 'La Niña'
Heavy rain; rain increase more than 6 % (normal 9 mm per year over the city but higher in the mountains surrounding the city)	Almost permanent dry periods with more heavy rainfall peaks	Rain decreases by about 9.6 % =>leading to droughts
Temperature increases, at least 2 °C (heat waves)		Temperature decreases (cold waves)
6.28 % increased water flow		13.72 % decrease of water flow

Source: Adaptation Strategy for CC MML, Project MML/Foro Ciudades para la Vida/AVINA, CAS-2011 (Expert Workshop MML 2012, LiWa 2012, IWS/ZIRN, Eduardo Calvo, 2012,IPCC)

[19] In the LiWA project, opening up to water governance framings and taking wider ecosystem issues into account, proved difficult, and the 'products' remain academic, with little that can be practically applied so far.

Table 6.2 Number of residents with less than 50 l/day, according to population growth and water resources assumptions under 2040 climate change scenarios

Scenarios	Current situation (2007)	Realistic population growth, 1.3 %	High population growth, 2 %	Low population growth, 0.3 %
No change in available water resources	609,080	1,672,866	2,972,093	713,902
Increase in water resources (+6.28 %)	n.a.	1,427,204	2,612,837	678,166
Decrease in available water resources (−13.7 %)	n.a.	2,348,109	4,020,022	961,876

n.a. = not applicable

Source: INEI 2007; estimations towards the future based on 50 l/pp/day

Thirdly, the MML climate change adaptation strategy and concerted city development project considered different discourses on water governance and the city's development. The new legal framework mandates called for a larger network of actors to be involved in discussions, such as NGOs, citizen service organisations, community-led groups, experts from various backgrounds and political representatives. This inter-institutional coordination also provided a path towards developing a discourse on transitions to adaptive capacity (Miranda Sara and Baud 2014).

The LiWA model, which outlines future uncertainties related to plausible climate change effects, was assessed through several rounds of consultation and research with the project partners. Table 6.1. shows the climate change scenarios for 2040, incorporating the possibilities of drought and heavy rainfall and worst case scenario, combining permanent drought with increased recurrence of heavy rainfall events. The outcomes from the scenarios (increase of droughts, decreasing water resources by more than 13 %[20]), were combined with projections of population increase (see Table 6.2), and showed that water stress and unequal distribution would worsen unless specific measures were taken.

Table 6.1 was used by the Chance2Sustain project to produce maps capturing the spatiality of water-related issues and estimate current and future water consumptions at city level based on current and future population numbers (Table 6.2). Two mapping processes were carried out. Participatory mapping revealed the perceptions on residents current and future vulnerabilities from three settlements. Maps of current and likely future water consumption rates were produced by integrating water consumption data from November 2007 collected from SEDAPAL, population data from the population Census (taken in November 2007 by INEI), official population projection rates by district (INEI, Census data) and official categories of minimum water demand (WHO). The mapping was done at water sector level, at which level population data was also aggregated.

[20] Bardossy A, Jochen S, Chamorro Alejandro, 2011. Modelamiento del Clima y Balance hídrico de Lima. Proyecto LiWa- IWS- Universidad de Stuttgart, confirmed later by ANA studies.

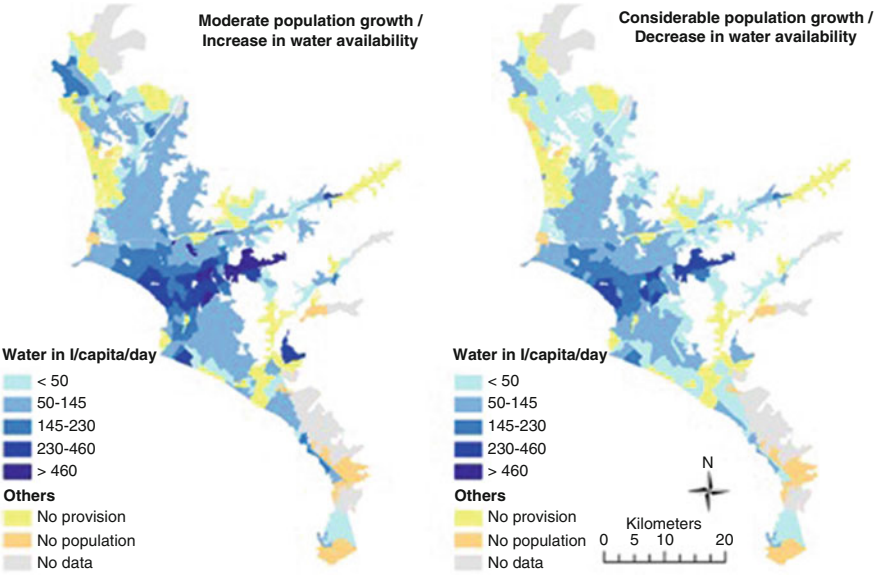

Fig. 6.3 Increase in water availability, combining population growth and future water consumption estimates, without changing existing unequal distributions (Source: SEDAPAL consumption data 2007; INEI 2007; Chance2Sustain project, produced by Pfeffer et al. (2013))

Future water consumption was calculated based on estimates of future water resources (no change, increase of 6.28 %, decrease of 13.72 %, determined in the scenario-building processes within the LiWa project) combined with different population projections – (realistic growth (1.3 %); pessimistic growth (2.3 %); optimistic growth (0.3 %) which vary by district). Figure 6.3 displays two contrasting scenarios – moderate population increase and more water, considerable population increase and less water. The maps in Fig. 6.3 show estimated future water consumption if an equal provision of 90 or 150 l/day to all residents of Lima is assumed. The maps were discussed in five workshops and various seminars with key-actors and experts, and continue to be used.

The city's water plant, however, is located at 250 m altitude isoline, meaning over 1.6 million inhabitants above the isoline will be more vulnerable to a reduced water provision[21] (Fig. 6.1).

The maps made by the Chance2Sustain project were brought into the MML's third project, in which a new Climate Change Strategy was developed and approved at city level. Although they were not used in the Concerted Development Plan, because the MML lacks the mandate for water allocation, the issues of water stress and vulnerabilities were in maps produced in the third project.

[21] Given the dependence on hydroelectric generation (more than 60 % in Peru), under a water scarcity scenario, energy to pump water will be a problem too.

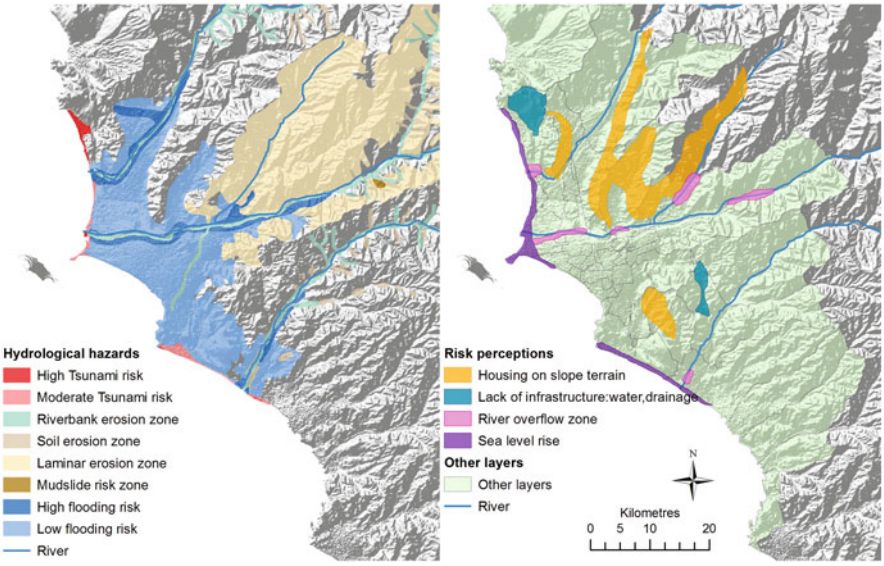

Fig. 6.4 Hydrological hazards in the Lima macro-region in contrast with the perceptions of vulnerability by key actors (Source: *Left*, from IMP/MML/CENCA (2011), Chance2Sustain project. *Right*, from Kaiser (2014))

Figure 6.4 contrasts two maps showing such risks, one summarising hydrological risks identified by experts of IMP/MML (International Development Research Centre et al. 2012) for the whole Lima Macro-region (flood, mudslides as well as sea-level rise) and the other showing the perceived water-related vulnerability by key actors involved in climate change strategy technical group discussions, IMP and other key actors. The experts of IMP/MML identified that almost 50 % of the Lima territory experiences water-related vulnerabilities that would be exacerbated by intense rainfall.[22] These events would have strong social and economic effects on the infrastructure of activities like agriculture, communication networks and services, and negatively affect GDP.

Just a few months after the MML climate change strategy project ended with workshops and technical group discussions, participating actors were asked to mark vulnerable areas on the Lima map.[23] It became clear during interviews that participants generally perceive the expected climate problems to affect a much smaller area than indicated by experts, even though most participants interviewed were part of the technical committees on Climate Change of the Municipality of Lima and the Regional Government of Callao, and some prepared the concerted development plan, 'Plan de Desarrollo Concertado de Lima'. The results in Fig. 6.4 show that on average, participants indicated only 20 % of the areas previously identified as vul-

[22] A recent study by CENEPRED (2015) identified more than 7 million inhabitants in danger of a heavy rainfall in Lima facing upcoming ENSO 2015–2016.

[23] This was on individual anonymous basis.

Table 6.3 Types of actors, knowledge, data and outcomes

Dimensions	Expert-scientific	Codified	Context-embedded	Tacit/social
Actors/networks	LIWA research project	Academic researchers from C2S	Professionals working in water-related sectors	CBOs, CSOs, residents
Sources/data	Data related to water supply including meteorological data;	Census data 2007	Workshops, interviews, forums, advisory committees, consultations	Interviews; participation in scenario workshops; pictures
		Water consumption data from water provider (SEDAPAL)		
		Poverty map (Sisfoh)		
Processing	Scenario processes; Mathematical modelling;	Population projections (0.3 %, 1 %, 2.3); GIS mapping	Social knowledge construction using maps as input	Spatial mapping; google maps as platform
Outcomes	Climate change drivers; scenarios (+6.28/–13.72)	Maps representing water consumption per capita and water inequality, poverty	Advise/contributions for mapping water inequalities	Maps presenting water vulnerabilities perceptions

nerable, even though all those interviewed were involved in IMP/MML workshops and discussions and recognised water governance and climate change as a priority.

This section concludes by comparing the types of actors, knowledge, data and outcomes of the processes discussed (Table 6.3.).

6.5 Knowledge Building in Lima: Discourses, Mapping, and Understanding Spatial Inequalities in Water-Related Risks

The three research and policy-building projects reflected the variety of ways in which understandings of 'water-related vulnerabilities and risks' are socially constructed. In the LiWa project, a scientific model was built up with internal evidence from the main water providing institutions and other government sources focused on developing future climate change scenarios for Lima. The LiWa project results were utilised by the Chance2Sustain research project to map spatial and social inequalities resulting from existing patterns of water-related vulnerabilities, risks

and expected climate change impacts. This provided additional insight from strategic interviews and recognised spatial inequalities, previous to and resulting from the current patterns of water provision and future shocks and stresses. These research outcomes were fed into policy-related discussions and into developing Lima's Climate Change Adaptation Strategy (Miranda Sara and Baud 2014). This process benefited from the existing culture of '*concertación*', which provided inclusive spaces[24] in which more and more types of actors could meet to debate issues, negotiate solutions and develop proposals for action.

Mapping has strongly contributed to such discussions and understanding water-related vulnerabilities, inequalities and multi-scalar issues. Firstly, the maps draw on different discourses and framings, data inputs and classifications at multiple spatial scales. Secondly, they visualise spatial inequalities and link multiple dimensions to one geographic locality. Combining multiple types of knowledge (cf. Table 6.3) they built a more comprehensive understanding of the dynamics and spatial differentiation of Lima's 'waterscape', combining human and natural processes (Swyngedouw 1999; Gudynas 2011). As a result, it became easier to discuss the legitimacy of different types of knowledge (construction) among several actors who acknowledge, contest to or intend to deny mapping results.

Thirdly, maps facilitated 'exchange on priorities, conflicts and synergies' (Pfeffer et al. 2013: 259), by providing inputs into negotiation processes between actors in water governance configuration and networks. These multiple knowledge types and generation processes allowed different actors to bring in diverse types of knowledge and visualise the perceived social and spatial water inequality. Fourthly, constructing iterative data in projects dealing with water vulnerabilities and climate change impacts, using maps and including many types of knowledge from different actors, builds mutual understanding and provides an improved basis for building agreements, transformations and changes. This is illustrated in the outcomes of the Climate Change Adaptation Strategy approved in December 2014 by the Metropolitan Municipality of Lima, where baselines have been adapted against serious droughts and intensive rainfalls in critical periods.

However, the discussion about water crisis as a governance crisis is reflected in the institutional fragmentation characteristic of Lima (Castro 2007; Bakker 2010). Such fragmentation makes exchanging information and knowledge across the boundaries of various institutions, and research and policy-building projects more difficult. Although mapping produces new types of knowledge, it is necessary to continuously ensure that it is incorporated into baselines for policy-making and implementation for this inclusion to gain wider acceptance (Zwarteveen and Boelens 2014).

Finally, the discourses of water as a human right and socio-ecological good have gained wider recognition in the Lima water governance configuration and been utilised by SUNASS, some experts from SEDAPAL and the Housing Ministry.

[24] Inclusive spaces are spaces of trust where mutual understanding is sought to encourage key actors to fully participate in building consensus on agreements, reduce conflicts among the group, and receive/welcome new sources of knowledge.

However, the dominant discourse of 'water as an economic good' still influences SEDAPAL's water distribution (those who pay more get more water). The exception is the case of powerful water users (such as the mining sector and other industries), who consume higher amounts of water but pay much less than urban users. This prevents reducing water consumption and limits the effectiveness of achieving eco-efficiency via market incentives alone.

The processes explained above have contributed to a more comprehensive understanding of water-related inequalities, vulnerabilities and risks, across the boundaries of local governance networks. They have also raised awareness and increased knowledge among actors in Lima's water configuration on the different discourses and ways of thinking when dealing with the uncertainties of future stresses and shocks. The approval of the city's Climate Change Strategy has received a clear contribution from these processes. It has also provided opportunities to reconcile or harmonise different water discourses and evaluate how far they interconnect with the metropolitan urban development approaches, which in turn determine the capacities to build up agreements and may contribute to reconfiguring water governance.

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Part III
Water Services

Water is a fundamental resource for human activities and sufficient access to water and sanitation services are particularly key to people's health and wellbeing. Cities function well with effective water services, that is providing water supply systems for a range of needs and purposes, and safely disposing and treating wastewater and sewage. Having said that, water supply and sanitation services (WSS) provision still constitutes a major challenge in many urban areas worldwide. While cities in the global north tend to focus on finding ways to increase efficiency and financial gains, many cities in the global south are additionally confronted with the task of extending services to those that currently lack access to formal service provision. Over the years, efforts to provide the entire urban population with access to WSS have resulted in different approaches emerging. When water is defined as a good, its provision is associated with its economic value and is priced as a cost-recovering service. Since 2010, when the United Nations (UN) Assembly explicitly recognised access to water and sanitation as a human right, growing emphasis has been placed on the social value of water, people's rights and universal access. The UN declaration has subsequently found its way into various international agreements (e.g. the recently approved Sustainable Development Goals) and been endorsed by many national governments. Campaigns for a human right to water and sanitation are often associated with anti-privatisation movements to guarantee citizens' access to life-essential resources and services but the UN declaration does not necessarily imply free or subsidised provision. As a consequence, the right to water and sanitation has been acknowledged and endorsed by a broad range of institutions, with noticeable differences about who ought to provide the service and how.

Contributions to this part of the book address the different approaches to water and sanitation as basic urban services, tackling issues of privatisation and remunicipalisation, human rights and today's changing landscape of governance pathways to their provision. Hofmann (Chap. 7) focuses on urban water and sanitation poverty in Dar es Salaam, Tanzania and offers alternative narratives to static universal definitions of urban water and sanitation poverty by portraying a more nuanced and multi-layered understanding of the problem. Applying a relational approach, this chapter examines different life stories from low-income residents, revealing what

shapes individual trajectories in and out of water poverty, while emphasising the importance of considering urban water poverty over time and under context-specific spatial conditions. The author offers valuable insights for developing feasible solutions to the problem that are embedded in local processes but frequently overlooked in mainstream approaches.

Many practitioners currently struggle to operationalise the right to water and sanitation locally, particularly in a context where demands for universal access encounter a system without the capacity to deliver. This is especially the case across the global south, where cities are frequently faced with the challenges of providing WSS services to their citizens in a context of rapid urban population growth and unequal development. Keatman (Chap. 8) draws together some of the emerging lessons learned about entrepreneurial models being trialled in Africa. Over the years, the share of small independent service providers has been growing, specifically for sanitation, and they are filling the service gap in many low-income settlements where public and private utilities are absent. Considering the need to improve basic service delivery to the poor and stimulate local labour markets. Keatman's chapter provides a thorough understanding of the incentives for engaging smaller-scale providers, the regulatory environment within which they work, and means to further develop entrepreneurial activities. She examines the extent to which current approaches successfully lead to sustainable business models and contribute to fulfilling people's right to WSS by providing feasible service delivery solutions for the urban poor.

Where the state alone often fails to deliver, communities themselves can make important contributions to WSS improvements and provision. Walnycki (Chap. 9) explores the emergence of co-production partnerships between communities and the state in Cochabamba, Bolivia, as an attempt to universalise access to WSS and realise the right to water. She examines services co-production in a context of plurilegal water governance arrangements, where diverse and overlapping formal and informal water providers interact. The chapter reflects on how far and in what way co-production partnerships can transform existing governance structures as well as help improve service provision and support marginalised local communities develop political agency.

Lobina (Chap. 10) focuses on a different shift in water supply governance, discussing the increasing trend of urban water services remunicipalisation – a return to public management – following the termination of private operating contracts. The author explores this trend as a paradigmatic policy change, that is a shift in water service management discourse from a privatist to a communitarian paradigm. Recent experiences in service remunicipalisation from Berlin, Germany and Buenos Aires, Argentina reveal that this trend is fuelled by different motivations, ranging from pursuing human rights to realising economic aims. Remunicipalisation therefore does not automatically facilitate progressive change and execute people's right to WSS but it unlocks it as a possibility.

Throughout this section, constant tensions emerge between cost-effective service provision and the need to meet people's right to WSS. Each chapter reveals the dynamic character of these tensions and how they influence service provision deliv-

ery and city governance. The potential role of alternative actors and service providers has been acknowledged in recent years and led to a variegated and changing landscape of governance arrangements in WSS provision. With their distinct focus, the aforementioned chapters equip us to learn from specific contexts exploring the potential, but also the limitations, of different actors and governance arrangements. Each contribution demonstrates how local circumstances (institutional, economic, social, environmental and political) shape urban water services trajectories – operating and delivering services, and influencing who can benefit and who loses out. It is unlikely that a sole provider and single service provision solution can meet everyone's needs, within and across cities. A fine balance needs to be reached between aiming towards universal access and environmentally and financially viable service provision. The state clearly needs to play a critical role in cities' water services trajectories but it cannot face existing and future challenges related to providing WSS in the urban context alone.

Chapter 7
Multi-layered Trajectories of Water and Sanitation Poverty in Dar es Salaam

Pascale Hofmann

Abstract Many cities in the global south keep on expanding without adequate infrastructure leaving a large number of people to experience varying degrees of water and sanitation poverty. Dar es Salaam, Tanzania, has been subject to numerous interventions aimed at improving service provision across the city with mixed and overall limited results. Most of them are driven by popular definitions of urban water and sanitation poverty that portray the problem in a simplified way. It is often assumed that once people gain access to some form of improved access to basic services, this access is sustained over time. Instead, the urban poor experience differing journeys as they 'travel' in and out of water poverty but their trajectories are insufficiently understood. This chapter applies a relational approach to unfold a select number of trajectories from people living in a low-income community in Dar es Salaam. The stories illustrate how and why certain households and individuals are able to move out of urban water and sanitation poverty while others are not and thus offers insights into the dynamic interplay between individual and collective agency. This highlights different and changing degrees of urban water and sanitation poverty in a settlement and reveals the power dynamics that condition inequalities and shape people's trajectories over time. These narratives offer a nuanced and multi-layered understanding that challenges fixed universal approaches.

7.1 Introduction

Despite substantial investment and numerous interventions over the last few decades, estimates suggest that about 663 million people are still without improved access to water and approximately 2.4 billion people lack access to improved sanitation, with Sub-Saharan Africa (SSA) recording the lowest levels of access (UNICEF and WHO 2015). Many cities in the global south experience urbanisation without adequate infrastructure, leading to fundamental intra-urban disparities whereby a large number of people suffer from varying degrees of service deprivation. Urban

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water and sanitation poverty (UWSP) has received different and often competing definitions[1] and the absence of a common understanding adds to the challenge of estimating and tackling current shortfalls. Tanzania, similar to other SSA countries, has been undergoing rapid urban expansion[2] while access to improved water sources in towns and cities has seen a decline since 1990 (Potts 2012; UNICEF and WHO 2015).

Figures above are based on the well-established definition of the Joint Monitoring Programme for Water Supply and Sanitation (JMP), which characterises 'improved' access as having an improved drinking water and sanitation facility within one kilometre allowing up to 30 minutes to use the facilities. This, however, is no guarantee for satisfactory or adequate access, neither an all-encompassing way of scrutinising UWSP. For instance, an improved water source might not necessarily provide safe water on a regular basis or be affordable for everyone (Hofmann 2011). As a consequence, improved access is not equivalent to adequate access and it is widely recognised that we need to aim for the latter, particularly to tackle water-related diseases (JMP Technical Task Force 2011; UNICEF and WHO 2011; WaterAid 2013; WHO 2012).

Adequate access to water supply and sanitation (WSS) implies that the service provided is safe, sufficient, regular, affordable and accessible (Hofmann 2011; UNICEF and WHO 2012). These aspects, now incorporated into the Sustainable Development Goal for WSS, are fundamental to the realisation of the right to safe drinking water and sanitation (WHO and UNICEF 2015). UN recognition of this right in 2010 constitutes a significant shift in the debate around water and sanitation, i.e. how these services ought to be delivered and whether water specifically should be considered as a good to be sold.

As a normative concept, UWSP and its experience needs to be captured in relative terms, specifying who suffers it, where, when and why by paying particular attention to the socio-cultural context where it manifests itself. In an urban setting, those considered water and sanitation poor typically belong to lower-income groups largely residing in informal settlements with deficient access to formal service provision, where facilities at the household level are rare. In cities like Dar es Salaam, the public utility is seriously underserving its citizens and large parts of the population are affected by intermittent water supply. Only an estimated 50 % of inhabitants are connected to the public water network and 10 % to underground sewers (Kombe et al. 2015). However, not all residents insufficiently served by the utility can be considered water and sanitation poor; those with the capacity to gain adequate access through alternative service providers without compromising on other needs cannot if their lives are not adversely affected. Instead, living in water and sanitation

[1] See the special issue of the International Journal of Sustainable Urban Development on Urban Water Poverty (2011, 3:1) edited by Allen and Bell for different perspectives on the issue.

[2] Urban expansion is not the same as or a consequence of rapid demographic growth but refers to multiple processes that change the spatial structure of cities over time (Lincoln Institute of Land Policy 2015).

poverty refers to those that are vulnerable towards unsafe, insufficient/irregular and costly services with negative impacts on their health, livelihood and well-being.

Drawing from fieldwork conducted in Dar es Salaam,[3] the chapter examines how individual trajectories of UWSP are influenced by the interplay between everyday hydro-social relations and external structural conditions (Lamsal 2012; Saatcioglu and Corus 2014). Tracing personal journeys in and out of UWSP over time helps to contrast and dispute popular reductionist definitions around lack of access to basic services (Maynes et al. 2008). A relational approach that plays particular attention to the dimensions of time and space (Somers 1994) is used to unfold a number of multi-layered trajectories in a low-income settlement in Dar es Salaam. With its diverse landscape of water supply and sanitation interventions initiated by various actors it offers a suitable environment where different trajectories can be observed. The next section problematises the limitations of prevailing definitions and approaches. This is followed by an elaboration of the relational approach adopted before applying it to examine life stories of a select number of residents from Kombo, a low-income settlement in Dar es Salaam where access to services from the utility is marginal.

7.2 Urban Water and Sanitation Poverty

Governments and international aid agencies alike commonly understand UWSP as an issue of maldistribution, whereby people are deprived of adequate access to basic services. While this is significant, many would argue that understanding UWSP simply in economic and distributional terms is not sufficient as struggles around access are frequently related to social and political marginalisation and exclusion (Mitlin and Satterthwaite 2013). Acknowledging the social implications of insufficient access to water and sanitation caused by 'poverty, inequality and unequal power relationships [….] exacerbated by social and environmental challenges' puts the spotlight on misrecognition and misrepresentation (OHCHR et al. 2010, p. 1). The human rights framework clearly highlights participation, non-discrimination and accountability as key variables to the attainment of human rights (UNICEF and WHO 2012). This is not to downplay the importance of distribution; however, maldistribution (of WSS) is often reinforced by conditions of misrecognition and lack of participation (Fraser 2007), an aspect frequently overlooked in prominent conceptions of UWSP (Hofmann 2013).

[3] The research is part of an Engineering Doctorate with funding from the Engineering and Physical Sciences Research Council (EPSRC Grant EP/G037698/1). Part of the study examining different institutional discourses on urban water poverty is published elsewhere (see Hofmann forthcoming). The fieldwork in Dar es Salaam referred to in this chapter was undertaken during four visits between May 2014 and June 2015 consisting of institutional interviews (with representatives from multi- and bi-lateral development organisations, national and international Non-Governmental Organisations (NGOs), consultancy firms, local and national government); focus group discussions (FGDs) with local residents, including Kombo; community meetings; transect walks; in-depth interviews with local residents; informal conversations and personal observations.

Interviews with policy-makers and key shapers of WSS interventions in Dar es Salaam[4] revealed that dominant views neglect the temporality of this phenomenon as they commonly assume that once people gain access this is sustained but many of the urban water and sanitation poor follow trajectories where they move in and out of UWSP for a variety of reasons. What is more, those living in UWSP are treated by and large as a homogeneous group with limited understanding of diverse social identities and distinct trajectories. In Dar es Salaam, policy-makers and service providers characterise the urban water and sanitation poor mainly in relation to their lack of financial capacity to meet their needs (Interview with utility employee, August 2014; Interview with Ministry of Water employee, February 2015). This treats 'all who belong to a particular social category as sharing equally the particular natural attributes (positive or negative) specific to it. Categorical attributes are often used for the construction of inclusionary/exclusionary boundaries that differentiate between self and other, determining what is 'normal' and what is not, who is entitled to certain resources [or services] and who is not' (Yuval-Davis 2006, p. 199) and is used to justify differential access in WSS.

UWSP is frequently associated with wealth and income inequalities (Ekers and Loftus 2008), though there is some increasing recognition of age and gender-based needs, particularly among the international development community, with several WSS initiatives focusing on women and children (Batty et al. 2011; Interview 14 and 25, August 2014; Gosling 2010; SNV et al. 2008). Some initiatives across the global south, often supported by development organisations, have problematised the issue of land tenure and tenure security in relation to WSS (Aristizabal 2004; Homeless International 2011; Scott et al. 2013; Scott 2013). Nevertheless, a sole focus on single elements of people's identity provides a limited understanding of the problem that could marginalise those differing from what is considered 'the norm' in other aspects, e.g. race/ethnicity, religion or ability (Dhamoon 2011; Hancock 2007). As a result, several scholars have voiced growing dissatisfaction with the independent analytical treatment of homogenous categories such as 'gender' or 'class' and the limiting explanatory power of this approach (Levy 2010; Yuval-Davis 2006). As argued by Symington:

> people live multiple, layered identities derived from social relations, history and the operation of structures of power. People are members of more than one community at the same time, and can simultaneously experience oppression and privilege (2004, p. 2).

This calls for a shift from universalising approaches that single out one category as most relevant and explanatory to considering multi-layered factors, relations and intersections. This chapter aims to reconceive UWSP by looking at everyday practices and quotidian trajectories from a relational perspective. This will lead to a more disaggregated understanding of 'the urban water and sanitation poor' and shed light onto the 'multiple axes of inequality' that influence people's trajectories (Prins 2006). The following section will advance on a relational approach by drawing on some of the intersectionality literature.

[4] Among those interviewed were representatives from DAWASA and DAWASCO (the two utility agencies), the Ministry of Water, EWURA (the national regulatory authority), local government, multi- and bilateral aid agencies, international and local NGOs and consultancy firms.

7.3 Revisiting UWSP: From Intersectional Identities to a Relational Approach

Intersectionality or intersectional analysis originally emerged from research on gender and race in the United States and the discontent with single-axis analytical frameworks but has since been more widely conceptualised and applied (Hancock 2007; for some useful historical reviews see McCall 2005; Nash 2008; Prins 2006). The key argument of intersectionality is that people's identities cannot be captured or reduced to a single category but need to be defined by considering intersections of multiple identities and relations. Part of the literature on intersectionality insists that in order to analyse inequality and marginalisation it is not sufficient to solely focus on marginalised groups but to further study those where power and privilege prevail (Choo and Ferree 2010; Christensen and Jensen 2012; Yuval-Davis 2011). While this can be important, there already exists a broad albeit unsophisticated awareness of who lives in water and sanitation poverty in an urban context. It is a much more nuanced and disaggregated understanding of the different trajectories of UWSP within such broad grouping that is currently lacking.

In the global south, the concept has been embraced largely by feminists since the early 2000s but its application in relation to issues of environmental injustice and inequality, particularly with regard to water and sanitation, has been limited (see Seward 2014; Symington 2004). Different approaches to intersectionality have developed whereby some would emphasise the constitutive role of social categories in people's identities and social inequalities while others downplay their determining character and underline the importance of dynamic relations (Prins 2006).

Over-emphasising categories and individual identities to the detriment of relational aspects run the risk of replicating the approaches that intersectionality is trying to critique (Dhamoon 2011; Nash 2008). In fact, newly created but fixed categories are equally problematic even if informed by aspirations of including those previously excluded (Somers 1994). Instead, people's UWSP trajectories are rooted in a particular place, they are multi-layered and they change over time:

> social categories such as race/ethnicity, gender, class, sexuality, and ability are socially constructed, fluid, and flexible; and social locations are inseparable and shaped by the interacting and mutually constituting social processes and structures that are influenced by both time and place (Hankivsky 2012, p. 1713).

The investigation of UWSP trajectories thus needs to be embedded within the intersection of time and place as key domains in shaping, challenging and restructuring social relations at the individual as well as the structural level (Yuval-Davis 2006). Methodologically, an integration of time, space and relationality moves away from categorical identities and emphasises 'the embeddedness of identit[ies] in overlapping networks of relations that shift over time and space' and allows for an understanding of how different trajectories are constituted and reconstituted over time by people's hydro-social relations in a particular historical and spatial setting (Somers 1994, p. 607). Life stories provide an important means to move beyond individual identities and explore intersecting relations that influence people's trajectories

through UWSP. Identity then becomes not a matter of categorisation but of narration. It 'plays a constitutive role but never in the same way' as people's trajectories are multi-layered and dynamic and cannot be classified based on a list of categorical affiliations (Prins 2006, p. 281).

7.4 Trajectories of UWSP in Kombo

The sub-ward of Kombo[5] is an unplanned settlement in Vingunguti Ward, approximately six kilometres from the city centre, within Ilala municipality in Dar es Salaam. It is located next to one of the city's nine wastewater stabilisation ponds established in the area during the 1960s (see Fig. 7.1). Kombo largely houses low-income households with a majority of tenants and has seen a large influx of people since the 1980s due to the establishment of nearby industries. Nowadays, only some residents are under permanent employment while many are involved in small enterprises and casual work (CCI, unpublished documentation). With regard to WSS, Kombo is characterised by a diverse range of local government, NGO and international development interventions and local practices that have emerged at different points in time to deal with the inadequate provision of infrastructure and services. Until the 1990s, the few households with utility water connections received regular water supply but most Kombo residents spent up to two hours a day to fetch one to two buckets of water from outside the settlement (Bayliss and Tukai 2011; female FGD, September 2014). By then, coverage levels were notoriously low across the city and the water supply system suffered overall from dilapidation (DAWASA 2000; Pigeon 2012). This has led to individuals in the settlement drilling their own boreholes and selling water to others while also attracting mobile water vendors (Bayliss and Tukai 2011; male FGD in Kombo, September 2014).

Connections to the utility network are still existent (serving approximately 25 % of Kombo's population) but insufficient to meet people's needs. At best, they provide water once or twice a week for a few hours (community meeting in Kombo, February 2015). Since 1998, two boreholes were constructed by Plan International (in 1998 and 2007 respectively) and one by local government, each with a number of public distribution points across the settlement and a few household connections. After the initial setup each scheme has been managed by communities. These interventions have improved access to water but reliance on private boreholes and water vendors is still significant. With regard to sanitation, most households depend on simple pit latrines with a few septic tanks and a limited number benefitting from a simplified sewerage scheme implemented in 2014 that connects household toilets to the nearby wastewater ponds using simplified technology.

[5] Kombo was recently sub-divided into two. As the fieldwork commenced prior to this sub-division reference to Kombo includes the newly created sub-ward.

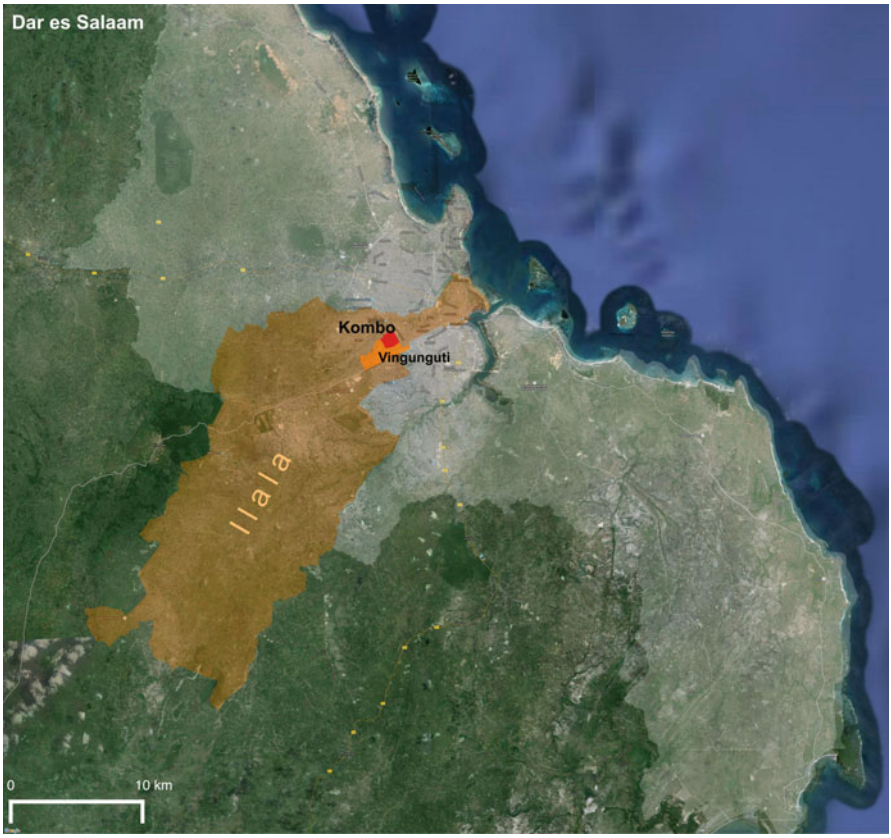

Fig. 7.1 Location of Kombo in Dar es Salaam (Source: Map data © 2015 Google Imagery © 2015 CNES/Astrium, CNES Spot Image, Digital Globe)

7.5 Multi-layered Life Stories of UWSP

Below are a number of relational stories from Kombo residents[6] that illustrate the dynamic interplay between agency (identities and lived lives) and enabling as well as constraining structural conditions, and people's varying influence over their hydro-social relations. The stories highlight different and changing degrees of UWSP in a settlement and reveal multiple power dynamics that condition inequalities and shape people's trajectories.

[6] Unless otherwise stated information is based on interviews and focus group discussions with Kombo residents. Their names have been changed for the purpose of anonymity.

7.5.1 Mary

Mary is a landlady that has been able to improve her access to WSS over time (see Fig. 7.2). She and her husband came to the area in 1989 and have built their house incrementally, financed through multiple income-earning activities (including the letting of rooms) and more recently access to micro-credit facilities. She is well established in the community, consolidated through being a sub-ward representative and an active member of the Tanzanian Federation of the Urban Poor (TFUP) since 2014. Initially, the couple let out two rooms but have managed over the years to extend their house and now accommodate a total of 12 tenants. After several years of relying on water sources from outside, they established a yard connection in 2009 from one of the private boreholes in the area and pay a fixed monthly rate of TSh25,000.[7] In 2014, the couple became one of the beneficiaries of a simplified sewerage pilot scheme initiated by the Cambridge Development Initiative together with the Centre for Community Initiatives (CCI), a local NGO. The system initially connected 20 toilets to the nearby wastewater stabilisation ponds and another 50 connections are underway.

Mary and her husband were able to reduce their level of UWSP largely due to their location within the settlement and tenure status. Tenants are intended benefi-

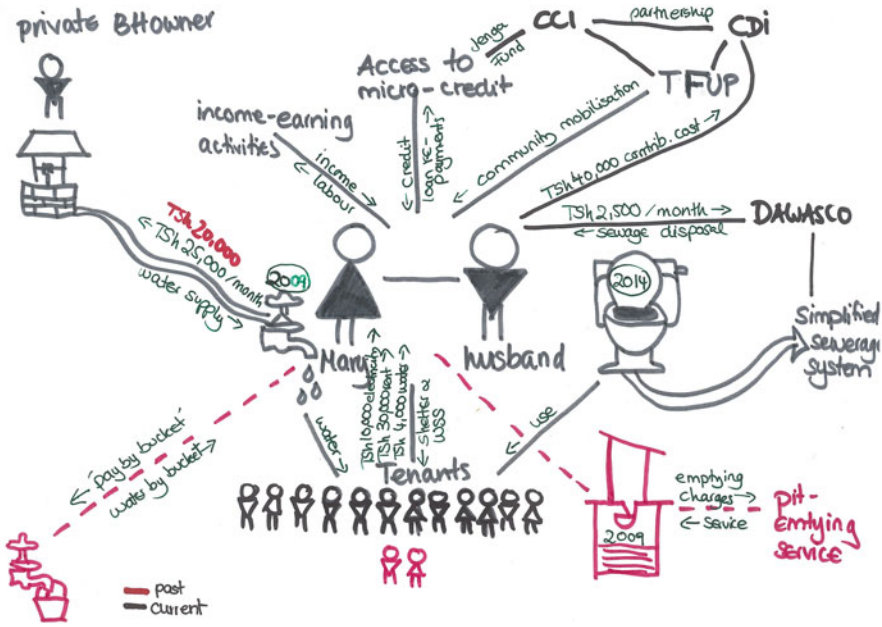

Fig. 7.2 Mary's multi-layered trajectory

[7] At an exchange rate of £1 = TSh3,200 (September 2015) this corresponds to £7.60.

ciaries but the intervention primarily targeted landlords as the owners of toilet facilities. This was partly because a few of the beneficiaries of the scheme relied on loans to pay a subsidised contribution of TSh40,000 and most micro-credit facilities in Tanzania are aimed at landlords to reduce the risk of non-repayment (Trémolet and Muruka 2013). Mary and her husband were able to take advantage of these favouring structural conditions to upgrade their simple pit-latrine, address issues of recurring floods and eliminate expenses associated with the need for frequent pit-emptying. Conversely, other landlords outside of the project perimeter continue to struggle with the safe disposal and treatment of wastewater.

One could contend that this has subsequently improved the lives of their tenants, too. Even though they are not charging directly for the improved sanitation facility, joining the scheme led to a rent increase per room from TSh25,000 to TSh30,000 per month, which can be a challenge for many tenants in the city with monthly incomes of TSh50,000 or less (Mkanga and Ndezi 2014). TFUP has been actively involved since the project's inception and advocated against related rent increases but reinforcement has been difficult as the Tanzanian law does not protect tenants against sudden rent increases (informal conversation with TFUP member, March 2015; Trémolet and Muruka 2013). With a start-up cost of TSh40,000 and TSh2,500 spent on monthly service charges, Mary and her husband have already managed to improve their financial situation while the tenants are paying for improved services. A similar picture emerges with regard to water whereby tenant contributions of TSh4,000 each exceed the monthly amount paid to the borehole owner.

Tenants are much more vulnerable and increases in rent could lead to growing levels of UWSP, e.g. they might be forced into seeking cheaper accommodation with poorer access to WSS. The relationship between landlords and tenants can play a defining role in people's trajectories (Scott 2013; Stephens et al. 2013). This is significant for an area like Vingunguti with high proportions of tenants and migrant populations, particularly with regard to scaling up initiatives like these. Absent landlords can further increase the danger of 'exploitative landlordism' and proliferate the displacement of tenants (Scott 2013; women FGD in Keko Machungwa, September 2014).

The above illustration establishes that geographic location can pose enabling as well as constraining structural conditions. But Mary's story takes this much further by highlighting multiple important relations, e.g. the intersection of place, time and identity in forming hydro-social relations. She would not have been able to benefit from the pilot scheme in the same way if she lived elsewhere in the settlement, if she was a tenant or if the intervention happened at a different time. Similarly, the diverse range of income earning activities of both as well as Mary's connectivity within the local community has allowed them to gradually move out of UWSP. In contrast, Joseph, another landlord with a toilet connected to the simplified sewerage scheme, is still struggling. He came to Kombo in 2007 with his wife after selling their house elsewhere in Dar es Salaam. As a former army employee Joseph receives a small pension and rents out two rooms at TSh20,000 each. In contrast to Mary, the couple cannot afford a household water connection but instead rely on private boreholes in the vicinity. Joseph is responsible for fetching water as his wife is too ill to do so and neither of them is currently engaged in any income-earning activity. Any potential

to increase the rent is limited as the smell from the nearby ponds renders their property less attractive. While he lives not far from Mary, Joseph is less established and resourceful and has a dependable wife. His agency, i.e. control over his hydro-social relations and the capacity to transform them by taking advantage of favourable structural conditions and resolving adverse ones, is limited (Sewell 1992).

7.5.2 Janeth

Janeth is a 24-year-old tenant that moved to Kombo with her mother and three siblings in 2007. Since 2009, she has been living alone renting a room near the sewage ponds, an area prone to flooding, and supports herself through money earned from playing football. Janeth joined a local TFUP group in 2013 and has been saving regularly ever since. She accesses water from two sources, a Plan International distribution point and a private borehole. They are both at equal distance but she feels that the quality from Plan International is better and sold at a lower price per bucket although it provides anything but a reliable service. Limiting operating hours and regular electricity cuts force her to frequently purchase more expensive water from a private borehole. As more people have been moving to Kombo without increasing the capacity of existing infrastructure, problems with community-managed systems have risen and affect particularly those residents that access distribution points that are further away from the borehole.[8] Janeth is currently not concerned about improving her access to water, particularly if it increases her expenses, as she is saving up to leave Kombo to open her own business and her consumption levels are comparatively low (20–30 litres per day). However, for residents with large families and those that rely on water for their income-earning activities purchasing by the bucket can be very expensive and time consuming. Mariam, a landlady has been living with her large family in Kombo for years. She accesses water from a private borehole five minutes away and used to spend more than TSh 25,000 monthly until she managed to establish an agreement with the borehole owner to pay a monthly flat rate of TSh15,000. This would not suit Janeth's circumstances and neither does it reduce the time dedicated to collecting water. However, for Mariam, who lacks the means to install a household connection, it reduces her expenses and provides a more convenient payment mechanism.

Being a tenant gives Janeth limited influence over housing conditions and services. As the landlord lives off-site, keeping the pit-latrine that is shared among all six tenants safe and clean poses a challenge. She was fortunate not to incur any rent increases since 2009 but has been a victim of yearly floods until her landlord took flood protection measures in 2014. While her level of UWSP has neither improved nor worsened over the past six years, it was largely her own decision. She has been working towards improving her situation by enhancing her knowledge and skills

[8] Community managed systems tend to have one borehole that supplies water to a number of distribution points within the settlement where residents access water.

through TFUP capacity-building activities and increasing her financial resilience through their savings scheme. Both will contribute towards the aim of opening her own shop next year.

7.5.3 Halima

Halima, an elderly landlady, is one of the private borehole owners in Kombo. The borehole was funded by her son and installed in 2013 to reduce the time spent on fetching water from neighbours. Halima is selling water to others at TSh30 per 20 litres, the same rate charged at the Plan International borehole. She claims selling is not for profit but to cover her electricity bill. Given the above-mentioned restrictions of the Plan International system, many residents are forced to supplement their supply with water from private boreholes like Halima's. Private boreholes currently improve access to water for a substantial number of people in Kombo. But without regulation to guide the position and number of boreholes and prevent from over-extraction it is not a system that can be sustainably reproduced. EWURA, the national regulatory authority, has developed guidelines to regulate informal service providers such as private boreholes and water tankers but they lack implementation (Interview with EWURA employee, August 2014). As a consequence, private boreholes emerge unsystematically with no official record of how much water is extracted. This means that Halima's supply is without limits and selling water to neighbours covers all costs incurred to extract water, i.e. electricity. With the installation of her own borehole she is able to dedicate the money previously spent on buying water to other purposes.

However, accessing water for free does not always improve people's level of UWSP. Yahaia, an older resident in Kombo receives water for free from the Plan International borehole because of his age.[9] His ability to benefit from these enabling structural conditions and thus his trajectory of UWSP is closely intertwined with and conditioned by his relationship with others. Due to his restricted mobility he relies on his grandson to fetch water. This has sometimes proven difficult as his grandson lives elsewhere in the settlement and is not continuously available during operating hours. Frequent electricity cuts pose an additional challenge and often require reverting to other sources against payment.

Individual practices like Halima's can seriously impinge on the amount of water available to others and compromise the environmental sustainability of the water source but people tend to be oblivious to wider implications of their own practices. This is further evident in relation to sanitation. Halima has a simple pit latrine that has not been emptied for years as the sandy soil in Kombo makes the faecal sludge

[9] Water through kiosks used to be provided free of charge until this practice was suspended in 1991 in the name of achieving financial autonomy of the utility (Pigeon 2012). Arrangements are in place whereby the elderly and those with serious illness or disabilities remain entitled to free water.

seep into the ground. With the majority of households relying on simple pit latrines this is a frequent occurrence while others in lower lying areas tend to open their pits during the rainy season to avoid paying for pit-emptying services. Thus, the risk of groundwater contamination by latrines is high. Many residents, like Halima, do not problematise this habit, which somewhat mirrors the government's lack of priority for sanitation (Thomas et al. 2013). Halima's account emphasises the relevance of relations between people and the environment, which materialise through her environmental interests. Halima has a desire to access water and dispose of wastewater to meet basic needs and improve personal well-being. In the absence of government provision she takes matters into her own hands to the detriment of the environment and potentially other residents.

7.6 Discussion and Conclusion

The life stories above offer interesting insights into the diverse trajectories of UWSP experienced through time on the ground. While Kombo has attracted a range of WSS interventions, the way in which people in the settlement benefit or not is not static and dependent on the dynamic interplay of agency at the micro-level and structures and institutions at the macro-level. Community-managed facilities supposedly provide a durable low-cost solution and are currently the utility's preferred option to provide services to low-income areas in Dar es Salaam (Interview with utility employee, August 2014; GIZ 2013). However, as witnessed through the stories from Kombo, residents do not benefit equally from community-managed systems. This is partly related to where people live but Yahaia's story demonstrates that his access is not only determined by physical vicinity. What is more, a latent relationship between the state and communities is largely a means to reduce the role of the former by transferring the responsibility to the latter (Allen 2012; see also Walnycki, Chapter 8, in this volume).

As community-managed systems struggle to operate effectively without the necessary government support to meet the demand of a growing population, it is largely left to the people themselves to activate their right to water but while the whole settlement is considered 'low-income', people do so with differing ability, opportunity and control. Private boreholes partially fill the gap but leave customers vulnerable to volatile rates, which in Kombo range between TSh30–100 per 20 litres (women and men FGDs in Kombo, September 2014; community meeting in Kombo, February 2015). For Janeth, who lives on her own and consumes less than 30 litres a day, this has not affected her much but for others it can reduce significantly other household expenditures and impact on livelihoods. The 'pay by bucket' approach that is operating at most water sources means that people only access the amount of water they are able to pay for momentarily, which is not necessarily a reflection of how much water is needed, and makes universal arrangements problematic.

Residents like Mariam commonly find it easier to pay on a monthly basis whereas others with very limited resources or temporary residents like Janeth prefer to organise their expenses on a shorter-term basis (female FGDs, September 2014; interview with Janeth, June 2015). Both agency and structure can have constraining features as well as enabling abilities. In Mariam's case, an established agreement with the borehole owner allows protection from *ad hoc* payments and volatile charges in the absence of a regulated service backed up by the State. Her case illustrates how constraining structural conditions at the macro-level can be overcome through the formation of hydro-social relations at the micro-level. Conversely, Mary's story paints a contrasting picture whereby enabling structural circumstances brought about by an intervention can reinforce unequal social relations at the micro-scale, i.e. between landlords and tenants. Evidently, individual trajectories intertwine and influence each other in ways that can move people out of UWSP or aggravate their circumstances.

Traversing through the different stories reveals their uniqueness while also recognising the influence of social and historical processes on individual lived trajectories embedded in a specific place. Therefore, they offer rare insights into the dynamic relations between the micro and the macro level, or as Maynes et al. call it 'the social and the individual' and the role of human agency (2008, p. 5). What represents the best option in terms of access to WSS to move out of UWSP varies from person to person and tends to change over time. Janeth maintains her basic access to WSS in order to expand her savings for a better livelihood opportunity but her needs are likely to change if and when she decides to settle down and start a family. For Mary, a water connection on their premises was initially unattainable but became a feasible step out of UWSP later on due to the increasing number of tenants. People's agency can therefore not be reduced to their social identity simply along categories like race, gender, social class or economic capacity. A relational perspective draws attention to power dynamics between the social and the individual and the various stories illustrate how these gain prominence at different times. Certain individual practices like private boreholes can offer improvements to UWSP in the absence of supporting structural conditions but not for everyone within a settlement. What is more, unless changes are implemented at the micro and macro-level to regulate borehole construction and groundwater abstraction these practices will eventually lead to depleting water sources and increased UWSP instead of presenting replicable long-term solutions.

The personal trajectories from Kombo residents have brought new voices and untold stories to the discussion on UWSP. They juxtapose and reject the flat and static ontology that is upheld in hegemonic discourses by offering alternative narratives. The needs of the 'urban water and sanitation poor' cannot be met by falsely treating them as a homogeneous group as this reinforces prevailing unequal power relations and discriminations, both between the universal groupings of the 'urban water and sanitation poor' and the 'non-poor' as well as within them.

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Chapter 8
Business Incentives and Models for Sanitation Entrepreneurs to Provide Services to the Urban Poor in Africa

Tracey Keatman

Abstract Local private entrepreneurs are fairly commonplace in the water and sanitation (WASH) sector – a World Bank study from 2005, covering 49 developing countries estimated there to be more than 10,000 independent water supply providers. Other studies suggest that the private enterprise market share for sanitation is even greater. Many of these providers work in and with poor communities where there are often no other services available. They operate at different scales, levels of formality and fulfil various functions. In the past few years, an increased focus in the WASH sector has helped to understand more about the incentives for engaging smaller-scale providers, the regulatory environment within which they work, and means to further develop entrepreneurial activities; both to increase basic WASH service delivery to the poor and stimulate local labour markets. Supporting emerging entrepreneurs who specifically help the poorest and offering business development services is a more recent approach. With the United Nations General Assembly and the Human Rights Council recognising the Rights to Water and Sanitation in 2010, the activities of all service providers – whether public or private, large or small – have come under scrutiny. This chapter gathers some of the emerging lessons learned about entrepreneurial models being trailed by the INGO WaterAid in Malawi and Tanzania to support service delivery to the poor.

8.1 Introduction

In the water, sanitation and hygiene (WASH) sectors, local entrepreneurs[1] are fairly commonplace. A World Bank study from 2005, covering 49 developing countries estimated more than 10,000 independent water supply providers (Kariuki and

[1] For this chapter, the term entrepreneur relates to any person or persons that are starting up or taking on a business approach to WASH service (and product) delivery. The definition moves beyond private sector groups that work as regular contractors – such as borehole drilling firms, masons,

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Schwartz 2005). Other work suggests that the private enterprise's market share for sanitation is even greater (BPD 2008). Many of these providers respond to an unmet demand for services, often costlier than access to WASH through formal or utility providers, and they work with poor communities where there are often no other formal (public or private) services available (Schaub-Jones 2011). Since the Rights to Water and Sanitation was adopted in 2010, more attention is being paid to how the service delivery role of local WASH entrepreneurs fits into the Rights framework and how 'these operators at the least do not interfere with the enjoyment of the human rights to water and to sanitation' (De-Albuquerque 2014a, p. 49). As yet, there is little academic or practitioner evidence about how the actions of WASH entrepreneurs on the ground actually interact with the Rights framework. However, various actors in the WASH sector have tried to professionalise the local entrepreneurs' operations and ensure equitable, affordable services to the urban poor.

This chapter begins by exploring the context of WASH entrepreneurs and their relationship with the Rights framework. It then introduces entrepreneurial models being trialled by the UK Non-governmental Organisation (NGO) WaterAid[2] in Tanzania and Malawi with urban sanitation service[3] providers and their low-income customers. Lessons learned from their experiences reveal how entrepreneurial activities can be planned and strengthened to support their operations in low-income communities.

8.2 The Entrepreneurial Context in the Rights to Water and Sanitation Discourse

Recent work has established a typology of informal WASH entrepreneurs, highlighting the diversity of their profiles, functions and the various scales at which they operate (from individual households selling water to neighbours through to standpipe operators, from tanker services to those operating small water supply networks, from latrine builders to pit emptiers), often with only limited oversight, financing or support from public bodies, NGOs and others (BPD 2008; Trémolet and SHARE 2012). Such providers typically operate in the informal private sector and little is known about how they actually function or their relationships to customers and

pump manufacturers, etc. It focuses more on the individuals and groups that 'run a business' in order to develop a sustainable and independent WASH service once external support ceases.

[2] The data presented in this chapter is drawn from an internal, desk-based assessment of WaterAid's entrepreneurial approaches. The assessment included a grey literature review and semi-structured interviews with WaterAid staff from several country programmes in Africa and Asia and from the UK office.

[3] Sanitation as a service implies that sanitation facilities or other supply activities are a sustainable service and not one-off actions. For example, this means that the focus is not just on providing a toilet but also on ensuring that human waste, once collected and contained by a toilet, is also transported and treated for reuse or safe disposal (Water Aid 2011; Harvey and Beale 2012).

authorities. Even for those working formally, discussing the merits and drawbacks of their services is clouded by a general lack of information. However, their contribution to providing services for the poor in some developing countries is up to 90 % according to World Bank estimates (Trémolet and SHARE 2012).

In the past few years, there has been an increased focus on the WASH development sector to learn about the incentives for engaging smaller-scale providers, the regulatory environment within which they work, and means to further develop and formalise entrepreneurial activities; both to increase WASH service delivery and to stimulate local labour markets and the livelihoods of those involved. Donors and international NGOs (INGOs), as well as business development experts and governments, are increasingly interested in the specific role of entrepreneurs in expanding basic service delivery to the poor. Funding and programmatic efforts are also being invested in trying to learn and understand the role that donors, INGOs and Business Development Service (BDS) providers should play to attract more entrepreneurs into the WASH sector and then to support their activities on the ground.

When the United Nations General Assembly and the Human Rights Council recognised the Rights to Water and Sanitation in 2010, the activities of all service providers – whether public or private, large or small – came under greater scrutiny as well as their relationships with the state, who remains the duty bearer of the Rights. In terms of operationalising the Rights to Water and Sanitation, the UN Special Rapporteur made recent efforts to identify how the Rights framework relates to WASH entrepreneurs and smaller-scale providers' activities (De-Albuquerque 2014b). The Rapporteur noted that:

> The obligation to fulfil the human rights to water and sanitation requires states to ensure that the conditions are in place for everyone to enjoy the human rights to water and sanitation. This does not mean that the State has to provide the services directly, unless there are individuals or groups of people who cannot access their human rights through other mechanisms. (De-Albuquerque 2014b, p. 27)

Where services have been formally delegated to non-state actors, the Rapporteur indicates that clear monitoring and regulation should ensure all service providers are protecting people's rights. In the case of smaller-scale providers – including independent entrepreneurs providing services to the poor – there may be no formal delegation of responsibility; rather, the service providers themselves have been self-motivated to provide such services or are part of small and medium-sized enterprise (SME) development programmes. As they are often 'under the radar', too small or unregistered to be counted in the formal system (of monitoring or regulation if it exists), the WASH sector is grappling with how to formalise and professionalise such providers and bring them into regulatory compliance. The Rapporteur specifically highlighted that:

> States' obligations to realise the human rights to water and sanitation apply equally to informal as to formal service providers. States are therefore required to ensure that these operators at the least do not interfere with the enjoyment of the human rights to water and to sanitation, and in the best cases that they contribute to the realisation of the rights. This is particularly relevant in the context of informal settlements, where residents tend to be disadvantaged and living in poverty, and are most in need of State support and protection.

> To date, far less attention has been paid to the regulation of informal, small-scale providers than to the regulation of utilities and large private companies. (De-Albuquerque 2014a, p. 49)

Given the quantity and the nature of these smaller service providers, many of which have emerged to serve as community-based organisations (CBOs), NGOs or small private companies, the Rights framework poses specific, additional challenges and contradictions. Firstly, such providers are responding to a demand coming from communities' coping mechanisms where there are no formalised services. Secondly, their 'business' model is based on the rationale of labour and profit generation by providing WASH services as a commodified good to poor consumers. Moreover, to provide stopgap services they may also charge more and confuse consumers around options for improved, formalised services.

Within the recent articulation of the Rights framework, it is too early to analyse how entrepreneurs are addressing the 'obligation to respect, protect, and fulfil human rights in a participatory, accountable and non-discriminatory way' (De-Albuquerque 2014b). However, many examples now reveal valuable lessons about the necessary conditions to support entrepreneurial approaches that seek to provide services to the poor in different contexts and contribute to realising these Rights.

8.3 Sanitation in Dar es Salaam

Sewerage coverage in Dar es Salaam, Tanzania is estimated to reach about 10 % of households (WA 2013), which leaves 90 % relying on on-site pit latrines and septic tanks. Those living in unplanned settlements cannot easily access pit emptying services due to the high costs involved and poor road access whereby larger emptying vacuum lorries cannot enter. Dar es Salaam Water and Sewerage Authority (DAWASA) and respective Municipalities have not traditionally supported existing local pit emptying businesses. WaterAid Tanzania (WAT) has responded by developing and testing a pit emptying technology (called the Gulper) with local entrepreneur groups as part of its urban programme. It operates with various stakeholders and focuses on innovative ways of getting poor households access to simple, low-cost pit latrines and emptying services in the urban and peri-urban unplanned areas of the city.

In June 2007, WAT began working with the London School of Hygiene and Tropical Medicine (LSHTM) to develop and test the Gulper technology over 3 years in two wards of Azimio and Kigamboni in Temeke Municipality and Vingunguti in Ilala Municipality. In addition to demonstrating appropriate business models at ward level, the project sought to foster an enabling environment for small-scale sanitation businesses. This pilot was succesful yet it was recognised that changes were required to the business model for it to have greater impact. Hence, building on their experience, WAT has been scaling up the project to reach 72,000 people from 2011 to 2015.

8.4 Sanitation in Lilongwe

WaterAid Malawi (WAMA) and the Lilongwe Water Board (LWB) have worked together since 2004 on improving access for the urban poor to water services in low-income and informal settlements and since 2007 on integrated sanitation and hygiene promotion. The Lilongwe City Assembly City Development Strategy 2010–2015 estimates that only 9 % of residents have a sewerage connection. The majority relies on traditional on-site pit latrines. Residents in medium- to high-income areas can afford septic tanks and hire private operators to empty the tanks when full. However, poorer households cannot regularly afford the costs of local, informal pit emptiers nor do they have the finance or space to build new latrines once old ones are filled.

As sanitation provision is typically perceived as a household responsibility, WAMA was interested in promoting investment in sanitation facilities by households and develop ways to provide low-cost solutions for poorer residents. During 2007, WAMA began working on urban sanitation activities with local NGOs and small-scale entrepreneurs. The process included identifying local artisans and masons in target communities to cast slabs and then sell them at market value. WAMA provided start-up capital (usually in the form of cement and tools) and then gave technical training on building different types of latrines, marketing and business management skills. However, this subsidised approach did not offer the right type of incentives for entrepreneurs to become involved. Rather, it was a perverse incentive whereby people perceived the materials and training as a free hand-out, which influenced their expectations and engagement. After 2 years, three or four trainees out of the first 18 remained active. In 2009, learning from this experience and the models being trialled by WaterAid in Mozambique and Tanzania, WAMA began a 2-year pilot pit emptying and sludge transportation project within its urban programme.

8.5 Thinking, Seeing and Acting Entrepreneurially: Supporting the Professionalisation of WASH Entrepreneurs

The engagement of NGOs and other WASH sector support agencies typically focuses on ensuring entrepreneurs' and SMEs' activities extend basic services to the poor that are safe, affordable, sustainable and non-discriminatory. Entrepreneur support programmes in the WASH sector often include some element of business planning, management support and monitoring so that poor customers are not excluded and that there is some level of accountability, i.e. that there are social as well as business, profit-making outcomes. Small entrepreneurs must comprehend and support the social enterprise model and balance that with entering into the sector due to the promise of an improved livelihood and profession. To explore how

sanitation entrepreneurs or SMEs could contribute to delivering urban services within the context of the Rights to Water and Sanitation framework, this section considers how their operations can be supported and professionalised through a structured approach to business planning for entrepreneurs (Green 2013).

Within Green's 'thinking, seeing and acting' conceptualisation of entrepreneurship (2013), *thinking* refers to the 'right' knowledge, mind-sets, motivations and behaviours to approach activities in an entrepreneurial way. *Seeing* means considering the operating context, especially where goods and services are aimed at poorer communities, and identifying how this environment helps or hinders entrepreneurial activities. *Acting* requires entrepreneurs to strategically identify opportunities and transform their ideas into real and tangible actions through well-planned and effective business models. These three dimensions are clearly inter-connected: e.g. having a conducive legislative and regulatory context which supports SMEs development facilitates the entry of entrepreneurs into the market; business plans are successfully executed when there is knowledge of customer demand, especially the willingness and ability to pay of poorer customers; budgets can be prepared realistically if there is knowledge of the existing market and where there is also access to available capital finance.

8.5.1 Thinking Entrepreneurially: Who Are the Entrepreneurs?

> It is more effective in the long run to take a business person and train them in the sanitation industry than it is to take a sanitation person and make them into a business person. (Sugden 2013, p. 1)

Depending on the context and the nature of the activity, sanitation entrepreneurs often have an existing link to WASH activities or to the community in which they will operate. For urban sanitation services, people are usually already engaged in informal, manual pit emptying or door-to-door solid waste collection and recycling. There is also an emerging view amongst WASH practitioners that efforts should be focused on working with these types of people with an existing enterprise or an interest in business approaches as they are typically more incentivised to engage or better understand the business approach's potential benefits and risks.

WaterAid Tanzania (WAT) has worked with existing CBOs to encourage the self-management of services and develop small businesses by collaborating with a group of existing informal pit emptiers in Dar es Salaam. To strengthen and build on their work, WAT helped them to review their customer base to see if their 'business' was marketable and supported the entrepreneurs with business development activities. Others engaged in the initiative were originally solid waste collectors and became involved in the Gulper initiative due to the training and income it might offer them.

WAT initially supported four Gulper operator groups from the local community, two of which are still in business. UMAWA, based in Temeke Municipality,

registered in 2001 as a CBO initially and became a registered company to gain access to loans. The NUMAGRO company registered in 2009.

Learning from the WAT experience, WAMA adopted the mechanised Gulper pit-emptying machine plus transportation tricycle motorbike that was being trialled in Dar es Salaam. A pilot project took place with WAMA local partner, the Circle for Integrated Community Development (CICOD) in a settlement of around 20,000 people. A community group of 15 people publicised and promoted the service and two members were trained in the business of emptying and transporting the sludge. CICOD managed the overall project. However, the community operator did not develop the necessary vision to turn the activity into a business that could effectively serve poorer customers. There also was a lack of business management training attached to the pilot to assess and promote entrepreneurial abilities. The community group became dependent on WAMA and CICOD to provide an ongoing service – which was ultimately not sustainable.

Unearthing the underlying incentives for why people may be interested in becoming a WASH entrepreneur is reportedly rarely considered in advance of setting up a business or initiative. It is often assumed that people are purely motivated by income-generating opportunities or training, which results in professional employment; little attention is paid to individuals' perceptions of risk and reward, their working behaviours or whether they are interested in specifically delivering services to the poor or underserved. To explore this dynamic further, Crowder (2013) analysed small-scale sanitation providers working in the informal sector in four slums in Dhaka, Bangladesh based on a framework that assessed entrepreneurial motivation and self-employment. This found that the motivations depended on whether the entrepreneurs were building or emptying toilets although in both cases, they were not highly driven to pursue their sanitation activities.

The financial motivation assumption probably rings true in many cases. As part of its pit emptying initiative in Dar es Salaam, WAT undertook research, which showed that people were primarily interested in becoming pit emptying entrepreneurs due to the prospect of having professional employment with a regular income. For others, however, incentives were more about enhancing their social standing, self-confidence or wider recognition. Incentives also changed over time in relation to the nature of the business, the characteristics of the market and access to capital or other local resources. Ultimately, these motivational factors may influence the likelihood of the business being a success.[4]

It is clear that more could be done by WASH sector support agencies to map individuals' incentives and the anticipated social and financial benefits for participating in business-related projects and to determine if planned activities realistically match peoples' expectations. Similarly, incentives may shift over time and people can become despondent or unmotivated. Further incentive mapping may also highlight what 'puts people off' engaging in sanitation business-model approaches.

[4] For a full categorisation of the 'Key determinants and motivational factors of entrepreneurship' see Crowder (2013, p. 28–30).

As WAMA believes it is more cost effective and efficient to work with small and medium-sized entrepreneurs rather than individuals, they have been working on ways to gather individuals together to better understand the competition and potentially collaborate more to aggregate and scale-up their activities. WAMA is also considering how to link up the smaller private masons/artisans to medium or larger private entrepreneurs to consolidate their efforts. Potentially the masons could become agents of the larger pit-emptying groups or could link up their service offering, thereby providing a one-stop sanitation 'shop' for latrine construction, sludge emptying and even reuse. WAT, however, is aiming to increase entrepreneurs' professionalisation by setting up networking groups and associations to encourage collaboration and to build their reputation and profiles. In both cases, WaterAid will seek to understand the impact on service pricing to ensure there is no detrimental effect for poor customers.

8.5.2 Seeing Entrepreneurially: The Enabling Environment for Entrepreneurship

This sub-section discusses how the – often challenging and evolving – physical, socio-economic, financial and legislative context can influence the 'market' for WASH services, the options for entrepreneurial operations and how different contexts can help or hinder such small businesses in their efforts to extend services to the urban poor.

In terms of physical access to WASH, especially in unplanned urban settlements, service provision can be hindered by a lack of road infrastructure, geographic distance and other constraints (such as a lack of community cohesion and community voice). Where accessibility and affordability issues limit the relevance of the larger pit-emptying services provided by tanker trucks, smaller-scale entrepreneurs have entered the market by offering manual pit-emptying or using mechanised systems, such as the Gulper technology. A more sophisticated version of the latter method also may integrate a decentralised wastewater treatment system (DEWATS) for waste management and reuse. Combining such technologies offers sanitation services in low-income, unplanned settlements and in essence, helps entrepreneurs tailor their service to the context and the potential customer base.

Access to capital finance for smaller-scale entrepreneurs varies on the nature of the business. There is more willingness to invest in water supply than sanitation and hygiene behaviour change, and reportedly more interest in the 'hardware than the software'. Finance may come from a number of sources, although typically more can be found for smaller scale endeavours (usually through donor programmes or micro-finance loans) and for the large scale entrepreneurs who may have good reputations and credit ratings and can therefore borrow from commercial banks or work on government-financed contracts. Schaub-Jones (2012) draws attention to the 'missing middle' – the SMEs providing services to the poorest that cannot easily access loans and therefore have to rely on self-financing models, customer ability

(and willingness) to pay them and by diversifying and selling their other services at a profit. To address this challenge, several sector organisations have trialled various innovative financing mechanisms with entrepreneurs in different countries (e.g. revolving loans in Tanzania, seed funding in India, micro-financing, etc.) to demonstrate to government and other key institutions (notably banks and other financial investors) the value of WASH business approaches and how they could replicate such financing models.

For example, the DAWASA and respective Municipalities in Tanzania have not traditionally supported local pit emptying businesses. Therefore WAT is promoting the development of financing mechanisms by working with local banks to show the profitability[5] and risk levels of the sanitation business and offer business loans or access to micro-finance for the entrepreneurs. WAT has established a Memorandum of Understanding (MOU) with KCB Bank Tanzania Ltd to operate a Fixed Receipt Deposit account where WAT has deposited around £11,000 as a guarantee for pit emptying operators. The operators receive a loan in the form of equipment (i.e. the Gulper and other materials) rather than money. WAT has also set up a revolving fund financing mechanism for about £3000. BDS groups manage both mechanisms while WAT continues to encourage other financing bodies to engage in providing financing mechanisms – including local government authorities (LGAs) that may be able to give funds directly to local entrepreneurs. By way of example, WAT has successfully influenced Ilala LGA in Dar es Salaam to replicate this model and they have set up a revolving loan through which they directly support an additional two pit-emptying groups.

In terms of cost recovery from individual community members and their willingness and ability to pay for services, recent WAT research showed that most community members would like to hire vacuum lorries for pit emptying but cannot afford it (WA 2013). In terms of the Right to Sanitation, the UN Special Rapporteur specifically commented on affordability as one of the criteria for ensuring access to the Right. The Rapporteur highlighted that:

> People must be able to afford to pay for their water and sanitation services and associated hygiene. This means that the price paid to meet all these needs must not limit people's capacity to buy other basic goods and services, including food, housing, health and education, guaranteed by other human rights. While human rights laws do not require services to be provided free of charge, states have an obligation to provide free services or put adequate subsidy mechanisms in place to ensure that services always remain affordable for the poor. (De-Albuquerque 2014b, p. 35)

For the small-scale pit emptiers and other sanitation-related service providers, even if customer willingness to pay is present, the challenge of physically collecting and processing payments as well as banking can pose additional challenges. WAMA has tried to overcome this by encouraging larger service providers to subcontract smaller ones; thereby reducing individual transaction costs and reducing overall charges for customers. This approach may also lessen the risk of customer non-

[5] The Gulper business in Dar es Salaam is making money for the UMAWA group for instance and the operators make about £60 per month.

payment, which may disproportionally affect the smaller providers and their ready access to working capital. However, it may also encourage some of the providers to work with less poor customers so they can ensure that their work remains profitable.

An alternative option for increasing the financial viability of serving the poor in this context would be to remove or reduce the transport and dumping costs by finding more solutions for local sludge management. WaterAid and others have been trialling several local waste treatment systems (e.g. DEWATS and solar sludge drying[6] in Bangladesh). There are often challenges when implementing these systems as they are typically pilot efforts which are not linked strategically to city or town-wide master development plans or factored into urban planning and regulation. There remains an appetite to link these solutions with pit-emptying businesses however. For example, to make their business more financially viable, UMAWA in Tanzania have increased their treatment capacity by installing an integrated DEWATS for treating waste onsite – they therefore no longer have to pay for a lorry to come and collect it and are also experimenting with producing biogas, which can be used for cooking (Hofmann, unpublished fieldwork notes). UMAWA is also considering attaching a solid waste collection service so that people do not put waste in their latrine (hence keeping the emptying cost lower) and raising awareness that this is in their interests.

Regarding the legislative context, legal provisions exist for alternative service providers in many country-level WASH policy frameworks. In Malawi, Bangladesh and India, policy recognises the role of entrepreneurs; however, it is often not formally acknowledged or considered as part of a wider WASH strategy or integrated into urban planning and development processes (if they exist). Similarly, a key challenge in many countries is the lack of clarity on roles and responsibilities for service provision; this has been complicated further by the challenges related to fulfilling the Rights to Water and Sanitation. This is especially true in regard to sanitation provision where different government departments are responsible for managing different aspects of the sanitation supply chain. In response, organisations (including WaterAid, the International Water Association, the Water and Sanitation Program and others) are working with governments to develop city-wide or integrated sanitation plans that take into account the needs and inter-related roles played by public and private providers.

8.5.3 Acting Entrepreneurially: Entrepreneurial Business Models

Much of the focus of WaterAid's (and other external support agencies) work with entrepreneurs has revolved around professionalising and/or formalising informal services and on ensuring services are reaching the poorest and most

[6] See this blog for further details of the work in Bangladesh: http://fsmactionresearch.blogspot.co.uk. Accessed 6 March 2016.

vulnerable – hence, protecting their Rights to access water and sanitation facilities. In some cases however, this has arguably focused more on finding the right technical approach for entrepreneurs to use rather than building their business management capacities and developing appropriate business plans which take into account the needs of the Rights framework. Plus, the transformation into viable, sustainable businesses for informal entrepreneurs does not happen overnight, so several support agencies are questioning how long they should engage with entrepreneurs/SMEs especially within the constraints of a projectised development system. Time, effort and a deep understanding of the local market context are all required to ensure that such businesses are operating strategically and that their ideas can evolve into longer-term, viable business plans.

In terms of business planning, literature on business models categorises them into different typologies based on what they do and where they derive and deliver value.[7] WaterAid and other INGOs have noted that such business analysis and planning is rarely pursued and there is reportedly little understanding of how to connect business planning with a rights-based approach. Some of the entrepreneurs that WaterAid has been working with, for example, have rudimentary business plans (or facets thereof) although several were initially conceptualised as donor-funded development projects rather than as entrepreneurial business approaches. This appears to have been a constraint on professionalising potential SMEs rather than supporting their business development and acumen.

An internal WaterAid review of the pit emptying pilot approach in Malawi from 2012 highlighted the various technical, financial and business management challenges faced. In terms of community group management and turning it into a business, the review found several obstacles to ensuring sustainability due to the lack of business management training and entrepreneurial ability as well as a lack of capital financing, ownership, innovation and vision for the business as a whole. This resulted in the community becoming dependent on WAMA (and local implementing partners) for the service rather than transitioning it into a successful business model. Ultimately, WAMA recognised from this pilot that finding (and stimulating) the right business entrepreneurs/partners from the start, supporting their business model development and strengthening the type of business model used would constitute a more appropriate and sustainable approach.

WaterAid (and BDS partner organisations) has supported some of the entrepreneur groups with understanding their customer base and market analysis. For example, WAT and partner BDS are conducting a market research analysis to identify and create a viable customer base with the newly created entrepreneur groups. Initial analysis shows high demand from low-income customers and Gulper operators in Tanzania have reported that more pit emptying requests come in during the rainy season compared to the dry season. Similarly, WaterAid has supported entrepreneurs to engage with customers and package their services – notably through

[7] For a clear review of the different categorisations of business models, see: Eight Models of Business Models, and Why They're Important. http://timkastelle.org/blog/2012/01/eight-models-of-business-models-why-theyre-important/. Accessed 6 March 2016.

existing links with partner organisations, local CBOs and community groups. WAT gathered customer satisfaction feedback on the pit-emptying service in Dar es Salaam and found that they were impressed by the lack of smell and the speed of the service (about 1 hour). People also regarded the service as good value for money. Providing a structure for this feedback enables the entrepreneurs to use the information as success stories and for further advertising. However, it is not clear if these services specifically reach the poorer segments of the population as the practice of opening pits during the rainy season to avoid paying for emptying services is still frequently practiced in Dar es Salaam and some pits have never been emptied because of the sandy soil (see Chap. 7).

In the longer term, WASH sector NGOs may not need to identify and train entrepreneurs directly but could continue to support, broker and monitor the services provided by BDS providers, to focus on influencing (with BDS providers, government, financial institutions, etc.) and to manage learning on the technical and socio-economic side (with entrepreneurs, research institutions, etc.). For example, WAMA is currently contracting a BDS provider – Tools for Enterprise and Education Consultants (TEECS)[8] – to do market analysis and develop a cadre of potential entrepreneurs through a bespoke training programme. WAMA believes other BDS groups will also then be stimulated to replicate this model and bring more entrepreneurs into the sector. The role of INGOs and other sector organisations would therefore be more of a catalytic one focused on sector strengthening and influencing providers to adopt a more rights-based approach to deliver services to the poor.

8.6 Conclusion

The challenge facing some WASH sector actors will be to shift the mind-set of existing staff towards such business approaches. Both WaterAid Tanzania and Malawi noted how they struggled to begin with as they traditionally worked with partner NGOs and CBOs rather than business entities. It took time to introduce staff and partners to business thinking and the potential benefit of smaller-scale entrepreneurs in extending services to low-income communities. Both WAT and WAMA learnt that business people are best supported directly by people who understand business and not necessarily by NGO staff – hence their role in the future would be more as a facilitator rather than a direct support agent. This may also minimise the risk of the entrepreneurs becoming dependent (and therefore possibly unsustainable) on WaterAid in the longer term.

There is significant agreement across the WASH sector that sanitation supply activities for the poor should be regarded as a sustainable service and not one-off actions. This clearly informs how organisations should engage with entrepreneurs, which activities they might focus on and how business plans should be structured to

[8] TEECS have worked previously with NGO Water for People in Malawi and can share their learning with WA.

address this sustainable service delivery approach. The lack of an enabling environment and structured and systematic business planning however could be constraining factors for replicating or scaling-up some of the activities undertaken by entrepreneurs.

NGOs, like WaterAid, and others working on rights-based approaches, providing support to business development, are also well placed to ensure that the Rights to Water and Sanitation are understood and interpreted in the context of such entrepreneurs. As this chapter has shown, there remains a critical role for NGOs and other external support agencies to ensure that entrepreneurs' and SMEs' activities extend basic services to the poor that are safe, affordable, sustainable and non-discriminatory and thereby upholding key aspects of the Rights.

In the shorter term, this may mean directly supporting the development of business plans with entrepreneurs to ensure their actions will actually extend services to poorer communities, i.e. to ensure that the operators 'contribute to the realisation of the rights.' In this way, such business plans could be developed *within* the context of the Rights framework rather than attempting to intervene once businesses are up and running. Support would therefore focus on balancing the profit-making incentive of entrepreneurial businesses with delivering a public good – i.e. external agencies would be playing a moderator role. This entails, as the WaterAid cases have demonstrated, focusing specifically on affordability – so that costs are low for poor customers but that the business costs are covered through diverse business approaches and innovative financing options (e.g. through advocacy work with banks and other potential financiers).

In the medium to longer term, the role of NGOs and other external agencies may focus more on supporting these providers to develop feedback and consumer engagement mechanisms so that the voice of poorer customers is heard and to improve accountability so that their rights can be upheld. Similarly, support agencies may also be required to support monitoring and to provide a back-up regulatory function for state organisations to ensure all service providers are protecting people's rights and are within regulatory compliance.

For a sustainable sanitation service provided by SMEs/entrepreneurs, as discussed earlier, it is vital to work with people who already have some form of related business and clear incentives for supporting a social business model. Such models, in addition, cannot become dependent on external agencies (such as WaterAid and others) so it is in the interest of external agencies to focus more on developing viable businesses and service providers' professionalisation via business planning and financial management up-skilling rather than by focusing on technical solutions alone.

Looking to the future, especially in the context of the agreed Sustainable Development Goal target 6.2 which demands an acceleration of pace and practice for sanitation and hygiene to 'achieve access to adequate and equitable sanitation and hygiene for all' by 2030, there is clearly more work to be done to analyse how external agencies and NGOs are feeding the Rights framework into their programmes with SMEs and entrepreneurs, and also to capture lessons learned on how

effectively this can be done on the ground. A step in the right direction would be to directly link business models to the Rights framework so that safe, affordable, sustainable and non-discriminatory services are available to all.

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Chapter 9
Contesting and Co-Producing the Right to Water in Peri-Urban Cochabamba

Anna Walnycki

Abstract The Bolivian government played a key role in developing and presenting the Human Right to Water to the United Nations General Assembly (UNGA). However, nationally water policies and institutions designed to realise the right to water have struggled to engage with a highly fragmented and informal water sector. 46 % of the residents in the city of Cochabamba rely on informal water providers. There are around 600 community water providers across the municipality, many of which experience serious practical and institutional challenges. Meanwhile, the poorest households and communities in the city continue to rely on expensive vendors. Drawing on research undertaken between 2010 and 2015, this chapter explores how community water providers in Cochabamba engaged with reforms around the right to water, and have sought to engage with the state and to develop co-production partnerships as a means of improving water services to low-income urban neighbourhoods.

9.1 Introduction

In a meeting held to commemorate the 15th anniversary or the Water War, the leader of the Coordinator of Water and Life, Oscar Olivera explained that the challenge of securing access to water as a human right remains unresolved in Cochabamba. Olivera explained that a large proportion of the city has no drinking water and another sector has limited access. He commented: 'the southern zone[1] must rise-up to make the water reaches the region' (Los Tiempos 2015).

Fifteen years after the Cochabamba Water War, Oscar Olivera, a leading member of the uprising, expressed dismay that many communities in Cochabamba are still without access to sufficient safe water services and that the state was a long way off realising the right to water. Despite the prominent international role that Bolivia played in advancing the right to water and developing the UNGA declaration on the

[1] Local name for low income and informal peri-urban region to the south of Cochabamba.

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right (UNGA 2010), national water policies and institutions struggle to engage appropriately with a highly fragmented and informal water sector. At the city level, the utility SEMAPA and the Misicuni dam project[2] have been plagued to varying degrees by insufficient investment, corruption, and institutional failings. Consequently, over 46 % of the city relies on informal water providers (SEMAPA 2015). There are around 600 community water providers across the municipality (Lavrilleux and Compere 2006), many of which experience serious practical and institutional challenges. Meanwhile, the poorest households and communities in Cochabamba continue to rely on expensive vendors ('aguateros' in Spanish). Drawing on research undertaken between 2010 and 2015, this paper explores how community water providers in Cochabamba have sought to engage with the state and develop co-production partnerships as a means of improving water services to low-income urban neighbourhoods.

9.2 Emerging Partnerships for Water Provision

Co-produced water services, developed using varying inputs from the state and civil society is one means of improving access to water that has received some support from the Bolivian state (CGIAB 2010), and which has also been promoted by grassroots community water providers in Cochabamba. The practical and strategic potential of co-production has been the subject of extensive debate since Ostrom (1996) considered the role that civil society could play in the delivery of services and the development of more equitable and economically-efficient local governments. This contributed to research exploring the synergies between the state and civil society, and the role that these partnerships could play in societies in the Global South, where social structures may not be egalitarian and state bureaucracies may be underdeveloped (Evans 1997).

Joshi and Moore (2004) developed the concept to allude to the provision of public services (broadly defined to include regulation) through regular, long-term relations specifically between state agencies and organised groups of citizens, who both make substantial resource contributions. This framework has been used to explore instances where the state is committed to developing basic services with the community and the strategic benefits for low-income and marginalised groups. Indeed, co-production initiatives have demonstrated potential to drive approaches that respond to the needs of the community, but which draw on the technical expertise of the city utility (see McGranahan 2013). These partnerships often provide the opportunity for communities to link community infrastructure with formal city

[2] The Misicuni Multipurpose Project is a dam that is under construction to the North West of Cochabamba designed to provide drinking water and irrigation to the city and surrounding areas. The project, which was conceptualised in 1952, has been underway in various forms since 1987. The dam was due to be completed in 2014 but has been subject to a series of contentious financial and contractual delays.

infrastructure; for example community-level water or sanitation systems can be linked up to the larger mainline pipes supplied by the city. This approach relies on community organising and partnerships that combine technical with local knowledge. The approach challenges traditional planning processes and combines a 'needs' and 'rights' based approach in an inclusive manner and focus on strategic political as well as practical gains to deepen more democratic planning and governance structures. There are, however, a range of co-production partnerships that emerge some of which are more beneficial to one partner than another, and which are dependent on more or less input from one partner over another (see Allen 2012).

This chapter considers how communities interact with the state to leverage co-production partnerships over time and under what circumstances. Well-organised low-income communities who are looking for basic needs solutions often pursue latent co-production, whereby the state allows communities to access some resources This can present strategic opportunities that communities can grasp in an attempt to gain further recognition by the state, or to bolster their organisations. But without strategic input from the state, these services are unlikely to be sustainable in the long-term (see Hofmann in this volume for an example in Dar es Salaam).

Institutionalised co-production arrangements are often the culmination of long struggles that shape meaningful partnerships with the state or as a result of state led interventions (see Allen et al. in press). Grassroots struggles for resources, recognition and rights can ultimately be incorporated into reforms and laws that formalise rights, and this arguably marks the de-politicisation of local grassroots struggles. This raises questions about the scope of institutionalised co-production partnerships, which are often posited as a pro-poor solution to basic service provision, to meet the needs of the most marginalised low-income communities.

9.3 Urban Community Water Provision in Cochabamba

In Bolivia, there are over 28,000 formal and informal water providers, but only 27 of these are regulated (MMAYA 2012). This figure includes utilities, cooperatives, and a range of community water providers that are governed by local norms and increasingly subject to water policies and a governance framework that has been developing since the election of Evo Morales in 2006. In Cochabamba specifically, there are 600 community providers serving high, middle and low-income communities across the city. The Zona Sur has urbanised without any formal water or sanitation infrastructure and is completely unserved by the municipal utility SEMAPA. In a recent study in preparation for developing the Metropolitan Master Plan for Water and Sanitation (MMAYA 2013), 189 community water providers were identified in the region. Twenty three belonged to formal resident associations, 122 were self-managed by a committee or association, there were 11 small cooperatives, 26 privately managed systems and 26 were managed according to traditional agrarian arrangements. This chapter does not seek to overlook this complexity, but will refer to these organisations as community water providers or CWPs from here on.

Fig. 9.1 The Zona Sur, Cochabamba (Photograph by Anna Walnycki)

Urban drinking water providers began emerging amongst the informal communities in the Zona Sur of Cochabamba during the late 1950s. This was spurred by migration that began as a result of the end of bonded labour in the late 1940s (Kohl et al. 2011). The city had been unable to provide enough cheap housing for the growing population and so small, sporadic informal settlements began emerging in the arid, mountainous land to the south of the city, which had previously been only sparsely populated by some farmers. Land invasions continued throughout the 1960s and 1970s, then during the 1980s, after the crash in the cost of metals and the closure and privatisation of the mines in accordance with a structural readjustment programme, a second wave of mining migrants led to the development of new informal communities, but this time further south of the municipality. Throughout this period the municipality deemed the communities that were mushrooming across the Zona Sur to be illegal, which excluded them from the citizen rights and basic services that their neighbours in the centre of the city enjoyed (see Goldstein 2004) (Fig. 9.1).

The first water committees were established around boreholes and wells that were sunk using collective resources and mutual aid and community labour. Over time, and as communities decided to invest in further infrastructure, such as water tanks and piped water systems that would deliver water to each household, commit-

tees introduced subscription fees. As the aquifer became increasingly depleted and contaminated (Gheilmi et al. 2008), communities began organising to buy water in bulk to distribute to members. A small committee would govern the CWP but decisions would be made collectively during regular meetings, and managed according to norms established by the community. Informal communities were organising diverse basic services, without much engagement with the state until the 1990s. One barrio elder from Villa 15 de Febrero,[3] a barrio in the Zona Sur explained.

> I arrived at the barrio 30 years ago, when there was nothing here, we cleared cactus and built roads together. So many local politicians have come to this barrio and promised to pave our roads, but we have had to do everything, pave roads, bring electricity, and extend the SEMAPA water supply. When I first arrived there were just two aguateros for the whole zone, now there are tens. The communities of the Zona Sur have had to manage their resources and so have become good at it; we should be supported to do this.[4]

9.4 Latent State Support and Emerging Co-Production Partnerships

In 1994, the Ley de Participacion Popular (LPP) was passed. This was part of a process that sought to democratise Latin American countries that have been subject to dictatorship rule for several decades by incorporating communities into local development and planning processes. The reforms would streamline the state but also diffuse its influence through traditional community structures such as the indigenous 'ayllu' council. The process would encourage these 'informal' communities to create formal grassroots community organisations known as *Organizaciones Teritoriales del Base* (OTBs or grassroots local organisations in English), which could then draw down on per capita resources from local government to address the development needs of the community. The reforms drew on rural development trends at the time and worked well in rural settings, but there was insufficient planning around how this process would work for informal communities in urban and peri-urban areas (Cielo and Céspedes 2008). In practice, some communities decided to use some of these limited resources to upgrade or construct a community water system. However, not all communities were able to formalise and achieve OTB status, and access the resources required. Indeed, the unequal distribution of municipal budgets has been the subject of much scrutiny. Firstly, the communities that were able to attain OTB status are able to draw down limited per capita resources, but they had limited influence over bigger projects. Consequently, municipal governments have tended to deliver roads and superficial interventions, as opposed to projects that could improve access to basic services (Achi and Kirchheimer 2006; Torrico and Walnycki 2015). Secondly, there are a significant number of informal

[3] Pseudonym.

[4] Barrio elder, Villa 15 de Febrero, 2 May 2010.

communities that have been unable to attain OTB status, because they are not formally recognised in the census, or because of on-going land tenure disputes. In district eight of the Zona Sur, 39 of the 73 communities are informal and cannot access any significant resources or influence local planning processes at the local council (see Torrico and Walnycki 2015).

This was not the only form of support for developing CWPs during this period. While the LPP provided resources for local development, some formal communities decided to develop water committees that were independent to the OTB, using community resources, or financial support from the church. During the 1990s and 2000s, the church provided significant support to formal and informal communities to develop community water systems in districts eight and nine.

9.5 After the Water War

During the 1990s, Bolivia was under pressure from the World Bank to privatise Cochabamba's water supply, as a precondition of the International Monetary Fund (IMF) and World Bank debt relief packages (Schultz and Draper 2008). In 1999, the state contract was awarded to the sole bidder Bechtel, which was granted sole rights to all the water sources in Cochabamba. Part of the concession was the development of the Misicuni dam project. The cost of this project and the ruling against subsidies by the state for water customers led to water price increases of up to 200 % for some communities within 2 months of the concession being granted. The contract also threatened to co-opt the CWPs (see Crespo 2003). Protests began in 1999 and brought together rural irrigator communities, Cochabambinos from the urban centre and wealthy northern suburbs, and, some CWPs from the Zona Sur, which would develop into the Water War. The Water War was pivotal to the future of the CWPs. Firstly, the eyes of the world had turned to this small city during and following the uprising. International non-governmental organisations (NGOs) were keen to understand and support the development of communities that had struggled to develop their own water systems and fought of the neoliberal Goliath. This led to an influx of projects undertaken by international actors, and funding for grassroots organisations to pursue alternative development agendas. Secondly, the state would be forced to engage with communities as it became politically unviable to pursue policies that would extend utility provision in a way that could be perceived as undermining the role of the CWPs. By 2006, this idea of communities participating in the development of basic services had gained significant ground.

9.6 Grassroots Struggles for Water Rights and National Reforms to Realise the Right to Water

Speaking in 2006, 12 years after the introduction of the LPP and 4 years after the Water War, Abraham Grandiddyer, a local community leader, began mobilising communities around some of the popular misgivings of some residents towards LPP in the Zona Sur, and their aspirations for more meaningful involvement and an agency for local development processes (Grandiddyer 2006). Soon after, 49 CWPs in the Zona Sur convened to form an association that was committed to developing co-produced water services, under the banner of *co-gestión* (co-management). The *co-gestión* ideal would allow communities to deliver and manage decentralised water services with support from the state. The Association of Communitarian Water Systems of the Zona Sur and the Cochabamba department (ASICASUDD-EPSAS), was set up as a social organisation, which sought practical support from NGOs and the state to develop the technical and institutional capacity of water committees in the Zona Sur. Over time, ASICASUDD-EPSAS became a block that represented CWPs in low-income urban neighbourhoods in the reforms to realise the right to water that were initiated following the election of Evo Morales in 2006.

The Water War was the first in a series of rebellions against reforms that threatened to undermine established systems of environmental governance (Perreault 2008, p. 151). It was followed by further uprisings, notably the Gas Wars (see Spronk and Webber 2007) and smaller uprisings such as the movement in defence of El Oro Azul (Blue Gold) that resisted the exports of water to Chile (see Mamani 2006). These social movements provided pivotal support to Evo Morales during his election campaigns and shaped the influence post-election reforms. Morales, Bolivia's first indigenous president would go on to guide the development of the 2008 constitution based on indigenous and human rights, which was designed to reform the state around an inclusive and redistributive model. The right to water became a discursive umbrella under which the sector was reformed in an attempt to universalise access to water. In practice the process would involve reforming and consolidating a fragmented sector characterised by a high proportion of informal providers, who, following the Water War, had to be engaged tactfully.

9.7 Reforming the Water Sector Around Rights

There has been a Bolivian water law in place since 1906, it was amended by law 2066 in 1999 to recognise the diverse and varied public, private, communitarian water providers that exist across urban and rural parts of Bolivia, from CWPs to cooperatives, to large utilities and their rights and obligations (see Zegada et al. 2015). In principle, CWPs have been recognised by the state since 1999, but few were formally registered at the time, and fewer still have been subject to any form of regulation. Since 2006, the state has endeavoured to respond to certain practical

challenges such as financing and accessing and channelling new water resources (MMAYA 2012), by developing new institutions and investing in infrastructural development, discussed below. But the old and out-dated laws continue to hinder the development of the sector, and developing a new law has proved challenging. Diverse civil society groups have put tens of proposals forward, but it has proven particularly difficult to reconcile the various diverging framings of water rights by rural and urban community providers, utilities, irrigator groups and the state (see Walnycki 2013).

Institutional reforms under the banner of the right to water have sought to develop and consolidate a highly fragmented water sector. The Ministry for Water and the Environment (MMAYA) was established to coordinate the sector soon after Morales' election. 'The Authority for the Fiscalisation of and Social Control over Drinking Water and Sanitation' (AAPS) oversees regulation. The National Service for the Sustainability of Basic Sanitation Services (SENASBA) is responsible for ensuring the sustainability of all water providers through community development strategies and technical assistance, and is the first of its kind in Latin America. The Environment and Water Executing Agency (EMAGUA) and the National Productive and Social Investment Fund (FPS) oversee the implementation of programmes and projects formulated by the MMAYA. In practice, urban water provision continues to be delivered according to a municipal model, often through public utilities or cooperatives that are complemented by community water providers. To date, the institutional groundwork for these reforms has been undertaken, but the state is a long way off developing a new water law and a regulatory framework that can accommodate the 28,000 providers in Bolivia. But this is a work in progress and the Bolivian state received a 78 million US Dollars loan from the Inter-American Development Bank to develop and consolidate this model (MMAYA 2012).

The process is thus dependent on legislation, which has not been finalised and has been contested, although communities have been consulted. SENASBA has sought to work with organisations such as ASICASUDD-EPSAS to provide capacity building support to CWPs, but staff have expressed that they have limited resources and understanding of the thousands of water providers that exist in Bolivia today.[5] Innovative ideas for regulation have been considered, such as a process of legalisation supported by ASICASUDD-EPSAS, whereby CWPs apply for a licence to provide water services, and incremental regulatory frameworks are developed that focus on developing smaller providers. An employee of the national NGO *Agua Sustentable*, who has been supporting the process explained:

There were many discussions between the state and social organisations between 2001 and 2006. The central debate was about regulation. Traditional regulation was interpreted to be too punitive. So an alternative approach to regulation was put forward, which advocated communitarian management and required a different type of regulation, less punitive and more supportive, an important element of this was technical and capacity building support. This was where two processes joined the

[5] SENASBA official, La Paz, 16 November, 2010.

discussions around Law 2066[6] that began in 2001, and the ideas of the new government.[7]

The MMAYA and associated bodies have been working with NGOs and social organisations to develop inclusive water governance arrangements that incorporate and develop water providers, and as we will see in the following section, this is often through co-production partnerships.

9.8 Realising the Right to Water in the Zona Sur

Morales' first presidential term brought hope to the water sector. Significant individuals from social movements and NGOs who had been involved in the struggles and discussions during the 2000s were brought into the process. The Minister for Water Rene Orellana (2008–2010) had a background in policy research and implementation, and came from the national Bolivian NGO Agua Sustentable. Orellana advocated a programme of technical and capacity building support for CWPs, complemented by financial support and inclusion into consultation around reforms to the sector.

CWP leaders from ASICASUDD-EPSAS were invited to participate in consultations around the Right to Water in the new constitution and new water laws (see Campanini 2007; Campanini et al. 2008), subsequent reforms to the sector, and even to join a planning committee for the Misicuni dam.

ASICASUDD-EPSAS approached the process cautiously, insisting that a mix of public and community water networks premised on *co-gestion* is required for the right to water to become a reality in the Zona Sur. While members agreed with the principle that everyone should have access to safe and clean water, a 'human right to water' is not something communities have ever fought for.[8] Some members even expressed that human rights do not exist in the peri-urban Zona Sur, and were not useful to improve access to water locally, 'there are human rights in the cities but not here in the Zona Sur.'[9] This idea is premised on the sense that the state, and the social contract on which human rights are built is largely absent from the Zona Sur. Some water activists and commentators (see Crespo 2010) were concerned that reforms to establish the right to water posed more significant threats to the autonomy of water providers, and that services would be appropriated by the state, as expressed by Oscar Olivera.

> … the right to water has been converted into a method of expropriating these communal forms of water management… (the) state is making inventories of water sources and systems, and establishing that the state is now responsible for water provision…The state is

[6] Law 2066 was established to protect water systems and rights in 1999.

[7] Senior Agua Sustentable employee, Cochabamba, 7 November, 2010.

[8] Cumbre por el agua y el Saneamiento Básico, Cochabamba, 25 and 26 June, 2010.

[9] CWP Participant workshop on the right to water, Cumbre por el agua y el Saneamiento Básico, Cochabamba, 25 and 26 June, Cochabamba, 26 June, 2010.

> using the idea of the human right to water to do this. But there is resistance from the rural communities and the urban barrios against this.[10]

In the subsequent years, activists and organisations such as ASICASUDD-ESPAS tried to influence the development of equitable partnerships with the state. In practice the state did not co-opt communities, instead, there proved to be insufficient political commitment and investment in the idea. Furthermore, and as this chapter will demonstrate, the state has not considered some of the local social processes that can make or break community water services, nor has it sought to develop more integrated watershed planning and management processes that could support CWPs.

9.9 Co-Production in Practice

From 2008 to 2012 ASICASUDD-EPSAS were also the focus of several state-led capacity building and infrastructural interventions. The association was a recipient of EU finance through the Programme to Provide Support for Water and Sanitation (*Programa de Apoyo Sectorial en el Abastecimiento de Agua y Saneamiento* or PASAAS). The finance was channelled directly from the MMAYA to ASICASUDD-EPSAS, providing a funding pot that CWPs could access for infrastructural projects and upgrading. The process subverted the established municipal model of service delivery by creating a direct link between communities and the state. ASICASUDD-EPSAS also worked with the utility and the MMAYA to develop two major pipelines designed to deliver water from the public utility to the CWPs in two regions of the Zona Sur. One of these was funded by JICA and completed in 2012, although SEMAPA has been unable to provide water for the pipeline due to on-going water shortages. ASICASUDD-EPSAS proposed another decentralised south-eastern pipeline that would extend provision to CWPs across the Zona Sur as soon as the Misicuni dam is finished.

The PASAAS project was one such project that appeared to signal national support for an alternative decentralised model of water service provision, based on *co-gestión.* It provided a major source of finance for CWPs belonging to ASICASUDD-EPSAS to develop or upgrade infrastructure. In practice funds were distributed between 41 CWPs for constructing tanks, upgrading and extending of pipelines, and installing sewage systems. Most projects were completed by the end of 2011 leading to 8280 household connections, benefitting 41,400 people in the Zona Sur (ASICASUDD-EPSAS 2012). Newly-formed state institutions dedicated to improving the operations of community providers also implemented financial, technical and institutional capacity building initiatives. However, there have been no attempts to engage with or to develop solutions for the communities that continue to rely on vendors. These tend to be recently established informal communities

[10] Oscar Olivera, Red Vida Conference Mexico City, 15 October, 2012.

that exist on the edge of the city. In district eight, for example, 39 of the 73 communities are informal and do not have CWPs, because they face specific physical and social challenges. Their positioning on the slopes combined with an increasingly depleted and contaminated aquifer has meant that communities have not been able to excavate new wells like their more established neighbours. Secondly, it takes time to establish trust and communitarian practices with neighbours, so neighbourhood councils and community structures are fragile or not fully developed to the extent that they could organise or afford to develop infrastructure or buy water in bulk.

Under Orellana, NGOs operating in the region expressed that the state had recognised the potential to develop the committees and saw ASICASUDD-EPSAS as viable water providers, but that this had not been the case following his departure and under subsequent ministers.[11] By 2012, ASICASUDD-EPSAS disbanded as a result of diminishing funds and internal conflict, and there has been no concerted effort to form another group. Instead CWPs engage on a one-by-one basis with state programmes and institutions, often supported by technical NGOs operating in the region. Today, the Metropolitan Master plan to develop water services for Cochabamba has proposed to develop a metropolitan water company that would ultimately manage the distribution of Misicuni water. Water would be delivered in block to decentralised municipal providers, along with independent water providers in the region including CWPs. However, the experiences of the ASICASUDD-EPSAS CWPs in the Zona Sur demonstrate that there are significant hurdles beyond simply improving infrastructure if co-production partnerships are going to be able to significantly improve access to water for low-income communities. There has, for example, been a failure to examine the capacity of CWPs to deliver to all households, particularly the poorest, and the challenges that communities have faced in building and maintaining participation at the local level.

9.10 Building Equitable Access and Maintaining Participation

Agua Sur[12] was established as a CWP in 1999 and was a member of ASICASUDD-EPSAS and part of the PASAAS project. When Agua Sur began operating in 1999, water was available to all members for at least a few hours every day, and during this period almost all residents were members. It is estimated that 370 households over two barrios have access to the system, which is just over two thirds of the population. There have always been parts of Villa 15 de Febrero that have relied on aguateros for their water. As the Zona Sur has grown, the committee has not been able to provide water to everyone as a result of dwindling supplies (which will be

[11] Interview with CEVI employee on 9 October, 2011.

[12] Pseudonym for a CWP in district eight where the author's doctoral research was undertaken.

Fig. 9.2 Agua Sur water tank

discussed later in the chapter) and infrastructural deficiencies. Members who had been in the barrio longer and who lived closer to the tank had better access to the service. The committee president Don Faustino[13] explained that just before they started upgrading the system in 2009, water was available twice a day for most residents, depending on where they lived in the barrio. Residents however, recalled that water was often only available a few times a week. Those living closer to the tank were able to access more water at the expense of the residents further away. This problem was often exacerbated by those who installed large water storage tanks that they would fill with committee water and use for the week and were not perturbed about restricting the water available to other committee members (Fig. 9.2).

The inequity of the system became more pronounced as the community outgrew the original water system. Newcomers took advantage of the substantially cheaper areas on the fringe of the barrio that did not have access to the system. These residents depended solely on water from aguateros, with most households relying on the water bought and stored in barrels. Finally, connection fees have increased over time. The PASAAS project funded the expansion of the water system to the whole barrio, but those who were not already members were faced with a join-up fee of 250 US Dollars, a common and contentious fee throughout the Zona Sur, which

[13] Pseudonym.

meant that the poorest residents on the south-eastern fringes could not afford the household connection.

Participation in water management has been advocated as a method of developing the institutional sustainability of a water system (Marshall et al. 2009), but developing community structures and maintaining participation can be tricky. Many of the communities that have CWPs have been in existence for 10–30 years. Recently established communities can be socially fragmented, and it might be difficult to develop relationships and sufficient trust to invest and co-manage a water system. CWPs are rarely found in the most recently established communities on the edge of the city.

As CWPs mature, there are fewer opportunities to participate in the running of the system and fewer opportunities for members to foster a sense of ownership over the system. In Villa 15 de Febrero,[14] workdays, which the community identifies as being key to sustaining participation, have become less frequent, and membership has become increasingly dependent on financial contributions and contractors, as opposed to participating in workdays.

Participation has become a burden for some and is even viewed as unfair. Being so close to the centre of the city, some residents feel that they should be entitled to the same services as those living in the centre. Communities that were involved in grassroots struggles for rights to provide water, now have aspirations to have equal rights to the city as their neighbours in the centre.

> I have been a (CWP) member for two years, there used to be water on a Sunday, but it was quite saline, we used to have to participate in the water meetings, but we have to participate in lots of meetings for all our basic services… it's not fair as it takes up so much of our time, not like those in the north… the *jalones*,[15] they don't have to go to meetings to get water.[16]

The proposed partnerships for delivering water services depends on communities managing water services, but the changing socio-economic composition of low-income barrios mean that the expectations and aspirations of residents change. CWPs that were previously prized as a communal achievement can become signifiers of unequal access to basic services and rights to the city.

9.11 Building Meaningful Partnerships for Water Provision in Low-Income Neighbourhoods

Community water providers have been woven into the Cochabamba waterscape as a result of policies that have directly or indirectly supported them over time. Their presence reflects deficiencies in service provision and water governance locally. However, their tenacity has provided a platform for low-income and politically marginalised groups to shape local and national water governance arrangements at

[14] Villa 15 de Febrero is a pseudonym.

[15] Derogatory term for the elites.

[16] Interview with resident of Villa 15 de Febrero, 1 August, 2010.

certain points. The relationship between the state and community water providers, particularly in the low-income settlements has always been unequal. These are communities that have been excluded from planning processes, branded as illegal, and denied the rights and services that citizens in the centre of the city have enjoyed. The alternative grassroots services and development processes that have emerged have sought to plug state insufficiencies, and at certain periods in recent history the state has sought to reciprocate, through funding and capacity building initiatives. These sporadic periods of engagement have hinted at co-production from time to time, but have not been sustained or characterised by substantial, long-term resources or political commitment. The processes that serve as kindling to these periods of engagement need to be better understood, as do the reasons why partnerships are sustained or disappear in diverse contexts. In urban water sectors characterised by high degrees of informality, which are widespread across Latin America, informal water providers have the scope to contribute to the delivery of water services. They can also provide opportunities for low-income communities to participate in decision-making processes and the development of democratic water governance arrangements (see Allen et al. in press). However, tolerating informal water provision is not the same as building a partnership, and on their own, community water providers face significant institutional challenges that undermine their capacity to deliver equitable access. Equitable, universal access and the human right to water, has to be guaranteed by the state, and cannot fall on the shoulders of low-income groups.

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Chapter 10
Water Remunicipalisation: Between Pendulum Swings and Paradigm Advocacy

Emanuele Lobina

Abstract This chapter considers whether remunicipalisation – the return of water services to public ownership and management following the termination of private operating contracts – has a role to play in the future of the urban water sector. It does so by looking at the process of remunicipalisation in Berlin, Germany and Buenos Aires, Argentina. Attention is paid to the interplay of: (1) pendulum swings between competing paradigms of water service management; (2) the paradigm advocacy resulting in the dominance and emergence of paradigms at local level; and, (3) the conceptual tensions between communitarian and privatist paradigms of urban water management. In both cases, the rigidity of the privatist paradigm has led to the emergence of the communitarian paradigm. Two different processes of remunicipalisation are observed: explicit paradigm advocacy in Berlin, and tacit paradigm advocacy in Buenos Aires. In neither case has the passage from private to public ownership automatically led to the dominance of the communitarian paradigm. Indeed, the causal relationship between remunicipalisation and progressive change is not one of necessity but rather of possibility. Nonetheless, the emergence of water remunicipalisation as a global trend in the last 15 years has profoundly reconfigured institutional trajectories in the urban water sector. The dominance of the privatist paradigm is now challenged in the global North and South and will continue to be in future. This is due to persistent demands by communities for water to be treated as a social good, and the shortcomings of water privatisation as a community development tool.

10.1 Introduction

In the global North and South, the urban water sector is at a crossroads and its institutional trajectories remain as uncertain as ever. For more than three decades, international organisations like the World Bank have relentlessly promoted water

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privatisation. This neoliberal project has been promoted in tandem with a number of national governments and the multinational corporations that stand to benefit from increased business opportunities (Lobina and Hall 2009). The promotion of water privatisation has been underpinned by theories predicting 'state failure' (Bakker 2013) and prescribing private sector management in view of superior private sector efficiency (Lobina 2013). This theoretical armoury, also described as public choice ideology (Self 1993), emboldened the World Bank to assert that 'there is no alternative' to water privatisation (Hall and Lobina 2009a, p. 82). Yet, developments in the last 15 years have exposed the intellectual fragility of this theoretical and ideological armoury and an increasing number of governmental authorities and local communities have refused to subscribe to the only alternative that they were offered under this neoliberal project. While the policy preferences of the World Bank and other mainstream actors remain unvaried, these developments are causing the redefinition of urban waterscapes.

The first development is the failure of the academic community to find evidence of superior private sector efficiency (Bel et al. 2010), which exposes arguments of 'state failure' as a caricature of the public sector and a romanticisation of the private sector. The second development is represented by the widespread social resistance against water privatisation (Hall et al. 2005; Lobina and Corporate Accountability International 2014), which questions both the desirability and the feasibility of the neoliberal project. The third development is closely related to the first two and consists in the increasing termination and remunicipalisation of privatised contracts. The major cities that since 2000 have decided to close the book on water privatisation and remunicipalise water services by bringing them back under public control include Atlanta, USA; Dar es Salaam, Tanzania; Jakarta, Indonesia; La Paz, Bolivia; and the symbolically powerful case of Paris, France (Kishimoto et al. 2015). Together with the fact that the overwhelming majority of the world's cities are served by public water operators (Lobina and Hall 2008), the emergence of water remunicipalisation as a global trend (Lobina 2015, 2016) is upsetting neoliberal plans to turn privatisation into the globally dominant form of water service provision.

Water remunicipalisation consists in the return of urban water services to public ownership and management following the termination of private operating contracts. It also represents a new form of water service provision that goes beyond ownership change to incorporate collective aspirations for social and environmental justice and offer new possibilities for creating progressive water policies (Lobina 2015, 2016). Increasingly, cases of water remunicipalisation are associated with progressive change including improved access and service quality, and enhanced democratic governance (Lobina et al. 2014). In addition, the public sector has historically made a decisive contribution to the universalisation of access to water services in the global North (Hall and Lobina 2009b) and the expansion and strengthening of water service provision in countries of the global South such as Brazil and Argentina (Castro and Heller 2007). These precedents bode well for the potential contribution of water remunicipalisation to progressive change. Therefore, understanding the process of water remunicipalisation is of high policy relevance

and instrumental to charting trajectories of institutional reform in the urban water sector.

This chapter is concerned with the process of remunicipalisation as a paradigmatic policy change (Hall et al. 2013) and aims to ascertain whether remunicipalisation has a role to play in the future of the urban water sector. While Hall et al. (2013) predict institutional trajectories towards remunicipalisation by focusing on the macro-dimension of urban water reform in two northern countries, this chapter does so by looking at its micro-dimension in a northern and a southern city. To broaden the representativeness of the case studies, the chapter looks at one case of remunicipalisation in the global South (Buenos Aires, Argentina) and another in the global North (Berlin, Germany). Both cases explore the tensions between paradigms of water service management leading to and following the implementation of remunicipalisation.

This chapter is structured as follows. The next section outlines the main policy paradigms in water service provision. The third section contains an overview of extant research on water remunicipalisation as an emerging global trend, and serves as background for analysis. Particularly useful here are the observation of the extent and acceleration of the international diffusion of water remunicipalisation. The fourth and fifth sections present the two case studies. In the concluding section, the similarities identified between the process of remunicipalisation in Berlin and that in Buenos Aires allow for confirming some of the findings of Hall et al. (2013) and for qualifying others. In turn, this allows us to suggest new directions for future research.

10.2 Paradigms of Water Service Management

This chapter is concerned with the social forces and factors that underpin the process of remunicipalisation, to consider whether policy advocacy will be conducive to the expansion of remunicipalisation in the future. Events leading to water remunicipalisation in the chosen case studies are interpreted with the aid of a framework that consists of: (1) Polanyian pendulum swings between competing paradigms of water service management, occurring at global level as a result of policy diffusion (Hall et al. 2013); and, (2) the paradigm advocacy, or the collective action and discourse resulting in the dominance and emergence of paradigms at local level (Lobina 2012).

As conceptual benchmarks for the orientation of institutional change in the pursuit of sustainable water development, urban water management paradigms can be defined in function of the principles that inform the ethos of water service operators (Lobina 2012). The communitarian paradigm conceives water as a public or common good and access to water as a human right. It also upholds community development and social equity as the ultimate goals of water service provision, whether this is pursued through state or community involvement. This paradigm advocates the subsidisation of water pricing to favour universal service access. The neoliberal or

privatist paradigm views water as an economic good or a commodity and rests on the centrality of the market as a regulating mechanism, of water privatisation as a form of delivery, of efficiency as the goal of provision, and full cost pricing as a financial mechanism (Castro 2009; 2016, forthcoming; Bakker 2007, 2008). Therefore, the communitarian and privatist paradigms are incompatible because they rest on two opposite conceptions of the nature of water service provision, respectively considering water as a public good and a commodity. The two paradigms also rest on two opposite conceptions of the means of water service provision, respectively emphasising the deployment of collective and individual property rights for the organisation of service delivery (Bakker 2008).

Drawing on Hall et al. (2013) and Lobina (2012), it is possible to summarise the analytical framework thus. The process of water remunicipalisation unfolds at the intersection of pendulum swings and paradigm advocacy. At the global level, pendulum swings between the communitarian and the privatist paradigm shape the normative environment for reforming water services. Local governance, collective action and governmental decisions on water service reform and ownership change are in fact influenced by the dominant paradigms produced by such pendulum swings. Policy diffusion mechanisms such as emulation and coercion represent a vehicle for the transmission of influence from global to local governance systems. At local level, actors form advocacy coalitions to reform local water services in reaction to the pendulum swings resulting from the international experience with water service reforms. Advocacy coalitions thus promote competing paradigms of water service provision. The conceptual tensions between the communitarian and the privatist paradigm, reflecting the tensions between irreconcilable ideas of water service provision, inform paradigm advocacy. The persistence of these tensions means that the problem of who and how should provide water services can only be reinterpreted but not solved (Lobina 2015, 2016), so that the pendulum cannot be expected to cease swinging (Hall et al. 2013).

10.3 The Emergence of Remunicipalisation as a New Form of Water Service Delivery

In the last 15 years, water remunicipalisation has emerged as a global trend. Kishimoto et al. (2015) identify 235 cases of water remunicipalisation that occurred in 37 countries from March 2000 to March 2015. Water remunicipalisation is diffusing across high-income, middle-income, and low-income countries, albeit to different degrees and at varying velocities. The remunicipalisation trend shows a marked acceleration in high-income countries where 55 cases occurred between 2005 and 2009 and 104 cases took place between 2010 and early 2015, nearly doubling the pace of remunicipalisation in the global North (Lobina 2015, 2016). The observation of the remunicipalisation trend in selected European countries has induced more than one observer to refer to an on-going pendulum swing in favour of public versus

private water operations (Wollmann 2013; Hall et al. 2013). However, it is the list of major cities that in different geopolitical contexts have decided to remunicipalise water services since 2000 that better suggests the importance of this emerging trend. This list includes: Accra, Ghana; Almaty, Kazakhstan; Antalya, Turkey; Atlanta, USA; Bamako, Mali; Berlin, Germany; Bogota, Colombia; Buenos Aires, Argentina; Budapest, Hungary; Conakry, Guinea; Dar es Salaam, Tanzania; Jakarta, Indonesia; Johannesburg, South Africa; Kampala, Uganda; Kuala Lumpur, Malaysia; La Paz, Bolivia; Maputo, Mozambique; Paris, France; Rabat, Morocco (Lobina 2015, 2016).

To appreciate the significance of the global remunicipalisation trend for the possible institutional trajectories of the global water sector, the above data require contextualisation. First, the global remunicipalisation trend is happening despite the considerable resources that international financial institutions have produced since the 1990s to promote the diffusion of water privatisation, and despite renewed initiatives to promote water privatisation (Lobina et al. 2014). Second, the fact that so many flagship privatisations of the 1990s have failed and have been prematurely terminated and remunicipalised points to the unsustainability of water privatisation. Third, these developments are at the same time redefining urban waterscapes, and opening the prospect for future changes in urban waterscapes. Decision-makers are in fact questioning the credibility of water privatisation, especially in light of the symbolically powerful remunicipalisation in Paris (Pigeon 2012), as recently acknowledged by French water multinationals (Lobina and Corporate Accountability International 2014).

Both in the global North and South, remunicipalisation is diffusing more rapidly in countries where water services have been privatised more extensively. This is the case in France where there have been 94 cases of water remunicipalisation from 2000 to 2015, with an acceleration that is unparalleled anywhere else in the world. This is also the case in Argentina, one of the countries of the global South that privatised most extensively in the 1990s, and where there have been eight cases of water remunicipalisation from 2000 to 2015 (Kishimoto et al. 2015). The relatively limited diffusion of remunicipalisation in countries like Germany compared to France can be explained by the fact that, like in the rest of Europe and the rest of the world (Lobina and Hall 2008), privatisation concerns only a minority of water operations. This narrows the opportunity for remunicipalisation.

The drivers for remunicipalisation often include civil societal and local governmental discontent with privatisation. This discontent stems in large part from the private sector's failure to meet theoretical expectations of superior efficiency and deliver on its promises to enhance sustainable water development. The false promises of water privatisation that have led to remunicipalisation include: poor operational performance of private companies (e.g. in Dar es Salaam, Accra, Maputo), under-investment (e.g. Berlin, Buenos Aires), disputes over operational costs and price increases (e.g. Almaty, Cochabamba, Maputo), soaring water bills (e.g. Berlin, Kuala Lumpur), difficulties in monitoring private operators (e.g. Atlanta), lack of financial transparency (e.g. Grenoble, Paris, Berlin), workforce cuts and poor service quality (e.g. Atlanta) (Lobina et al. 2014). In many cases, both in the global North and South, social mobilisation led to local governmental decisions to termi-

nate unsatisfactory private contracts and remunicipalise water operations (Hall et al. 2005; Lobina et al. 2014).

What makes water remunicipalisation a new form of public service delivery beyond ownership change are the aspirations for social and environmental justice that inform social mobilisation and collective demands for the return to public services, and the opportunities that remunicipalisation offers for innovative and emancipatory urban water trajectories. These opportunities are for the adoption by public service providers of institutional and operational policies consistent with the communitarian paradigm. For example, remunicipalisation has led to the introduction of advanced forms of public participation in decision-making – with civil society representatives sitting on the Board of Directors of the new public water operators – both in Grenoble (Lobina and Hall 2007a) and Paris, France. In Paris, efficiency savings obtained after remunicipalisation allowed the new public enterprise to reduce tariffs, increase financial contributions to poor households, launch a water saving campaign, and refrain from cutting off water supply in squats (Sinaï 2013; Pigeon 2012). However, the policy process of remunicipalisation can be characterised by tensions between competing paradigms. In Jakarta, Indonesia, a civic campaign has demanded the remunicipalisation of a water concession and used a citizen lawsuit evoking the respect of the human right to water to achieve this aim (Zamzami and Ardhianie 2015). These aspirations for collective ownership to realise collective civil rights, consistent with the communitarian paradigm, have been met with a governmental proposal to corporatise and part-privatise the local water operator, a proposal inspired by the privatist paradigm (Jacobson 2014). To explore similar tensions between paradigms, the chapter proceeds by looking at the remunicipalisation processes in Berlin and Buenos Aires.

10.4 Water Remunicipalisation in Berlin, Germany

Preparations for the privatisation of Berlinwasser (BWB), Berlin's water operator, started with its commercialisation in 1994 when the Senate of the city-state of Berlin decided to restructure the public company under private law. The Senate of Berlin then decided to privatise BWB by selling part of its capital (Lanz and Eitner 2005). This initiative was motivated by the prospect of turning BWB into a company making profits for its public owners by operating international contracts. Eventually, the Senate of Berlin decided to privatise BWB by selling part of its capital to the private sector. This decision was presented as 'a necessity in the face of rising city debts' and as an opportunity to make BWB an important commercial player in the global water market (Beveridge 2012, p. 56). The inevitability of the partial privatisation of BWB was accepted by most political parties represented in the Senate (Beveridge and Naumann 2014).

The decision to privatise BWB occurred in an economic and fiscal context shaped by the fall of the Berlin wall in 1989. In fact, this had led to the collapse of previously subsidised industries in both parts of Berlin and to widespread job losses in

the public sector, causing mounting debts for the local government. Also, the decision to privatise was made in a historical moment when the promises of commercialisation, privatisation and globalisation were uncritically discussed (Beveridge and Naumann 2014). In the 1990s, the pendulum was widely believed to be swinging in favour of water privatisation (Wollmann 2013). The dominance of the privatist paradigm at local level was thus facilitated by the influence of pendulum swings and by policy diffusion in the form of emulation or, more precisely, conformity with the prevailing norms of behaviour.

In 1999, 49.9 % of the shares of BWB were sold to a consortium including multinationals RWE and Veolia. The agreement provided for a return on equity for the private shareholders to be eight per cent, and this level of profitability would be guaranteed by the state of Berlin for 28 years. The private contract was highly controversial as it led to 'severe under-investment' and the explosion of prices (Händel 2013; Lanz and Eitner 2005). These arrangements were consistent with the privatist paradigm and its uncompromising belief in water as an economic good to be fully costed, and on the centrality of the market as a regulating mechanism needed to achieve efficiency. Another practice consistent with the privatist paradigm as well as the interests of the private shareholders was keeping the private contracts commercially confidential so that the favourable treatment of private sector interests could not be challenged by public opinion (Beveridge and Naumann 2014).

The controversy surrounding the private contract, fuelled by dramatic price increases, favoured social mobilisation against water privatisation. In 2007, the citizens' group *Berliner Wassertisch* (Berlin Water Table) started campaigning for the disclosure of the confidential contracts, and obtained the support of environmental groups and other social movements. Frustrated with the left-wing city government's acceptance of water privatisation, the campaigners decided to use a public referendum to force the Senate to amend legislation and publish the secret contracts. The Senate responded by engaging in a legal standoff with the campaigners to prevent the referendum from taking place (Beveridge and Naumann 2014). Nonetheless, in February 2011, over 660,000 Berliners voted in favour of the proposition 'Berliners want their water back' turning the popular referendum into a triumph for the campaigners (Terhorst 2014). The referendum had made the private contracts so unpopular that, in the city elections of September 2011, remunicipalisation 'was in the manifesto of three of the four major political parties, despite the fact that Berlin still [had] huge debts' (Beveridge et al. 2014, p. 66). The contract was terminated as the state of Berlin bought back the shares owned by RWE in April 2012, and the shares owned by Veolia in September 2013 (European Water Movement 2013).

The aim of the referendum was not confined to the mere publication of the private contracts but included remunicipalisation. Drawn by the Berlin Water Table, the charter on the management of the remunicipalised BWB shows that the campaign for remunicipalisation in Berlin had been inspired by the communitarian paradigm. The Berlin Water Charter states that BWB must serve the common good, universal access to water in Berlin should be guaranteed as a human right, water should be affordable for all Berliners, and direct democratic participation in BWB's decision-making should be guaranteed (Berliner Wassertisch 2013). However suc-

cessful the referendum campaign in promoting BWB's remunicipalisation, other factors might have played a role in orienting public opinion and ultimately governmental decision-making in favour of public ownership. For example, policy diffusion and the emulation of Potsdam and other German cities that had previously remunicipalised water services also proved influential (Beveridge and Naumann 2014).

The tensions between the communitarian paradigm, as enshrined in the Berlin Water Table, and the privatist paradigm that informed the conduct of the privatised BWB are apparent. Testament to these tensions is the rejection by the Berlin Water Table of any form of future privatisation or part-privatisation of water operations, 'not even in the context of so-called public-private partnerships or similar models' (Berliner Wassertisch 2013, p. 2). But the tensions between the two competing paradigms remain, even after remunicipalisation, as the effects of privatisation continue to be felt. On the one hand, the total cost to taxpayers of the acquisition of BWB's private shares was EURO 1.3 billion 'which [would] be paid for through higher water bills over the next 30 years.' This financial burden casts doubt on the sustainability of water operations after remunicipalisation (Lobina et al. 2014, p. 8) threatening to undermine the aspirations of the Berlin Water Table for affordable and socially equitable charges. In this sense, the implications of a 2014 decision by Germany's Federal Cartel Authority to impose a 17 % price reduction and force BWB to pay EURO 254 million back to consumers[1] remain to be seen. On the other hand, the remunicipalised BWB has rejected calls for introducing advanced forms of public participation and has established a consultative consumer council[2] much in line with the practice of private water operators (Lobina and Hall 2007a). As the remunicipalisation process consolidates, these tensions between competing paradigms appear unlikely to be solved in the near future.

10.5 Water Remunicipalisation in Buenos Aires, Argentina

Preparations for the privatisation of water services in Buenos Aires began immediately after the election of Carlos Menem as President of Argentina in 1989. Menem implemented an extensive programme of privatisation as his administration declared a state of economic emergency justified by rampant hyperinflation. The decision to privatise water supply and sewerage in Buenos Aires was made by decree, without public consultation, and no alternatives to privatisation were discussed. The Argentinean Government was the leading actor in the advocacy coalition that promoted water privatisation. Other actors joined the coalition to support the

[1] Email communication from Carsten Herzberg, 11 April, 2015. For further details, see: http://www.bundeskartellamt.de/SharedDocs/Meldung/DE/Pressemitteilungen/2012/05_06_2012_Wasser-Berlin.html;jsessionid=A4390F5E224B8CFE9D8E2F395DE6CCB6.1_cid387?nn=3591568

[2] See http://www.bwb.de/content/language1/html/14273.php. I owe this insight to Carsten Herzberg.

implementation of the privatisation. The World Bank provided technical assistance and advice on selecting the concessionaire and the World Bank's International Finance Corporation later became a minority shareholder of the private operator Aguas Argentinas. Offered a 10 % shareholding in Aguas Argentinas, the main trade unions assuaged their resistance and, convinced of the inevitability of privatisation, turned into supporters of water privatisation. Public opinion was conquered by the governmental discourse that privatisation was the necessary cure for hyper-inflation and that there was no alternative to it (Loftus and McDonald 2001).

The neoliberal paradigm therefore became dominant as the macroeconomic crisis restricted the range of policy options that public opinion considered as realistic. Policy emulation contributed to reinforce the dominance of the privatist paradigm. For example, the World Bank-funded team of legal and financial consultants who assisted the privatisation process was UK-based (Loftus and McDonald 2001). They could thus draw on the experience of the 1989 water privatisation in England and Wales, an example that influenced the emergence of the privatist paradigm elsewhere (Lobina 2005b). But the dominance of the privatist paradigm in Buenos Aires can also be explained by the latency of the communitarian paradigm in collective discourse in a context of anaesthetised dissent. Social mobilisation failed to challenge the dominance of the privatist paradigm even as private water operations generated increasing controversy (Loftus and McDonald 2001).

In May 1993, a consortium led by Suez-Lyonnaise des Eaux started operating the Aguas Argentinas concession. It was only 8 months later that Aguas Argentinas requested to renegotiate the contract, beginning a pattern of escalating bills, underinvestment and considerable profits. This pattern would persist until the collapse of the Argentine economy following the financial crisis of December 2001 (Azpiazu and Forcinito 2002; Lobina 2005a). Throughout this period, the profitability of the concession was prioritised over the achievement of social objectives. Network connections that proved unaffordable as a result of full cost pricing (Loftus and McDonald 2001) were financed through a solidarity tax on all consumers, with little contribution from the private operator or external finance. In addition, network connections in peri-urban areas were financed through a community contribution of labour and a municipal contribution of materials. Finally, to guarantee the remuneration of international shareholders, water charges were indexed to the US Dollar so that currency devaluation risk was transferred to local consumers (Hall and Lobina 2007; Lobina 2005a).

The December 2001 crisis was followed by years of legal confrontations between the concessionaire and the Argentine government. Aguas Argentinas' insistence on increasing water prices to compensate for the 2001 devaluation of the local currency conflicted with governmental requests for tariff reductions to avoid exacerbating the social and economic crisis (Lobina and Hall 2007b). In 2006, the government cancelled the concession contract and remunicipalised water and sanitation services by appointing the public operator AySA. Despite the change from private to public ownership, AySA was 10 % owned by trade unions like Aguas Argentinas used to be. Also like its private predecessor, AySA involved residents in expanding water access in low-income neighbourhoods (Azpiazu and Castro 2012). Conversely, the

practice of financing investments in the extension of the service changed following remunicipalisation. In October 2006, a long term investment plan of 5.69 billion US Dollars was approved to achieve full service coverage, 52 % of which was to be financed through tariffs and the remaining 48 % by the central and local governments (Lobina and Hall 2007b).

In the absence of prominent social mobilisation for remunicipalisation, the communitarian paradigm emerged in the wake of the December 2001 crisis as the Argentinean government refused to accept that the profit motive takes precedence over social considerations (Azpiazu and Castro 2012). A practice associated with the communitarian paradigm that has been introduced with remunicipalisation is the use of public finance to enhance affordability and service access (Lobina and Hall 2007b). This contrasts with the reliance on full cost recovery through tariffs and charges typical of the privatist paradigm as embodied by the Aguas Argentinas concession. However, elements of the two paradigms appear to coexist under the new public operations. The 10 % shareholding held by the trade unions in AySA is a marketised form of workers' participation in the workplace. Like the continued involvement of residents in the extension of network connections in peri-urban areas, this is proof of the lasting influence of privatisation. It is however not necessarily in contrast with the achievement of progressive change under remunicipalisation. Indeed, the fact that the public sector is not subject to the profit maximisation imperative allows for flexibility in allocating resources for achieving sustainable water development (Lobina 2013).

10.6 Conclusion

The two case studies presented in this chapter show how, operating at the macro-level of paradigmatic policy change, pendulum swings and policy diffusion provides the stimulus for paradigm advocacy at the micro-level of urban water reform. This exogenous stimulus has been illustrated in relation to opposite types of reform, privatisation and remunicipalisation, whose implementation is informed by paradigms that embrace irreconcilable notions of water service provision: the notion of water as a public good and a human right enshrined in the communitarian paradigm, and the notion of water as a commodity which characterises the privatist paradigm.

In both cases, the pendulum swing in favour of the privatist paradigm was favoured by a strong sense amongst policy participants of the inevitability of water privatisation. Also, the rigidity of the privatist paradigm and its unsuitability to address sustainable water development objectives has led to the emergence of the communitarian paradigm. This was accompanied by two different processes of remunicipalisation: explicit paradigm advocacy in Berlin, and tacit paradigm advocacy in Buenos Aires. In Berlin, an explicit advocacy coalition was formed between the Berlin Water Table and the social movements that supported the local referendum. In Buenos Aires, the Argentine government acted in conformity with the communitarian paradigm without engaging in concerted collective action. These different

processes have one commonality: they are explained by the irreconcilability of ideas of community development and the profit motive that is the cornerstone of the privatist paradigm.

Both in Berlin and Buenos Aires, doubts can be raised as to whether the passage from private to public ownership automatically led to the dominance of the communitarian paradigm. Indeed, the persistence of operational practices associated with the privatist paradigm points to a non-linear relationship of causality between the process and outcome of remunicipalisation. Otherwise put, the relationship between remunicipalisation and progressive change is not one of necessity but rather of possibility. The aim of this chapter is not to assess the outcome of water remunicipalisation, nor the results of path dependency in paradigmatic policy change. This is deferred to future work.

What the cases discussed here show is that, due to the rigidity of private operators in prioritising the profit motive over community development, social groups that uphold the communitarian paradigm and the idea of water as a human right will continue to mobilise against water privatisation. In addition, governments that recognise the unsuitability of privatisation to achieve ambitious sustainable water development objectives will continue to consider remunicipalisation as a credible policy option. The emergence of water remunicipalisation as a global trend in the last 15 years has profoundly reconfigured institutional trajectories in the urban water sector. The dominance of the privatist paradigm is now challenged in the global North and South and will continue to be in future. This is due to a combination of persistent demands by communities for water to be treated as a social good, and the shortcomings of water privatisation as a community development tool.

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Part IV
Water Politics

Throughout the work of many political ecologists, water has been used as an entry point to understand the politics of urban change, from the global to the household. Examining the different scales at which water politics are deployed simultaneously offers a unique perspective to explore the infrastructural power of the state and the market in othering 'illegal' or 'unauthorised' settlements and their dwellers, the collective agency of the urban poor in producing blue infrastructure in cities and how gender, class, ethnicity and age are negotiated to reproduce or challenge water inequalities.

The three chapters in this section present different routes to re-problematise the relationship between citizenship and urban water and sanitation systems, offering a critical consideration of how infrastructural paradigms, visions and projects constitute in-fact citizenship projects, through which different relationships between the state, the market and ordinary citizens are asserted, negotiated or contested.

Zooming into contemporary urban visions – from the Smart City to the Resilient City – White (Chap. 11) examines how planning narratives that advocate sustainable urban water trajectories are becoming a compelling way of understanding how current impacts and future pressures shape water politics. He argues that while such visions represent a significant shift from the techno-rational supply-oriented emphasis of the twentieth century, they still regard aspects such as land use change, new technologies and innovative policies as the most critical elements driving more sustainable and beneficial urban water trajectories. Taking a historical perspective, White invites the reader to explore the wider socio-political contexts within which change might occur. This reveals how path dependence and institutional, cultural and technological norms may resist attempts at change, before examining the actual challenges of effective policy transfer across what are distinct territories and contexts. The chapter concludes by discussing how water has become just one of an increasing number of competing urban visions fighting for attention, resources and action.

Adopting a comparative perspective, Brazilian geographer Ioris (Chap. 12) demonstrates the frailties of such conceptualisations in the face of the ongoing neoliberal transformation of global cities. He adopts a political ecology perspective to

contrast how neoliberal infrastructural planning has played out in Glasgow, an intriguing example of a post-industrial European conurbation, and Lima, a paradigmatic emerging megacity at the intersection of post-colonial legacies and market globalisation. Ioris argues that despite their idiosyncratic complexities, these two cases are highly emblematic of the controversies surrounding water governance. He notices that, in metropolitan areas, public participation has been appropriated by the same agencies that in the past promoted highly centralised, disjointed and politically-asymmetric administration. Furthermore, he argues that positive results from increased water services investments and rationalisation have been undermined by the discriminatory and short-term basis of urban water governance discourse and practice. This contrasting examination confirms the fruitfulness of adopting a comparative view across the so-called global North and South. The chapter concludes by highlighting the importance of finding new forms of engagement at various levels, which go beyond the dominance of market-based power within contemporary urbanisation.

In the last chapter of this section, Indonesian scholar Putri (Chap. 13) focuses on the relationship between water and citizenship by interrogating the conflicting historical territorialisation of domestic water management in the urban 'kampungs', formed in colonial Batavia (nowadays Jakarta) outside the enclaves of state-led planned settlements. Her analysis reveals how citizenship has been moulded and remoulded over time outside the modernity project of the colonial state through multifaceted territorial struggles over water and land management. Putri's historical exploration resonates with the reality that a large number of women and men still face in many post-colonial cities across the global south, where parallel infrastructural projects to those conceived by the state emerge and evolve outside officially recognised standards, utilising a diversity of socio-ecological networks to meet their inhabitants' water and sanitation needs. She concludes by arguing that the persistence of the kampungs' water and sanitation systems should be read not just as evidence of their socio-ecological relevance, but as potentially alternative paradigms of citizenship for an improved governance system in the urban water sector.

Reading urban water trajectories as a lens into urban politics allows us to grasp how rights and entitlements are enforced, protected, encroached, claimed and denied resulting in different and enduring trajectories of urban environmental (in) justice, across the global North and South.

Chapter 11
Past, Present and Future Urban Water: The Challenges in Creating More Beneficial Trajectories

Iain White

Abstract Alternative visions of cities that treat water more sustainably are becoming more compelling as understanding increases of current impacts and future pressures. Here, an alternative relationship between water, space and citizens is commonly advocated that represents a significant shift from the techno-rational supply-oriented emphasis of the twentieth century. In discussions connected to any transition to a more beneficial urban water trajectory, aspects such as land use change, new technologies or innovative policies are frequently held up as being critical elements. Rather than focus on any notional Water Sensitive City as an outcome to be achieved, this chapter complements this literature by critically examining the processes that may help or hinder transitions of this nature. It firstly explores the historical states of urban water management and links to the wider socio-political context within which change must occur. It then analyses issues related to the speed and scale of land use change, emphasising how every urban area has differing flows of finance, regeneration opportunities or free development space. The argument then turns to path dependence and how institutional, cultural and technological norms may resist attempts at change, before focusing on the difficulties in enabling effective policy transfer across what are distinct territories and contexts. It ends with a discussion on how water is just one of an increasing number of competing urban visions – from the Smart City to the Resilient City – all of which are fighting for attention, resources and action.

11.1 Urban Water: Introducing the Past, Present and Future

Water has been critical to where cities originate, their development, and the standard of living of their inhabitants. However, the relationship is complex, and in high-income nations it is easy to forget how vital the effective management of the resource

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is. We need continual availability and protection from its potential impacts: too much or too little water can have devastating consequences. To achieve this delicate balance, for the last 200 years or so water in cities has been predominately managed by a technocentric paradigm. Hard infrastructure places water where society needs it to be – captured and transported to people's homes and businesses, moved swiftly away in drains at times of precipitation, or enclosed behind embankments and walls to prevent damage. This approach has been widely adopted throughout the developed world and has laid the foundation for huge advances in economic growth, health and quality of life.

Yet arguments to rethink this strategy have been gaining in power, particularly over the last two decades, and calls for more sensitive and sustainable water management are becoming increasingly prevalent (Mitchell 2006; Bell 2015; Scott et al. 2013). Although a technocratic emphasis served to solve the arch nineteenth century problems of sanitation and water supply that were so closely associated with the emergence of the industrial city, as a corollary it also created the foundation for difficulties in the present that seem to resist easy resolution – from diffuse pollution, to surface water flooding, to expensive infrastructure provision (Douglas et al. 2010; White 2010). Critically, these are all predicted to worsen in the future. From the risks of climate change altering precipitation patterns (Intergovernmental Panel for Climate Change 2014), to rising urban populations (United Nations 2011), to talk of water and wastewater 'infrastructure crises' (Cromwell et al. 2007), it is clear that the future trajectory of urban water is going to be far from smooth and unproblematic.

It is also apparent that in many circumstances it is the water management orthodoxy itself that has created and is perpetuating these impacts, such as the historical view of water as being more of a hazard to be removed than resource to be retained, or long-standing norms of disciplinary involvement that privilege certain technical approaches. Perhaps counter intuitively, despite huge advances in science, technology, infrastructure and managerial practices, cities on all continents are grappling with water management as a key twenty-first century problem.

In response to a growing awareness of the undesirable impacts of long-held water management regimes, new ideas and concepts are becoming more prevalent. Here, water is increasingly seen as less distinctly separate from the built environment – an 'other' to be controlled – and more an intrinsic part of an urban metabolism; continuously shaping, enabling and producing (Gandy 2004). This metabolic influence can be viewed throughout the various elements of the city, whether in regard to the use of land, the behaviour of citizens, or the opportunity for economic or leisure activities (Heynen et al. 2006). Significantly, this viewpoint goes beyond its functionality and instead acknowledges the wider transformative potential of water: it shapes us, just as much as we shape it.

Emerging in parallel with these new relational understandings are discourses that advocate an alternative ontological view, such as the 'water sensitive city' (Howe and Mitchell 2012; Wong 2006) or 'water sensitive urban design' (Donofrio et al. 2009). Central to these normative perspectives is an engagement with the urban water cycle and increased integration between engineering and ecological

professions, with opportunities to redesign the city, change institutional and planning norms, or alter citizen interaction encouraged (Ashley et al. 2013; Carter and White 2012; Wong and Brown 2009). As water management is redefined as a transdisciplinary and integrative issue that has heightened importance in urban decisions, it is anticipated that the wider costs of water will be mitigated and the benefits will be more easily realised. It is important to note that future water visions like these are not necessarily deemed to provide a teleological end point or specific goal that needs to be achieved, rather by highlighting impacts and opportunities they serve to emphasise the need and rationale for change more broadly (Brown 2012). Above all, they persuasively recast water as a valuable resource; one which if managed correctly can bring a wide range of environmental, social and economic advantages to a city.

However, despite emerging critique the predominant managerial regime for urban water has proved remarkably resistant to change. While a host of factors from construction, materials or modelling have been improved, crucially, the overall methodology that frames the management of urban water remains steadfastly instrumental, technical and rational. Indeed, the modern systems in place in most countries today would be readily recognisable to those pioneering water engineers of nineteenth century Paris or London. The approach has also been supported by parallel technical advances in areas such as science, modelling or engineering. As a result, this bespoke expertise is also given a powerful capability and mandate to act, with dedicated agencies and funding streams established to deliver more of the same modes of infrastructure and manage these significant assets to create shareholder value.

It is valuable to take a step back and observe not just *how* we manage water, but the wider social, economic and institutional aspects that both serve to underpin and perpetuate this approach. As a consequence, despite calls to adopt the principles of a more water sensitive city this has proved a difficult transition as it is not just an infrastructural problem, but rather one embedded in science and society more generally.

This chapter unpacks how this situation has occurred, examining how actions in the past have created the present relationship between water and urbanity and focuses on the processes that may help or hinder and future transitions. The chapter highlights how resistant to change water management practices have become, being underpinned by historic land uses and scientific approaches, disciplinary silos and governance structures, and locally competing policies and priorities. In recognising that the problems of the present have their seeds in the past, the argument is focused on exploring the issues that may inhibit the ability to generate and normalise a more sustainable urban water future.

11.2 Contextualising Change: The Journey, Destination and Milieu

There have been a number of attempts to delineate a typology that is able to succinctly capture and summarise the historical states and trajectories of formalised urban water management since its initial development in the nineteenth century. For example, in a study of Australian cities Brown and her collaborators (2009) identify six states that are presented as operating as a nested continuum. The first three of which, the 'Water Supply City', the 'Sewered City' and the 'Drained City', represent a loosely historical chronological view, while the 'Waterways City', the 'Water Cycle City' and the 'Water Sensitive City', are less readily visible with the last of which being a desirable destination to move towards. They further highlight the importance of 'disturbances' that facilitate innovation, adaptive capacity and the possibility of differing trajectories taking place. Alternatively, Gandy (2004) suggests that the initial public health phase could be clearly considered as akin to a 'bacteriological city', but that distinct typologies since this time they are more difficult to precisely ascertain. Since the late twentieth century political economy aspects such as fragmentary pressures, privatisation trends and shareholder value are all increasingly in evidence and he argues that notions of linear characterisations of discrete transitions between well-defined states have instead become subsumed within a more messy relational and hybridised metabolic system.

These examples are both useful in explaining how perceptions of the water in cities have altered temporally and ideologically. More pertinently to this chapter these twin stances point towards how we can understand the processes of change. Here, the debates in this area tend to be twofold; either a form of solution-focused urban Darwinism, perhaps incorporating futurist discussion of a utopian state to gradual transition towards, such as demonstrated by the 'Water Sensitive City' (Howe and Mitchell 2012), 'Water Centric Sustainable Community' (Novotny et al. 2010), 'Absorbent City' (White 2008) or a more generalised form of 'Blue Urbanism' (Beatley 2014). On the other hand, discussion focuses on the social and political spheres, where the instrumentalism of urban water infrastructure is considered indivisible from the broader societal contexts within which it operates. From this perspective, developments in capitalism and neoliberalism have shifted the emphasis away from the strong early focus on achieving universalism of supply towards the present configuration where water is routinely seen as a means to produce private profit. As a consequence, the resource – and any possible transition – is redefined as being heavily subjected to politics, conflict and power (Swyngedouw 2004).

Together these literatures offer valuable perspectives for understanding issues connected with urban water trajectories. They highlight how societal expectations change over time, identify a number of possible 'best practice' models to shift towards, and also emphasise the intensely political, economic and cultural arenas within which urban water issues now find themselves. Indeed, the tight links between water and politics have led to urban water being described as operating as

a ‘sociotechnical system’ (Graham and Marvin 2001, p. 8) where a ‘hydro-social contract’ (Lundqvist et al. 2001, p. 355) can be seen to exist. What is clear is that any discussion of trajectories needs to be positioned within both a discussion of outcomes and a consideration of the processes and milieu within which those may be achieved. In short, any transitions are grounded in the nature of a place.

It is within this context that the following discussion is situated; one where notions of change may be more incremental than fundamental, and where future cities are used as a means to analyse current processes and practices rather than as a distant teleological goal. What is common is that alongside an increased understanding of water impacts and pressures, there are consistent calls for a more sustainable shift in urban water systems. However, in addition to the thorny subjects of politics and power, any transformation also needs to occur within a spatial planning context, which is itself highly political. This chapter now turns the discussion towards the realities of enabling land use change of this nature, in particular emphasising how previous decisions and current frameworks offer resistance to meta-narratives that aim to promote thematic urban visions.

11.3 Exploring Land Use Change: Speed, Scale and Competition

In debates connected to any transition to a more beneficial water trajectory, a different urban form is frequently held up as being a critical element. Here, an alternative relationship between water, space and citizens is advocated over multiple scales in order to influence demand and supply, or limit wider societal impacts. For example, urban sprawl is a very expensive way to live. Not only does it carry significant economic demands for new infrastructure provision but it locks those costs into future maintenance regimes for decades to come. Therefore, densification is usually recommended as it plugs houses into existing water networks, reduces the need for new infrastructure and limits the wider impact of sprawl on the environment (Spier and Stephenson 2002). Equally, at a smaller spatial scale more sustainable approaches to manage water within the urban area are widely advocated as a means to reduce diffuse pollution (White and Howe 2005; White and Alarcon 2009), as are building scale measures concerning recycling greywater or blackwater on site, or adopting Water Sensitive Urban Design techniques (Wong and Brown 2009). What these aspects all have in common is a desire to control the location and function of development, and to engender new behaviours. They also tend to link to the planning system as the main mechanism able to exert influence over development – but how malleable is the urban form? And how receptive are industries and people to these possible changes? Questions such as these are critical in debates concerning urban water futures as not only may change be resisted, but previous land use decisions have a surprising longevity and stickiness regardless of the desirability of any new plans.

A good historic example to illustrate this point concerns the Great Fire of London in 1666. The fire burned over four days, quickly devastating parts of central London and the nature of the urban form played no small role in this. The predominately wood and pitch building materials used were highly flammable, while the labyrinthine design and narrow distance between overhanging buildings both allowed the fire to spread quickly and made access difficult for the citizen fire fighters. The scale of the loss was staggering. It is estimated that around 13,000 homes were destroyed and a huge portion of the city was in need of complete reconstruction (Platt 2004). However, this volume of newly available development space creates opportunities too. The day after the fire was extinguished Sir Christopher Wren proposed a new design for London to King Charles II, one that would create an urban form less susceptible to this particular risk. It was modelled on the wider, grand Boulevards in evidence across much of Europe and provided a striking difference to the compact and twisting medieval pattern in place at the time.

Yet, despite the enormous power of the monarch and the desire for change, Wren's plan was never implemented and the reasons why are exactly the same as why a similar notion to redesign a city would be so difficult to execute in the present: individual property ownership. Simply put, after the flames died down people had the desire and the right to rebuild and carry on as before. Even as far back as 350 years ago, where power was extremely concentrated and where there was a much simpler legislative and political context, plans to transition to a different urban future proved impossible to implement. In the absence of huge state intervention designed to buy up differing plots of land it proved unworkable; the grand scheme could not disregard the context of the burgeoning mercantilism of the time, just as much as we could not discount norms of individual freedoms and capitalism in the current period.

An alternative approach to rapid wholesale change is that of incremental transition as new development and regeneration provides opportunities to gradually reshape and recast the urban form. From this perspective a plan to adopt the principles and practices of a more water sensitive city is a long term objective; not just a distant outcome, but also a process or means to influence an array of decisions concerned with water, space and society. There is an inherent logic to this approach, not only does the planning system enable the state to influence development proposals in this manner, but strategic planning elements also allow plans to be consulted, agreed upon and made statutory. Therefore, if a vision was implemented in this manner it should have a mandate and an effect. However, even if this could be achieved there are still a number of factors that could impede the effectiveness of this tactic; most notably the speed and scale of change, and competition over the uses of space associated with capitalism.

With regard to the first of these elements, research detailing the annual rate of all urban change from a city perspective is surprisingly thin on the ground. The rate and spread of urban sprawl receives attention (e.g. Siedentop and Fina 2012). There are also statistics in many countries regarding new homes built, greenspace loss, or land use change from, say, agriculture to residential (see, for example, Department for Communities and Local Government 2014), but these are not necessarily in the

specific form that this query demands – which is the overall rate of development churn of new *and* existing urban areas regardless of formal changes in land designation. Here, for instance, any development provides the ability to influence the relationship between water and society, even if the category of land use remains constant. Yet, even if figures on this topic were available they may not represent a long enough time span, or reflect the dynamism of socio-political pressures, to enable the data set to allow robust judgements to be drawn regarding the speed of any future urban transformation. The paucity of data, therefore, is partly due to the emergent nature of strategic spatial analysis of this nature, which has developed rapidly alongside the increase in computing power and visualisation tools such as Geographical Information Systems, but it is also connected to the difficulty in compiling such information in a way that makes sense.

This leads us onto our second point, as scalar issues would also come to the fore. From the onset, there is an epistemological problem endemic to the field of urban studies more generally concerning where to draw the lines around a settlement to allow easy spatial comparisons. It is just the city, or does it include suburbs, peri-urban areas, or city-regions? It is something connected to metropolitan form or the more functional relations that may not be so easily delineated? New urban terms also evolve, each with their own theoretical, epistemological and ontological frames, casting further doubt over the clarity and specificity of the research object. Over recent years the spatial lexicon continues to gain in sophistication to the extent that it has now been posited as being in an unstable state of continual creation and dissolution, where new post-this and post-that labels jostle alongside the ongoing development of emergent concepts such as Edge Cities or Limitless Cities (Taylor and Lang 2004). This maelstrom of creative destruction goes beyond semantics and instead provides a problematic context within which to consider the feasibility of a stable and long-term transition to any *single* discrete urban concept.

To compound matters, not only does the potential research object have a tendency to expand its boundaries, but within a city there is huge variation: some areas are incredibly vibrant and experience a high turnover of development proposals, while others languish and remain largely unchanged for decades. Then there are the occasional natural or manufactured shocks, for example the Christchurch earthquake in New Zealand in 2011 or the IRA bomb in Manchester, UK, in 1996, both of which resulted in significant changes to core areas of the city within a very short time and gained huge political momentum of their own regardless of the state of the current plans in place. Simply put, when drawing conclusions regarding the rate of urban change it is hard to generalise due to the vagaries of development, space and capital. Even if ontological clarity is gained on a single vision, every urban area has differing flows of finance, regeneration opportunities, historical protection areas and free space.

While the discussion so far has mainly focused on land use change and the planning system, many of the aims of a more sustainable urban water future do not require planning permission, being connected to elements such as technology uptake, institutional operation or individual behaviour. The argument now explores

transitions research connected to these wider institutional, cultural and technological elements.

11.4 History Matters: Institutionally, Culturally and Technologically

This section highlights how any transition to a different urban form is heavily reliant upon a number of wider social, economic and cultural factors, building on the argument that the existence of plans of this nature are no guarantee of tangible progress, never mind success. With regard to technology, for example, the social context is vital to any uptake. Innovation can frequently be resisted by both people and policy-makers, whether because of an uncertainty over costs and performance, a lack of cultural legitimacy, ill-suited legislation, or institutional inertia – all of which can cast doubt on the potential of future technological solutions to solve emerging environmental problems. David (1985) uses the example of the QWERTY keyboard layout to illustrate this argument. This design was originally implemented to slow down manual typewriters, the keys of which had a tendency to stick with high-speed use, but it has continued through to the digital era despite other models being more efficient and easier to master.

A similar point can be made regarding the ability to implement the technological innovations that are frequently mooted as a solution to change the relationship between society and water. Here, new technologies may be championed that can reduce demand or capture water on site. As a result, it may be expected that developers and consumers will gradually move to the preferred approach. One of the problems in this regard is that experts and policy-makers often assume that their interventions are aimed at calculating, rational individuals where the only imperative is to convince people to use them (see Geels and Smit 2000). Following this assumption, consumers will make the 'correct' choices, and technology will transfer to practice. In reality, this is far from true. Guy and Shove (2000, p. 10) instead argue that: 'similar technical strategies do and do not make sense for different reasons and at different moments in time, and that their adoption depends on the sometimes competing perspectives and priorities of a whole network of organisational actors. Whatever else, the picture is certainly not one in which proven knowledge is seamlessly transferred from research to practice.' This societal complexity also provides a challenge to the remorseless rationality of neoclassical economics, where people are frequently assumed to act logically in response to market forces, and where more effective solutions will inevitably prevail.

The culture of institutions or decision-making further complicates matters. Water is governed by many differing stakeholders, each with their own perspectives and constraints. While traditionally urban water has predominately been considered as operating squarely within a supply-oriented logic under the auspices of the engineering profession, it is clear that the socio-political context and the temporal

aspects of transitioning to an alternative demand-oriented future means that it is also a concern for the social sciences and society more broadly. There may be contrasting frameworks or ways of knowing, which can privilege long-held approaches and resist the new working practices that any transition may demand. For example, norms in infrastructure provision are rooted in modelling, risk and cost-benefit analyses while those concerned with planning and land use change may have a remit for community engagement, more efficient spatial organisation or more intangible notions of place-making (Potter et al. 2011). Perhaps, most unlikely of all given international trends in neoliberalism and capitalism, is a government stance acknowledging urban water as a serious enough issue to warrant unprecedented state intervention in the market or new hybridised forms of governance involving as wide an array of actors and agencies as housing developers, multi-national companies, and individual homeowners. This represents a quandary at the core of all public policy initiatives: if plans are without power they may only have limited influence, but if they do then they may be less likely to be implemented.

In transitions literature, institutional, cultural or technological causality problems such as these tend to be neatly encapsulated by the phrase that 'history matters': decisions in the past shape decisions in the present – our path is partly laid (see Peters 2001). Here, parallels with evolution are seen to exist where reversibility is difficult to achieve, and the huge historic investment in infrastructure has effectively served to restrict current investment decisions or ways of working. The notion that future choices are constrained by previous decisions is known as 'path dependence', where system elements such as persistence or durability, normality seen as positive aspects, instead serve to replicate practices (David 2001). Path dependence can be weak or strong and occurs due to experiencing increasing returns from specific practices, and where positive feedback and self-reinforcement combine to 'lock-in' a prevailing trajectory (Page 2007). We can see how the provision of infrastructure or cultural norms of water use map clearly onto these criteria, but its effects are much more pervasive. For example, in a meta-analysis of factors that can inhibit the ability to deliver sustainable water management, Brown and Farrelly (2009) identified a typology of 12 barrier types, including issues related to community, resources, responsibility, knowledge, vision, commitment and coordination.

A useful aspect of the path dependence perspective is that it highlights how water practices have a deterministic dimension that means change may be actively resisted without enabling aspects such as issue champions or supportive contexts (Brown 2012). Simply put, any future Water Sensitive City is constrained by the means designed to deliver the previous Water Supply City.

11.5 Policy 'Mobility' and 'Transfer': Internationalisation in Local Contexts

Any urban water transition will necessarily have to navigate the world of policy; the encompassing and dynamic nature of which can be daunting. A host of socio-spatial initiatives, such as demand strategies, sustainable urban drainage policies and water efficiency targets, may all be in force and operated by a variety of stakeholders, and subject to changes in political emphasis or wholesale replacement as new trends and ideas emerge. The ongoing requirement to design, monitor, integrate and adapt policies, combined with restrictions on staff resources and time, means that policy development frequently takes ideas and proposals from elsewhere and seeks to convert these into local solutions as may be the case with urban water. More sustainable urban water futures are one such proposal, but while best practice, exemplar projects or agenda-setting initiatives can provide enormous assistance, policies that are successful in one place may not be effective in a different social, cultural or political context. The opening of the Guggenheim Museum in Bilbao in northern Spain as a means of driving urban renewal is a case in point. While it is commonly seen internationally as providing the catalyst for significant inward investment and the striking rebranding of the city as a cultural destination, it is a story that is highly unlikely to be replicated elsewhere, being a product of a particular place, time and context rather than an off-the-shelf policy product.

Peck (2003) highlights factors such as the internationalisation of conferences and consultancy firms, and the formation of new transnational institutions and professional networks as enabling and globalizing the policy transfer process. As such, the effective mobility and proliferation of policy ideas between places is much more complex than a simple focus on appropriation and translation. Policy is territorial and relational; being the product of locally dependent interests, actors and agencies, and its mobility can be dependent on as wide a range of issues as the flow of global capital to the local practice of power (McCann and Ward 2011). This situation is made even more complex by considering how global capitalism demands competition; cities and nations vie for investment and attention, creating an ever-capricious policy vogue. In addition to the risk of adopting a 'ready-made' policy that might not be effective in a new locality, the political emphasis on quick results may also lead to a rapid incorporation that can undermine local democratic processes. Perhaps more fundamentally, it can serve to marginalise planning, and its ability to shape local space and place, in favour of a role centred on enacting international policy ideas within a global marketplace.

Further, even after the process of design and implementation, new policies can be subject to resistance. Actors including policy-makers, the business sector and communities may have long-standing frames, routines and practices through which a prevailing system is reproduced and current trajectories resist change – past decisions, therefore, can lock actors into particular pathways in a similar vein to that discussed in the previous section. In sum, new practices can also initially be resisted at the level of institutions, technical systems, culture and legislation, which can be

path-dependent and require significant reinforcement in social, cultural, economic and technical domains (Geels and Verhees 2011; Simmie 2012). Appreciating the issue of resistance to change and territorial inertia can also be used in a positive manner, however. Here it is desirable to highlight the possibility of creating new and more beneficial pathways, and shedding light on the steps needed to secure their eventual 'lock-in'. This is a significant issue for transitions, as much of the onus is on engendering changes and normalising new practices and behaviours.

The key message from this section is that any transition towards a more water sensitive city has to occur within local and national social, political and economic circumstances (Brown et al. 2009) – homogeneous policy norms do not map well onto heterogeneous social, political and environmental contexts. While, policy and technology can play a vital role in enabling differing urban water futures, there is a need to recognise that the way we know and represent the world is inseparable from the ways in which we choose to live in it (Jasanoff 2004); knowledge and solutions are embedded in societal contexts, not separate artefacts to be generated and applied. As a consequence, transitions also demand a high degree of coordination, interrogation and adaptation by key stakeholders. This also includes adopting an interdisciplinary collaborative scientific perspective, where, for example, the natural sciences may research catchment behaviour, while the social sciences analyse possible planning and legal mechanisms, taxation regimes or economic incentives.

11.6 Conclusion: Recognising the Pluralism of Trajectories

Essentially the question of urban trajectories can be distilled down to advocating an alternative vision of how we use space over time. A more sustainable urban water future considers space in the Euclidian sense connected with how water interacts with the built environment, and adopts a more spatial perspective that has the ability to integrate wider elements such as governance, decision-making and individual behaviour. Appreciating the temporal factors is equally important. For example, even estimating a rate of land use change of between 1 and 3 % per annum, any alteration will take many decades and perhaps even the best part of the twenty-first century. This brings the new danger: if a plan takes this long to implement there is a chance that it will never be fully in place. For instance, Berman (1983, p. 15) argues that a feature of modernity is that it fosters an environment of 'perpetual disintegration', where a host of factors from social processes, to globalisation, to demographic change interact, fluctuate and become superseded. To put it another way, can you think of any city wide plan that was designed in the 1960s that is both still in operation today and has managed to maintain political momentum, stakeholder engagement and public acceptance throughout this time? It is this argument that provides a key counter to notions that visions could be posited as possible end states. While the idea of a prospective blueprint can be compelling and aid in gathering focus, in reality academic critique is commonly on the poor sustainability of current processes and practices: in this regard prospective urban visions are not

necessarily futuristic – an end-state to transition towards – they are a key tool to better understand the present.

While urban change does have a strong influence on water, it should also be recognised that this aspect is just one element of planning, and one that can be very low down on the priority list in comparison to economic growth or housing provision. This is apparent by examining the nature of urban policies in any given city; in reality only those areas that have experienced significant flooding or drought have elevated the agenda to a place where it would have the opportunity to gain precedence over other issues. In addition, to keep pace with the sheer dynamism of contemporary society there has been huge theoretical creativity and conceptual innovation, and, as a result, there has been a veritable explosion of urban labelling to the extent that the confusing taxonomies have been accused of fostering obfuscation rather than illumination (Taylor and Lang 2004). As a consequence, future water visions are also in a conceptual contest with other potential notions of cities, such as the 'Smart City' (Hollands 2008), 'Resilient City' (Vale and Campanella 2005) or 'Just City' (Fainstein 2010) – all of which are fighting for attention, resources and action, and wield their own concepts, ideologies and strategies. More critically, there should also be an acknowledgement that any potential new 'lock-in' as part of a transitional strategy may also need to be 'unlocked' at some point in the future – if there is one thing that is apparent from studying the past, it is that societal requirements can change quickly.

That is not to discount the value of such exercises, however. It should be noted that analysing urban transitions from a pragmatic and practical spatial angle as this chapter has done, does not capture their wider scope and purpose. For example, they are particularly useful in highlighting an urban possibilism and the means by which this could be achieved, they identify wider spatial networks and the roles of key stakeholders, and focus on flaws, inconsistencies and impacts of current norms. It should also be acknowledged that transitions are necessarily pluralistic: it is not simply a choice between a Water Sensitive City or a Smart City. There may be multifarious concepts being mooted, all of which have their own trajectories that may not overlap or may even be complementary rather than in direct competition.

In sum, it is argued that discourses of urban metabolisms or urban water trajectories are implicitly embedded in the nature of the 'urban', as well as the more explicit end vision or discussion of policy, process or practice. As such, from a more abstract perspective any new urban vision such as this reveals itself to be a strong cultural signifier that casts light not just on the relationship between water and society, but rather connects to a deeper narrative on the kinds of societies we would like to inhabit in the future.

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Chapter 12
Water and the (All Too Easy) Promised City: A Critique of Urban Water Governance

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Abstract The reform of urban water services, and the related reorganisation of environmental conservation, has been influenced by novel approaches focused on flexibility, adaptability and partnership that are commonly described as the agenda of water governance. This new agenda, widely accepted worldwide in the last three decades, entails a convergence of de-regulation and re-regulation policies, including incentives for decentralisation and market-based solutions. The chapter specifically examines the influence of urban water governance reforming public services and environmental conservation in Glasgow (UK) and in Lima (Peru). These two case studies, despite their idiosyncratic complexities, are highly emblematic of the controversies surrounding water governance. Glasgow is an intriguing example of a post-industrial European conurbation and Lima is a paradigmatic case of an emerging megacity at the intersection of post-colonial legacies and market globalisation. In both metropolitan areas, recent projects and policy adjustments reveal the achievements, but also the shortcomings of water governance. One main problem is that public participation has been appropriated by the same agencies that in the past promoted highly centralised, disjointed and politically asymmetric administration. Furthermore, positive results from increased investments and rationalisation of water services have been undermined by the discriminatory and short-term basis of the discourse and practice of urban water governance.

12.1 Introduction

The need to improve urban water systems has been the object of wide-ranging institutional reforms and considerable investment programmes, particularly in the last three decades, when it became increasingly evident the convergence of systemic problems such as growing water pollution, deficient supply and worrying levels of inefficiency. Regulators, experts and the general public have explicitly recognised the socio-ecological complexity of urban water management and called for a better

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integration of multiple and historically disconnected demands (United Nations 2004). Most of these recent and ongoing responses have been highlighted in the principles and instruments of the water governance agenda, which has entailed a transition to more adaptable practices, beyond the traditional forms of government interventions, aiming to include the action of both the state and a myriad of organisations and movements that constitute the non-state (Conca 2006). Urban water governance is now a central pillar of the promise for enhanced life and better cities through gradual changes in existing policies and mainstream procedures (Gunawansa and Bhullar 2013).

Considering the vast literature on the subject, it can be easily observed that governance has several definitions, but it is essentially a synthesis of de-regulation and re-regulation approaches that are more market-oriented and include incentives for decentralised institutional changes (Ioris 2014a). The term has been described as combined reactions to the previous focus on government as the prime actor in shaping society and managing resources and ecosystems (Olsson and Head 2015) and its replacement with a new emphasis on the alliance between public agencies, community organisations and business groups (Tretter 2008). The pursuit of governance, instead of conventional state interventions that prevailed during most of the twentieth century, has involved a range of flexible strategies and innovative mechanisms of public administration. These are designed to accomplish complex policy objectives, realise values, manage risks and recover negative impacts. In addition, governance has important synergies with calls for neoliberal state reforms, ecological modernisation and market-based conservation and the use of natural resources.

The urban water governance's specific agenda aims to foster integration across disciplines and bring together the natural, social and economic aspects of the sustainability of water services (Morinville and Harris 2014). Water management approaches have mainly moved towards cost-effective investments in infra-structure, containing environmental impacts and providing flexible water and sanitation services, often with an active or indirect involvement of the private sector. Such association between business and water governance was vividly demonstrated at the 2015 World Economic Forum held in Davos, when the 'water crisis' was considered the highest source of risk presently haunting the international community. However, treating water as a policy priority under the influence of water governance ideas has not prevented management problems from worsening and the controversy around water rights increasing, particularly in the context of fast growing cities and metropolitan regions.

The uneven results and tensions associated with urban water governance provide a remarkable example of the important junction between improved national policies on public services and environmental conservation, on one side, and the persistence of localised impacts and unfulfilled demands for social inclusion and political recognition, on the other. The experience of water governance, so far, betrays a reductionist, conservative concept of the city, which denies the fundamental role of political disputes and socio-spatial inequalities in producing problems and perpetuating failures (Roberts 2008). That is a serious conceptual and practical problem, given that the city, as any other lived and constantly reshaped space, cannot be

properly understood without reference to the political struggles and alliances that play a critical part in its own organisation (Ioris 2012a). The urban should be regarded as a process of socio-ecological change, urbanisation must be seen as the driving-force behind many environmental issues and the field where those problems are experienced more acutely – especially in a global society that is increasingly living in urban areas (Heynen et al. 2006).

In that challenging context, the goal of this chapter is to investigate the intricacy of mainstream urban policies under the influence of the multifaceted water governance agenda. Despite much literature on governance, specific discussions on the connections between past and present conditions are still largely missing and need to be properly analysed as much as between local and general trends of urban policies affected by water governance. The present discussion is situated in the field of urban political ecology (UPE), encapsulating theoretical and investigative efforts employed to explain socio-natural phenomena mediated by political power and part of producing long-term urban spaces. UPE's subject matter is the inescapable interplay between ecology and politics in the sense that urban ecology is inherently political while politics is necessarily ecological. In contrast with the political neutrality, often advocated by governance scholars, a UPE perspective reveals a fundamental connection between water, power and the state apparatus in using and appropriating water in urban areas (particularly considering the genesis of public policies, the criteria for water allocation and the political use of investments in water infra-structure).

The task at hand – here and beyond – is to creatively combine a critique of the prevailing techno-bureaucratic paradigms with formulating alternative models of socio-spatial organisation and economic production. Given the restricted space available, the chapter focuses on the comparable influences of urban water governance agendas in reforming public services and the evolution of environmental conservation approaches in Glasgow (UK) and in Lima (Peru). The two case studies, regardless of obvious idiosyncratic differences, highly illustrate the controversies surrounding market-based water reforms and are also clearly complementary. Glasgow is an intriguing example of a post-industrial European conurbation and Lima is a paradigmatic case of an emerging megacity at the intersection of post-colonial legacies and market globalisation. This chapter will lay bare how recent projects and policy adjustments in the two cities condense the shortcomings of the latest approach to water governance and how public participation has been appropriated by the same agencies that in the past promoted highly centralised, disjointed and politically asymmetric approaches.

12.2 The Urban Water Dilemmas of Glasgow (Scotland)

This section will examine the evolving waterscape of Glasgow, the largest urban conurbation in Scotland, and evaluate the direction of recent initiatives launched to improve public services and foster environmental conservation. The achievements

and failures of water-related projects there constitute an illustrative example of the controversies around supposedly innovative solutions and the influence of past legacies and socio-spatial inequalities. The city is located within the floodplain of the River Clyde, in the west coast of Great Britain, with most of the metropolitan area extending onto a steeper relief. The socio-ecological disputes and urban development strategies onsite can only be properly understood in relation to the long transition from an industrial past characterised by mining and manufacturing into a post-industrial, service-based economy. The metropolis grew considerably during Victorian industrialisation, particularly due to iron and steel steamships being built along the banks of the Clyde after 1860. Glasgow then became an important locus of violent proletarian struggles in the first decades of the last century, a movement famously known as the 'Red Clydeside'. However, due to changes in global trade and the redistribution of labour worldwide, manufacturing activity declined dramatically in the post-World War II decades. Since the 1950s, the region underwent a period of economic deterioration and developed into one of the most deprived localities in the United Kingdom. Mounting urban problems triggered the adoption of various redevelopment approaches and, since the 1980s, Glasgow has become fertile ground for neoliberal experimentation, which has impacted urban renovation plans (MacLeod 2002).

Water management issues became an integral, but frequently neglected, element of those intricate, but highly contested, trends. Due to economic expansion, the river had to be modified to satisfy the needs of burgeoning commerce and industry from the first quarter of the eighteenth century. Trade began to improve in Scotland, particularly after the Act of Union in 1707, when Scottish merchants were given rights to trade freely with English colonies in America. Trade demands forced a succession of efforts to make the river more accessible for ships ever increasing in size and, since the start of industrialisation in the region, there was a constant concern about the geographic limits imposed by the river on navigation and trade. However, the relationship between the city and its main river in a context of fast industrialisation and sustained urbanisation was never easy. Munro (1907, p. 8), more than a century ago, pointed out that 'the Clyde (…), when one comes to think of it, is not one river, but three, so wholly different are her character and destiny at different parts.' This observation related to the fact that the upstream section of the river was relatively well preserved, while the middle and lower sections were significantly impaired because of the intensification of economic activities, which produced not only negative social consequences in terms of inequalities and labour exploitation, but also affected the river's geomorphological and ecological condition and impacted domestic and industrial water uses.

The Clyde and its many tributaries had become so polluted that, since 1834, the City of Glasgow started to look for alternative sources of public supply. In 1859, drinking water for the larger urban areas in the Clyde came from Loch Katrine, a neighbouring catchment in the southern section of the Scottish Highlands. The Loch Katrine project was the largest public water supply system in Scotland from when the analogous Loch Lomond was constructed to its opening in 1975. Interestingly, throughout the years, it had been recurrently declared that water was

abundant in Scotland and the existing sources were sufficient to satisfy a rising demand. The belief in the abundance of water resources led to a highly overstretched supply system and mounting levels of water pollution within the Glasgow conurbation (Ioris et al. 2006). Although more alarmist projections of water scarcity never materialised, developed water resources were clearly adequate to meet demands, although local problems in terms of quantity and quality still persisted (SDD 1984). On the one hand, the Clyde region's economy faced a dramatic transformation with the aforementioned decrease in the shipbuilding industry since the 1950s. From being a river lined with shipyards, only a handful remained and the Clyde lost its international position in the global manufacturing market. On the other hand, metropolitan Glasgow became associated with the social ills (which actually predated deindustrialisation) of an appalling housing environment, chronic overcrowding, unemployment and deficient public services, including inefficient water distribution systems, lack of wastewater treatment, contaminated waters and poor flood defence (Ioris 2014b).

The metropolis' difficult socio-economic situation and the risk of a return to radical grassroots protests (inspired by the example of the Red Clydeside movement between the 1910s and 1930s), paved the road for introducing specific policy reforms aimed at addressing the pending problems. However, instead of conventional solutions centred on the state, the emphasis was on the neoliberal platform of urban redevelopment and water governance according to an entrepreneurial ethos and an anti-welfare ideology (directly attached to the neoliberal policies introduced by Margaret Thatcher in the 1980s). This ultimately resulted in escalating contradictions, sharpening inequalities and entrenched social exclusion (MacLeod 2002). The process of selective and conservative urban modernisation, which privileged market-based strategies, continued in the following decades and, despite some localised or sectoral improvements, metropolitan Glasgow is still a hotspot of multiple forms of deprivation.[1] As in many other British regions, those disadvantaged by urban development are more likely to live in areas impacted by the effects of economic restructuring, deindustrialisation and defective public policies (Pacione 2004).

Such socio-economic and socio-ecological deficiencies have important synergies with the insufficiencies of recent plans to improve urban water management according to water governance ideas. In the eyes of politicians and corporate groups, the water sector needed to experience a transition from the previous focus on hydraulic infra-structure works to a new phase based on the adaptive, co-evolutionary coordination of improved responses that should be implemented at multi-actor and multi-scale levels. A more sustainable way of managing aquatic systems was expected to emerge from integrating multiple needs and interests, as in the case of the European Union Water Framework Directive (WFD), which commands that the public should help to define the rationale, framework, outcomes and validity of the decision-making needed to achieve and maintain the good ecological status of all water

[1] More at http://www.scotland.gov.uk/Topics/Statistics/SIMD/SIMDInteractive. Accessed 20 January 2015.

bodies. The influence of governance-informed strategies was evident with the launch of the joint venture Scottish Water Solutions between the public water utility (Scottish Water) and two consortia of private water companies invited to deliver thousands of engineering projects (Ioris 2008). Following the same rationale of outsourcing to the private sector, in 2014 the Scottish government announced significant investments to upgrade water mains and the wastewater network in the Greater Glasgow area (part of £3.5 billion investments nationwide).

However, both infra-structure constructions and environmental management initiatives have exposed a highly technocratic interpretation of water problems and the prioritisation of solutions biased towards certain groups of interest, which directly reflect the asymmetries of power behind water management. The most evident element of the socio-ecological tensions is that the Glasgow metropolitan area continues to negate its formative, defining river and marginalise significant proportions of its people. Still a quarter of Glasgow's total population live in the 5 % most deprived neighbourhoods of Scotland (half in the 15 % most deprived), where there are the highest rates of suicide and child mortality in the country and where often more than 50 % of the population receive incapacity benefits (Centre for Social Justice 2008). It must be noted that, after a century of deterioration of water quality due to domestic and industrial pollution, and the subsequent loss of many species of fish and invertebrates, the situation has been improving since the 1960s (to a large extent, due to the dramatic reduction of industrial production). The River Clyde, which had lost its entire migratory fish population in the 1860s and was virtually fishless in the lower reaches, has recovered to the point that salmon and other migratory species are now returning. The migratory fish first reappeared in the 1980s, but only in 2002 the survey was sufficient to show that salmon had come back in healthy numbers. Nonetheless, Moss (2003) affirms that present management approaches only represent the solution to the largely nineteenth century problem of gross organic pollution and ignore much greater current problems, such as diffuse pollution, contaminated land and rapid land use change.

Despite the colourful language of European and Scottish policies, the susceptibility of marginalised social groups to uncertain public services (such as the regular failures of Scottish Water) and poverty-related hazards remain a central element of their daily life. Morisson et al. (2014) demonstrate a significant correlation between economic deprivation and environmental contamination in post-industrial areas of Glasgow, despite numerous regeneration programmes carried out in recent decades. An assessment published by the Scottish Environment Protection Agency (SEPA) in 2008 estimated that only 39 % of surface and groundwater bodies have good or better ecological status and the main pressures were related to urban drainage, diffuse sources of pollution and impacts from the industrial past. It is no surprise that, ahead of the 2014 Commonwealth Games, the pollution of the popular Strathclyde Loch (in the municipality of North Lanarkshire) was a matter of serious apprehension due to the risks of poisoning or infecting athletes during the open-air swim (Herald Scotland 2012).

The complexity of water management issues in Glasgow, as a hotspot of Scottish and British socio-ecological questions, demonstrates that the politics of urban

ecologies is an integral phenomenon shaped both by moments of concerted action or social upheaval, as in the case of repeated protests against incinerators and landfill sites in North Lanarkshire (Dunion 2003). Glasgow's politico-ecological problems continue to be predicated upon the long trajectory of industrial and post-industrial expansion that continuously reproduces mechanisms of ecological disturbance and forge new arenas of confrontation. Especially in a context with such sharp socio-spatial and socio-ecological inequalities, particularly across low and high income households and between privileged and deprived neighbourhoods, the water's urban political ecology represents an important entry point into the complexity of city problems, past legacies and uncertain futures. Most interventions on hydrological systems in recent decades tended to generate costs, benefits and risks that are distributed unevenly across spatial, temporal scales and social groups. Nonetheless, those social and spatial inequalities seldom considered when formulating and implementing new water regulation may be an indication of the geometries of power behind the ongoing institutional reforms offered by the governance agenda. On the contrary, the pursuit of water governance in Glasgow was profoundly connected to state reforms and the primacy of business-friendly policies. That is an important connection with the trajectory of water governance reforms in Lima, one of the emerging Latin American megacities.

12.3 The Steady Advance of Neoliberalism Over Public Water Services in Lima (Peru)

The attainment of universal and reliable public services constitutes an old promise of all Latin American governments since the early years of independence (though with some interruptions throughout the national history). After nearly two centuries, however, the situation is still one of marked inequalities, patchy coverage and controversy. The circumstances of Lima are not uncommon in other parts of Latin America, but service failures are even more acute here due to extremely limited water reserves and new settlements fast spreading over hills and sandy areas. The consequences of very low rainfall rates (less than 20 mm per year) and short rainfall periods (June to August) are aggravated by the extensive degradation of the three urban catchment areas and aquifers contaminated by salt water and diffuse pollution, as well as a high percentage of leakage and only around 9 % of sewage treatment. The result is that, notwithstanding the recent initiatives (see below), more than 16 % of the population (almost 1.5 million people) still don't have a safe supply of water (Hordijk et al. 2014). According to the statistics published by the national statistical agency INEI in 2012, 8.5 % of the population rely on water trucks, 3.9 % on public fountains and 4.3 % on extracted water from boreholes or watercourses.

To be sure, local water services have been improving in the last 20 years under the influence of broader macroeconomic and legislative reforms informed by urban water governance. Investments were urgently needed to cope with the Peruvian

capital's dramatic growth since the middle of last century. Internal migration led to a 'demographic explosion' and Lima grew from 645,000 inhabitants in 1940 (10.4 % of the national population) to more than 9.0 million in 2013 (about 30 % of the Peruvian population and almost half of its gross domestic product or GDP). The city's main period of expansion was between the 1950s and 1970s, when demographic growth was sustained above 5 % per year. What happened in the water sector of metropolitan Lima in the recent past has been strongly influenced by the national state's reconfiguration and the introduction of urban policies influenced by the water governance ideas (comparable to the experience in Glasgow discussed before) after the failure of heterodox economic experiments in the 1980s.

Rather than a straightforward process, the conservative modernisation of Lima's water industry epitomised a range of intricate and polymorphic transformations that attempted, directly or indirectly, to incorporate water use and conservation into market-like transactions. With the election of Alberto Fujimori in 1990, the time was ripe for a novel alliance between national and international business groups according to the neoliberal recipe advanced by multilateral agencies. The country became one of the main 'laboratories' for experimenting with neoliberal policies, including market deregulation and delegation to the private sector of activities previously undertaken exclusively by the state. Such changes did not spare the public water services, but reconfiguring the local water company (SEDAPAL) and introducing a new regulatory framework (managed by the newly created agency SUNASS) were unquestionable evidences neoliberal policies were spreading. In the end, the neoliberalisation of Lima's water sector – essentially, the adoption of market-based institutions of water management and the commercial-like operation of public utilities – became a key feature of the expanding business environment in the country. Water neoliberalisation comprises of a fluid, and highly contingent, combination of ideological constructions, disguised interests, technocratic rationality and, at best, circumstantial improvements. Lima now has a large contingent of low-income residents living in slums and sandy hills, but at the same time significant sums of money circulate through household water tariffs, local water vendors (around 1000 water lorries still in operation) and the contracts with private companies operating with the public utility.

Interestingly, the institutional water reforms implemented in the 1990s (when privatisation was the ultimate, but unfulfilled, goal) can be compared with the more recent phase in the 2000s (marked by other ingenious mechanisms of private sector involvement). When water utility privatisation was abandoned due to operational and political risks, the emphasis shifted to mechanisms that were more palatable to the general population, such as selling stock market shares, privatised construction works and expanding local commercial transactions. After the initial neoliberal reforms of Fujimori (1990–2000), the governments of Alejandro Toledo (2001–2006) and Alan García (2006–2011) specifically adopted the discourse of water governance as a main political platform. Despite differences in strategies, there was a clear line of continuity between the two phases, which indicates the persistence and growing pervasiveness of water neoliberalisation in the metropolitan area of Lima. There have been constant announcements of new projects and construction

works, increasingly embracing private sector partners, but the bulk of the money for new investments continues to be apportioned by the state at the expense of a larger public debt.

Technological dependency and more frequent stakeholder complaints, together with the structural difficulty of the water authorities to engage with local residents, seem to be another untold side of the reforms (although those problems certainly predated introducing neoliberalising policies). For instance, the appealing rhetoric of economic development and social inclusion articulated by President García, combined with a solid parliamentarian majority and firm international support, provided the political legitimacy for a new phase of water neoliberalisation in Peru. Since the early days of the García administration, it was strongly reaffirmed that SEDAPAL will remain open to the opportunities to involve private investors and to increase profitability. The president launched the programme Water for All (APT) in 2007, which created growing space for foreign companies interested in participating in Lima water services through a series of so-called 'megaprojects' (Ioris 2012b).

The intensification of business transactions involving water goes much further than large infra-structure projects, but has permeated large parts of the public policies aimed to improve water services in Lima. At the same time that the authorities claimed that APT was a programme of social inclusion, there is a growing space for market-like solutions, such as paying for ecosystem services, increasingly seen as a promising management strategy for the Peru's water companies. Examples of affirming commodifying rationalities include forming local water markets in the periphery of Lima. Some of the poorest areas, such as Pachacútec, have become the testing ground for micro-credit schemes described as the 'new paradigm' of sanitation in Peru. The experiment involved creating so-called 'small sanitation markets' and was sponsored by non-governmental organisations (NGOs), government and international agencies. Local shops were encouraged to sell sanitation equipment and toilet units to the residents, making use of financial assistance provided by five intervening banks. Although on paper it may have seemed an interesting idea, in practice promoting the micro-credit by international agencies was met with scepticism from the locals, as the project struggled to make progress, local residents complained that the equipment and technology were not appropriate to their wooden houses and, ultimately, only the better-off part of the community could really benefit from the micro-credit conditions.

The result of the reforms has been an odd mixture of pro-market initiatives under strong state control, deeply marked by the long tradition of authoritarianism and private appropriation of public matters that permeated Peruvian history. The experience in reality has been a combination of neoliberalism and neostatism, which means a convergence of regulated market competition and state-sponsored flexibility. At the same time, institutional adjustments were fraught with path-dependent trends that often produce inconsistencies between senior politicians' discourse and their practice. Altogether, with more than 3 billion US dollars of estimated investments in the last 20 years, the expansion of the hydraulic infra-structure is undeniable, although it also meant a deeper exploitation of wage-labour, higher tariffs, and

significantly higher number of complaints. A comparable situation existed under the presidency of Ollanta Humala, in office since 2011, who introduced another anti-scarcity plan along similar lines and with comparable promises of universal water supply in Lima by 2017. The Strategic Plan 2013–2017 of SEDAPAL contains five main goals, including service improvement, financial stability and the universalisation of public services, to be achieved through flexible, governance-informed management approaches.

At least three fundamental trends continued to challenge the overall direction of the recent reforms and the promise of better water services in Lima. First, the metropolis still experiences unplanned and unchecked territorial expansion, as well as a densification of the consolidated *barriadas*. Because of the uncontrolled occupation of hilly areas above the maximum reference altitude of the existing system, water distribution permanently requires additional and uncertain infra-structure. That represents a vicious circle of social exclusion, reactive action of the state and opportunities for a new round of populism. A related issue is the emphasis on a lack of attention to water demand management (something that has little political visibility) and an almost entire reliance on the more visible engineering constructions and supply augmentation (regardless of the social and environmental impacts of the new projects in the source areas). Second, because of the low fiscal capacity of the national state and the very limited revenues from those employed in the informal sector (i.e. the majority of the clients of SEDAPAL), the expensive investments on water services continue to depend, for the most part, on foreign loans. The willingness and ability to contract loans and other credit facilities varies between one administration and the next, which reduces the opportunities for long-term planning. Third, the declining availability of water reserves around Lima and in the Andean mountains is a serious threat to achieving higher standards of living and socio-economic development in the metropolitan region. Sadly, the initiatives introduced in Peru since 1990 have not been able to interrupt the trend of growing risks and rising uncertainty.

12.4 Conclusions: Beyond Simplistic, Politically Eroded Responses

The brief commentaries included in the preceding sections demonstrate that the improved urban condition promised through the pursuit of a range of initiatives informed by ideas around water governance has been in fact negated by the simplistic and technocratic basis of most policies and responses. The failures of recently introduced policies and management strategies reveal the troubling gap between the ambition of contemporary urban planning and the lived reality of many urban spaces suffering from water scarcity, flooding and environmental degradation. In theory, instead of the conventional exercise of authority, the search for governance was supposed to create lasting and positive changes according to targets such as openness

accountability, effectiveness and participation (Batterbury and Fernando 2006). The water industry of those two cities was therefore seen as a strategic economic sector with the ability to attract commercial partners and help to convey the message that the countries are 'open for business', as in the case of public-private partnerships and construction contracts. That was to be achieved through an increasing monetisation of water and the interpretation of multiple values according to money figures attached to the natural resources, infra-structure investments and public services. At the same time, the engagement of multiple environmental stakeholders was expected to be coordinated, non-confrontational, facilitate regulatory efficiency and improve the performance of public services. In practice, however, there is growing evidence of persistent inadequacies and mounting risks in both metropolises. A large proportion of the water management problems remains not only unresolved, but is being presently reinforced by the priorities of an exclusionary pattern of regional and national development. Claims about the need to pursue higher levels of operational achievement have essentially helped to hide a business-friendly environment and techno-bureaucratic rationality that systematically denies the underlying socio-economic causes of the water problems of Glasgow and Lima.

In politico-economic terms, it is difficult to deny that water governance has been broadly influenced by the material and discursive attention of neoliberal policies to economic growth and capital accumulation above social, political and environmental considerations. Imposing market-based responses to long-standing problems (e.g. uneven coverage, insufficient services and declining stocks of water) has been an integral component of managing the reorganisation and institutional reforms of public water services. Governance can be read as an adjunct of the neoliberalisation of public policies, within which the state is circumscribed and contained by a mesh of organisations that originates from outside the democratic arena (Gandy 2006). Governance-informed policies adopted in Lima and Glasgow also reveal that water neoliberalisation not only happens through the formal delegation of services and utilities to the private sector. On the contrary, one of the main lessons learned from these two metropolitan areas is that the success of neoliberalising strategies depends much more on the intensification and manipulation of investments, contracts and revenues in a way that allows the flexible involvement of national and international companies, although the apparatus of the state remains firmly in control of any new initiative and plays a very important role in the legitimisation of new agendas.

Contemporary water governance approaches have both attempted to respond to environmental degradation and expand the penetration of capital into areas formerly beyond the reach of the market (such as environmental conservation and public water utilities). One particular aspect of mainstream urban water strategies is that these have not only changed the interrelations between state, people and nature, but have forced alterations in the role of the national state as the ultimate responsible for the success of flexible, market-friendly approaches. To overcome difficulties and maintain the direction of the reforms, the state had to adjust its own configuration (e.g. create new regulatory agencies) and its strategies in relation to the public and the business partners (e.g. more aggressive communication campaigns and legislation on public-private partnerships). At the same time, the state has remained

responsible for the more expensive procurement of raw water sources and recovering degraded river catchments.

One of the most perverse and unfortunate consequences of the, overt and covert, emphasis on strategies informed by the contemporary agenda of governance (as much as by related concepts such as ecological modernisation, sustainability and smart regulation), is that the hegemony of mechanisms informed by governance has helped to hide the maelstrom of inherently limited water management reforms and prevented the emergence of a creative thinking about urban water. The loose vocabulary of governance – which instinctively incorporates expressions such as subsidiarity, empowerment, public participation and eco-efficiency – has served as justification for adopting narrow water management methodologies that in practice correspond to the interests of the stronger political and economic sectors. It is often the case that water governance theorists neglect the politicised dimension of both the causes and the solutions to water management problems. Likewise, public policies and official texts frequently minimise the fact that managing urban water systems is embedded in multiple power disputes that evolve from the household, neighbourhood and catchment level to the urban, region and international scales. Most interventions related to urban water governance consider stakeholders as disconnected, atomistic participants whose opinions can be easily plugged into pre-established decisions and managerial structures, whilst the legacy of social inequalities and institutional distortions continues to receive only scant attention. Instead of those ideological assertions, the evolution and present configuration of urban water management thus constitutes a synthesis of long-standing socio-natural interactions and state-society relationships that are certainly not politically neutral. The small, microscale manifestations of the politicised urban landscape – as in the case of water management problems and attempted solutions introduced in the periphery of Glasgow and Lima – are not simply the residue of macro, intense political clashes, but the metropolitan and the household are interconnected spheres of activity that interact and potentialise each other.

The ultimate conclusion is that genuine alternatives to that long tendency of urban inequalities require not only a critical understanding of the connections between past and present, but also between personal and interpersonal attitudes with national and international scales of interaction. It is necessary to develop conceptual and methodological approaches able to reconcile urban processes with wider development pressures, sectoral demands and socio-spatial relations. This should start with recognising that the multiscale and intertemporal sources of water politics is the first step towards resolving problems, given that the current situation is the combination of past legacies and pending demands, as well as place-based interactions and national and international pressures. The resolution of water dilemmas also requires going beyond simplistic, pre-defined frameworks – as in the case of urban governance – but actually depends on how citizens perceive their claims and, more importantly, how they are able to collectivise and negotiate their demands through identity, economic activity and spatial location. It is only through questioning and contesting mainstream water management reforms that genuine, really democratic, alternatives could emerge. Crucially, calls for social and environmental justice

cannot only be about redistributive action (i.e. removing the inequitable distribution of goods and bads that notably affect low-income, disadvantaged communities), but are also related to recognising the politicised complexity of socio-ecological systems and the meaningful involvement of wider sections of society in making decisions that inevitably affect their own lives and the collective urban future.

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Chapter 13
Moulding Citizenship: Urban Water and the (Dis)appearing Kampungs

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Abstract Establishing a modern domestic water management system in Batavia, colonial Jakarta, involved struggles over territories between different actors. The multifaceted territorial character of managing water and land reveals the highly contested notion of citizenship as there were continuous processes of service inclusion and exclusion within complex interactions among different state institutions, the private sector and communities. While the twentieth century colonial government addressed water and sanitation issues as part of modernity projects, urban kampung communities simultaneously used diverse socio-ecological networks to meet their water and sanitation needs. However, their strategies did not always comply with the modern sanitation standards idealised by the colonial state. The existence of Batavia's kampungs preceding and following the inception of modern planning system reflects their capability of undergoing socio-spatial transformations within the contexts of limited state intervention on the provision of basic services and under the condition of unequal spatial development processes. The kampung dynamics seem to call into question the existing form of state-led management systems in providing water and sanitation services. The systems pretty much favour the marketisation agenda at the operational level, while keep idealising universal access to services at the discursive level despite the exclusionary nature of infrastructure planning. The persistence of kampungs has likely proven their socio-ecological relevance, and potentially forms the foundation of an alternative paradigm of citizenship for an improved governance system in the urban water sector.

13.1 The Spatial Dimension of Citizenship in Urban Water Governance

Access to water supply and sanitation has been used as an entry point to unravel, deconstruct and reconceptualise the notion of citizenship. In one way or another, many scholars have shown that water and sanitation service commercialisation has

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brought along new different understandings on rights and obligations within the state-market-citizen relations (among others, Allen et al. 2006; Castro 2004; Graham 2000; McFarlane 2008b). More and more, communities are no longer perceived as 'citizens' whose rights to water and sanitation services should be fully met by the state. At the same time, the state is no longer seen as the only actor responsible for universal and equal access to basic services. In this chapter, I attempt to contribute to the scholarly debate on citizenship and water governance by examining the history of Jakarta's urban water sector. Responding to the failing concept of nation-state citizenship to ensure access to water for all inhabitants, I present a new meaning of citizenship to further elaborate its discursive potential in the urban water sector.

I begin to explore the concept of citizenship by looking at the idea of *place-based community* to understand local dynamics of place in relation to the wider socio-ecological dynamics. I further discuss the case of kampungs and its communities. In colonial periods, the indigenous word 'kampung' referred to urban settlements of different ethnic groups that were non-Chinese and non-European, or villages in rural areas. Today, a kampung is a type of neighbourhood where blue-collar workers, low middle class families and informal sector workers live together and support the economy of the whole city.

Perhaps the significance of *place-based community* in the water sector is obvious. Fulfilling the needs for access to water and sanitation in a certain neighbourhood requires collective efforts that are beyond individual households. Moreover, the ecological metabolism of a closed hydrological cycle (surface water flows, groundwater infiltration, evaporation, precipitation, and return as flows through landscapes and water bodies) is inseparable from the social metabolism involving a wide variety of human activities that are embedded in different places with diverse political settings, cultural norms and water use traditions. Consequently, securing continuous public access to water and a healthy environment necessitates an understanding about the interdependency of different 'local' socio-ecological metabolisms (cf. Swyngedouw 2006).

I see two crucial issues in exercising the concept of citizenship. Firstly, there is a need to comprehend at which territorial scale the collective efforts of communities would emerge as a local socio-ecological entity for water management, considering that there are multiple territorial processes attached to diverse processes of 'community' formations and 'membership' formulation (see also Brownlow 2011; Jeffrey et al. 2012; Leitner 2006). Secondly, it is of political and theoretical importance to understand whether each local community member or group as a whole has access to governing the urban water sector at greater scales (see Castro 2004). Led by these two issues, I seek to redefine the notion of *place-based citizenship*.

The very basic idea of citizenship as a mark of belonging and commitment to a specific place that once was stifled by the nineteenth century conception of nation-state has re-emerged within scholarly and public policy debates (Desforges et al. 2005; Leitner 2006). The debates revisit the scalar dynamics attached to the notion

of citizenship to understand contemporary formations of citizenship within the contexts of, among others, fast changing urban dynamics that happen along with migrations within and across national administrative boundaries, more complex environmental problems and their diverse impacts on different community groups, as well as the increasing roles of non-state-centred institutional arrangements in development like informal economy, grassroots movements and international organisations (Desforges et al. 2005; Doshi 2013; Ghose and Pettygrove 2014; Leitner 2006; Swyngedouw 2005). Moreover, there are diverse governing practices in which the performance of citizenship has been rescaled within a more local context, allowing the more contemporary conceptualisation of 'active citizenship' in accordance with the recent transition to give more space to community participation (see Desforges et al. 2005; Ghose and Pettygrove 2014; Swyngedouw 2005).

The state plays an active role as a collective institution in shaping the boundaries of citizenship, e.g. by developing water infrastructures. Access to water and sanitation has been acknowledged as a universal human right. Partly responding to this, modern planning institutions were conceptualised within the context of industrialised countries and their different forms were transplanted elsewhere during the colonisation era (see for example Brummelhuis 2005; Home 1997; Ravesteijn and Kop 2008). But in reality everywhere, establishing a planning institution was more effective for refuting the principle of universal rights rather than for guaranteeing the entitlements. Lo Piccolo (2010) argues that every planning initiative moulds the boundaries of citizenship, as planning processes influence how resources are redistributed and consequently shape spatial and a-spatial forms of social control. Citizenship, theoretically and practically speaking, is therefore an instrument that differentiates particular subjects from others.

The contradiction between the aim to meet the universal need and the exclusionary nature of planning practice has never been absent in the historical trajectory of Jakarta's water sector. The long-standing discrepancies in accessing water and sanitation among kampung communities can be explained by analysing the spatial planning and development processes during the colonial era, which to a certain extent have influenced practices today. Following this introductory section, I look at the spatial distribution of kampungs relative to the early development of Batavia and their socio-ecological transformation preceding the modernisation of the colonial town (Sect. 13.2). I then revisit the historical trajectory of state-led water infrastructure development in Batavia along with the development of the modern colonial state (Sect. 13.3). In section four, I re-examine the idea of citizenship and suggest a new meaning for improved water governance. As improved water governance necessitates linked initiatives at different territorial scales, this new meaning should be created and practiced at two interconnected levels. The concepts of national citizenship that urges the state to formally grant access to universal rights of the domestic water provision system, and place-based citizenship that opens access to the governance of water and its services, need to co-exist (following Castro 2004).

13.2 Urban Kampungs as Place-Based Communities and Their Socio-ecological Meaning

Pre-twentieth century Batavia had two major spatial enclaves: the walled town and the surrounding kampungs. The walled town predominantly comprised of the technologies of colonial governmentality, or the governmental rationality structuring the relations between those who are governing and governed (see also Kooy and Bakker 2008b). There were continual changes affecting the kampungs' geographical distribution and the colonial town's territorial demarcation. Below are two simplified episodes of Batavia's gradual spatial transformation before the colonial state implemented the modern policy on urban development.

In the seventeenth century, two types of spatial enclaves co-existed with distinct characteristics and very clear lines of demarcation between their territories. When Batavia was erected in 1619, there were already other Asian trader settlements and the surrounding indigenous villages. Indigenous settlements emerged in the southern part, relatively more inland and far from the walled urban centre. Lives in the kampungs were strongly embedded in ethnic traditions. In some historical maps owned by the Netherlands Royal Tropical Institute kampung names refer to ethnic origins, rural villages or indigenous plantations (*kebun*). The walled town mainly housed the European population who were pursuing colonial trading activities and industrialised agriculture. In stark contrast, a kampung represented the indigenous communities' economic activities, a legacy of the pre-colonial income structure in Java.

There was no unique concept of territorial demarcation as a basis of community formation in pre-colonial Java and village socio-spatial organisation was in 'a state of flux' (see Kusno 2006). The traditional inland trade took the form of small and isolated person-to-person transactions in several market nodes, constituting the spatial manifestation of the public sphere (Alexander and Alexander 1991; Christie 1991; Ray 1995). The power of a sultanate, a kingdom, or a nobleman was measured by how many people and subservient peasants were under his influence (Kusno 2006). The cycle of subsistence agriculture significantly formed the logic of community formation. Communities in the kampungs were sustained through their attachments to the land, which significantly supported the socio-ecological metabolisms of subsistence agriculture.

With such spatial-temporal dimension to Batavia's kampungs, it seemed that managing water for domestic needs was organised by small groups. There was no demographic data on kampung communities in the early colonial era. However, several old maps documented by the Netherlands Royal Tropical Institute show that subsistence agriculture made the kampungs greener and less dense than the walled city and its vicinities. Some kampungs evolved attached to natural streams. Communities used surface water for washing and bathing. Agriculture and fishery activities kept the natural cycle of water function in a household's immediate environment, i.e. their compound. Wells and streams were water sources, while wetlands and natural infiltration wells functioned as water purification systems.

Houses were elevated, in part, to give some space for water to flow beneath the structures before infiltrating into the ground.

The level of population density and diverse patterns of dwelling agglomerations led to a simple yet complex domestic water management. Like land, water was a common (re)productive good, but there was also a vital need to manage it at greater territorial scales. Arranging the microcosm or the housing, was not separated from the macrocosm, which included the agriculture fields and the river systems (Lansing 1987; Waterson 1997; Widodo 2009). There was a relatively solid system of pre-colonial water institution in Java for irrigation and flood management, organised either by the state or the communities in various sizes and mechanisms (see Christie 2007; Hunt 2007). Managing domestic water supply and wastewater treatment systems was not as advanced as the agriculture and coastal drainage systems. Nevertheless, domestic water management in the kampungs was relatively independent from external political meddling.

The inter-scalar dependency of indigenous water management systems was disrupted during the later colonial era, referred to in this section as the second episode of pre-modernising Batavia's socio-spatial configuration. Marking this period was the 1733 malaria outbreak that killed 2000 Europeans out of 20,000 people inside the walled town (see Van der Brug 2000). A significant factor causing this calamity was the engineering approach to tame the marshy land of Batavia. The port town was built to resemble its sister city, Amsterdam, adopting an 'offensive spirit' to engineer nature (Hooimeijer 2009. See also Chap. 1 in this volume by Disco). Rivers were straightened and bordered by concrete walls, new canals were dug and the excavated soil was used to erect foundations for buildings (Caljouw et al. 2005). Unfortunately, the engineering system was challenged by Java's ecological setting. The canals did not function as expected, they were often blocked and the city was filled with stagnant water because precipitation was heavier and rivers carried thicker silts from higher areas (Kop and Ravesteijn 2008; Ravesteijn 2008).

Towards the nineteenth century, the colonial government actively enhanced the pre-existing spatial fragmentation in Batavia. The indigenous population was no longer considered as a danger to political stability and slowly integrated in the colonial economic system. However, the thick walls of social boundaries kept a sharp distinction between the colonial city and kampungs. Borders between the kampungs themselves became significantly narrower, but there was a gradual shift from ethnic-based communities to the racial categorisation, especially between the colonised and the coloniser.

The indigenous communities continued living in kampungs as separate enclaves from the settlements planned by the colonial state, notably due to their lower social position in the economic structure, but also to their continual attachment to different traditional socio-economic spheres (see Blackburn 2011; Blussé 1981; Booth 1988; Elson 1986; Ray 1995). They responded to the regime's exclusion and oppression by living with or close to their specific ethnic groups, and maintaining their traditional socio-economic networks (see Guinness 2009). Indeed, their participation in the capitalist economy was limited to jobs that generated a very low income, as they

were systematically excluded from more strategic roles (Alexander and Alexander 1991; Booth 1988; Elson 1986; Ray 1995). As such, communities continued to rely on subsistence agriculture and fishing, working on their own or rented land, and in between several (seasonal) jobs as labourers, coolies and crafters (see Booth 1988; Elson 1986).

The malaria outbreak led to the European population gradually migrating to southern areas outside the walls. In 1810, the colonial government officially moved the town centre from Old Batavia to the southern area called *Weltevreden*. Many communities were evicted from existing kampungs in *Weltevreden*. Batavia's remaining kampungs accommodated the evicted communities, but in later years more people from rural areas also settled there. Over the nineteenth century, in rural areas across Java, subsistence agriculture land was seized for export-crop plantations, causing forced migration to urban areas as people searched for new income sources (Elson 1986). As a result, the kampungs grew faster and became denser. While the colonial city housed around 7800 European populations and 27,000 Chinese, by the end of the nineteenth century the surrounding kampungs had accommodated around 2000 Arabs and 68,000 diverse ethnic groups of native Indonesians (Abeyasekere and Owen 1987). The land available for household agriculture and fishery decreased, destroying community ecosystems, while poverty and the incidence of cholera simultaneously increased in the kampungs (see Booth 1988; Elson 1986).

13.3 Setting Boundaries of Citizenship: Laying Down Pipelines and the Birth of Modern Housing in Twentieth Century Batavia

As of 1870, the first liberal policies were implemented in the East Indies (now Indonesia). Private companies and individuals could participate in trading and appropriate land with 20–75 year leasing. This led to a huge inflow of Europeans to Batavia between 1870 and the 1930s (Kop 2008; Van Roosmalen 2008). Responding to this new socio-economic situation, modern state institutions were formed to fulfil their aspirations for good housing and improved environmental conditions (Blackburn 2011; Van Roosmalen 2011). Also, engineering works shifted from solely focusing on economic production, to incorporating public health concerns, as concentrated demographic growth was perceived as a threat to public health. Following the Department of Public Works' (BOW) formation in 1866, a public water service was created in 1873 (Kop 2008).

It was in this socio-economic context that modern citizenship came into existence in Batavia. Citizenship, as having the right to access basic infrastructures for living, was granted to those who contributed to the city's economy. Granting the basic rights to those with a specific economic status needed certain territorial processes. Although conceptualised as individual entitlements, the concept of rights

Fig. 13.1 Batavia in 1935: the colonial city and spatial distribution of kampungs (Source: redrawn by the author based on the following maps: Batavia 1897 and 1935 (Courtesy of KIT/the Netherlands Royal Tropical Institute), Batavia hydraulic situation 1900 (Kop 2008), Batavia water networks 1900 (Kop 2008), Artesian supply water networks in Batavia 1873–1922 (Kooy 2008), Ethnic distribution of the population in Batavia (Abeyasekere and Owen 1987))

was articulated through physical infrastructures for certain groups of people living in the same geographical areas.

In the first decade of the twentieth century, engineer Van Breen developed an integrated network of canals and rivers in Batavia (see Fig. 13.1). It was designed for flood management, irrigation and flushing, besides keeping the main functions of the water bodies as a water source. During the wet season, these water networks were expected to protect the inner city of Batavia from floods, while during the dry season water was channelled for flushing. In 1910, city flushing became the public works agency's second priority after clean water provision (Kooy 2008; Kop 2008). In nineteenth century Batavia, depositing human waste in the ground or discharging wastewater into open waterways was considered appropriate; it was assumed that the soil would destroy any pathogens, while a fast stream would dilute the waste and wash it away (Kop 2008). By the twentieth century, the government realised that this practice was not sustainable and considered human and domestic wastewater a serious problem.

While benefiting those living in the inner city, the water infrastructure designed by Van Breen diverted the unwanted flows of flooding and wastewater into lower areas of the city, mostly bringing calamities to the kampung communities in these areas.

Channelling storm water and quickly removing wastewater away was widely implemented without considering the effects on the environment outside the 'protected' or 'safeguarded' territory. By draining the city as soon as possible instead of holding, treating, and absorbing water in urban areas, groundwater recharge was limited, causing water scarcity and declined traditional wells.

Figure 13.1 illustrates state water infrastructure in 1935, separating the colonial city from most of the surrounding kampungs. The Van Breen system had a technical function, but at the same time it created a social divide. Fundamentally, their geographical distribution helped define the administrative boundary of the new colonial town, centred in *Weltevreden*. The old town's wall had been demolished, but the new urban agglomeration in *Weltevreden* needed a geographical definition. The borders of twentieth century Batavia also differentiated the inner kampungs from the others located further in the southern areas.[1] Those that lay within the borders became the main targets of the colonial government's development policies.

The 'new' city was a forum for controlling the population and imposing new orders and rationalities. Spatial planning became an effective governing instrument. A zoning system was introduced, with new (luxurious) housing clusters (see Harjoko 2009; Van Roosmalen 2005). Spatial order based on racial segregation was intended to be replaced by one based on class, instrumentalised through the designs of urban planners (Cobban 1992; Kusno 2000). Still, there was a considerable lack of affordable housing for non-Europeans so urban kampungs provided their only option. The twentieth century progress in spatial planning helped increase discrepancies in water and sanitation access through discriminative housing policies and public space provision systems. New houses for the Europeans became the first target for piped water network expansion, whereas kampungs were left behind (see Kooy 2008).

By the 1920s, the 119 km of water pipelines only served around 4000 inhabitants (less than 4 % of the total population); the beneficiaries were mainly Europeans and a few Chinese (Ibid. 2008). The clean water provision reduced water-borne diseases (a health report cited in Kop 2008), but not among indigenous or Chinese populations (Blackburn 2011). By 1918, the government had built 100 public bathing places and 15 public washing points for the kampung communities, reaching 70,000 people (see Kop 2008). However, this was insufficient to meet the overall demand for clean water and accommodate water supply preferences in the kampungs across all of Batavia. Figure 13.2 shows that in the mid-twentieth century, some communities still washed using water from the main canals along the boulevards, despite its poor quality. This practice continued due to limited water supplies to the kampungs and because housing did not comprise enough interior space for such activities.

[1] Under the influence of ethical policies, more attention was paid to kampungs and the Kampung *Verbetering* initiative (kampung improvement) was launched. This initiative aimed to improve roads, pathways and drainage, but only in kampungs defined as parts of the urban centre (see Harjoko 2009; Verschure 1979).

Fig. 13.2 Washing in Molenvliet, ca. 1950 (Source: Courtesy of KITLV/Royal Netherlands Institute of Southeast Asian and Caribbean Studies)

The policy assumption behind the spatial distribution of water infrastructure networks was not to deliberately ensure equal access to water for all inhabitants. Native inhabitants supposedly had less need for water than other community groups (see Kop 2008). Moreover, many Javanese were known to share traditions of collective bathing in public spaces for social and religious ceremonial purposes (Quinn 2011; Van Dijk 2011). This was understood as a sign that they did not want individual domestic connections to water supply (see Kooy 2008). The policy-makers did realise that different ethnic groups had different water consumption patterns, but this merely served to legitimise the focus on meeting the needs of European populations while neglecting the preferences of others.

State institutions are arenas of interplay between those who govern and are governed, from which several rationalities concerning populations and resource management arise (Chatterjee 2004; Kooy and Bakker 2008a). In these arenas, certain ideals of sanitary behaviour were constructed (Jewitt 2011; McFarlane 2008a), with which indigenous communities could be disciplined into compliance with modern European ideals (see also Kusno 2000, 2010). The presence of taps inside modern houses became a conspicuous consumption norm that enhanced social stratification (Saunders 1984). Individual access to water supported personal hygiene practices introduced by the Europeans. Contrary to the old Javanese tradition of collective bathing, the Europeans bathed privately. European bathing practices were adopted by Javanese elites, especially after modern housing had been introduced and soap was massively advertised in newspapers. Toilets, bathrooms

and soaps became inseparable from the (re)production of norms and beliefs about cleanliness (Van Dijk and Taylor 2011).

As an integral part of state institutions, planning also had an intangible dimension to pair the territorialisation processes of physical planning. For example, water consumption norms addressed populations as fluid subjects in the city despite their attachments to certain places or communities. Consumption norms are part of governing institutions that function across territories and could be seen as the glue for integrating different spatial discrepancies in basic infrastructure services. This integrating principle constitutes a concept of citizenship. But in the case of Batavia, it was already discriminating since its inception. It was European-biased and the government provided no room for others to channel aspirations and perform more powerful roles.

Certain territories have to be defined as a platform to articulate and actualise the concept of citizenship. Through spatial planning practices, moulding citizenship will always imply an exclusive entitlement process. In Batavia, it was expected that there was a voluntary association to the state provision system of basic water infrastructure services. But in fact, no such voluntary membership existed. To enjoy access to state water and sanitation services, one had to follow, and afford, particular standards of living. These standards were institutionalised and enforced by the government through certain networked infrastructures such as canals and water pipes. The territorial demarcation directed by the engineering logic attached to the Van Breen system, for example, had framed the discourse of public sphere. Mainly within this delineated territory, the colonial policy of public health and water sanitation service provision were further implemented. Moreover, Van Breen's technological instruments increased the territorial visibility of the colonial city, marking the presence of the establishing regime (see also Kaika and Swyngedouw 2000).

13.4 Revisiting 'Citizenship'

While the concept of citizenship could guide governmental instruments to provide services according to the so-called universal rights, in reality, water and sanitation service provision systems are often developed solely to politically legitimise a governmental regime. As also argued by Chatterjee (2004) as well as Kooy and Bakker (2008b), the government treated the inhabitants as objects of race-based or class-based development policies, rather than citizens with equal rights to water and sanitation. Batavia was created with various forms of injustice and these inequalities were socio-ecologically reproduced through planning initiatives. The modern approach to water and sanitation needs was implemented by enhancing the pre-existing social division and spatial fragmentation.

I argue that there were two factors leading to the concept of modern citizenship failing to function as a framework for inclusive development process and improved water sector performance in Batavia. Firstly, modern citizenship was constructed with the spirit of dividing the whole hydrological cycle to comply with the strictly

divided productive and reproductive sphere within the modern economy system. Citizenship was built on the right to consume, while the city's production as a whole was exclusively organised under one management of the state and according to European ideals. *Guaranteeing universal rights to water and sanitation* was reduced to *promoting individual access to a certain type of water infrastructure*. The colonial government constructed modern urban socio-ecological metabolism by moving towards standardising water infrastructure for domestic needs at city level. Through the process of modernising by standardising, it failed to guarantee basic rights for water and healthy environment for all.

Secondly, by centralising the collective efforts to manage water resources at city level, the colonial government neglected a wide variety of socio-ecological metabolisms at neighbourhood level. Such a governing approach was contrary to the needs for a hydrological balance through creating an ensemble of different socio-ecological processes across territories, necessary for continuously supplying water and improving environmental sanitation in the city.

The production of modern Batavia implied complex territorialisation processes. Modern citizenship was constructed by imposing a very clear demarcation lines. However, targeting particular groups in society within the delineated areas was in fact a contested process. This could not eliminate a plurality of practices in perceiving the environment and relating to society. The fluid process of place-making in Batavia challenged the way colonial government set up the water management system by homogenising the needs for water and sanitation services. The multiple processes of inclusion and exclusion incorporate complex socio-political dynamics across borders. Hence, it could not be argued that the discrepancy in access to water and sanitation services (quality and quantity) in Batavia was merely a result of physically excluding others within the urban territory in which a certain type of service was provided. Including kampung communities of colonial Batavia within the state infrastructure service would not have guaranteed actual subscriptions to the service or satisfaction of diverse needs. Neglecting different 'water practices' within communities led to the first problematic step in the policy-making processes at the time.

The existence of kampungs was the essential socio-ecological metabolism of the city. Urban kampungs were the socio-spatial product of active community-driven processes by which low-income populations found affordable solutions for accessing housing and food while maintaining jobs in the city. However, within the governing system introduced by the colonial government, the knowledge possessed by kampung communities became a non-part of the imagined collective domain of the 'modern' provision-consumption sphere. The colonial policy-making processes did not recognise kampungs as socio-ecological entities in which communities could perform collective efforts to meet their water and sanitation needs. I argue that one vital aspect of new citizenship would be to recognise specific, community-based knowledge as the basis for an inclusive governing system. Place-specific ecological metabolism in interactions with different territorial dynamics embedded within kampungs constitute essential knowledge to improve the overall urban water management, but are very often forgotten because of the benign neglect of authorities.

There are some principles that could be derived from the experiences of communities in Jakarta's traditional kampung. Keeping the water cycle closed was part of the naturally-inseparable socio-ecological metabolism within the productive and reproductive spheres at neighbourhood level. The right to consume also meant the obligation to protect water sources at local level. A new concept of citizenship could be developed to promote collective initiatives for providing water and sanitation services by and to people that belong to the same place. The first condition of place-based citizenship is a consensus regarding location and demarcation lines of the collective entity. But, place-based citizenship also needs to perform as a collective membership and have certain responsibilities to the larger society i.e. urban citizenship. In return, the urban citizenship needs to protect the rights of communities to sustain as socio-ecological entities.

As there are many different ways to organise water resources and environmental sanitation, it is crucial to continuously define the most appropriate collective and context-specific provision systems of water-related services. A decentralised approach to water management, applying affordable and small-scale technological systems, is considered appropriate for Jakarta today due to its social, ecological and place-making diversity (see Putri 2014). The approach opens room for localised planning processes to accommodate local socio-spatial characteristics in specific urban settings. In this way, there are opportunities for local actors to decide how water infrastructure systems are planned, operated and maintained.

To conclude, new citizenship in urban water governance is centred around place-based citizenship for open access to govern water and water services. Although the idea of place-based citizenship opens community participation in the water sector, it is a great challenge to create space for citizen empowerment with which communities are not seen as clients or consumers relying on decisions of powerful others to fulfil their basic needs (Allen et al. 2006; Hickey and Mohan 2005). New citizenship necessitates *place-based citizenship* to be paired with *national citizenship* that implies the role of the state beyond the needs to formally grant access to universal rights of the domestic water provision system. The state needs to grant the rights of communities to actively govern. If differentiation as a consequence of planning cannot be avoided, the challenge is how to ensure that such differentiation does not lead to unequal access to quality water and sanitation services and related social injustice. Instead, there should be *varied treatments of difference* leading to the recognition and accommodation of specific community needs, such as the low-income groups residing in Jakarta's kampungs.

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Conclusions: Retracing Urban Trajectories Through Water

This book retraces urban trajectories through contrasting attempts to tame water, to domesticate its flow and regulate its quality and quantity, and transform it discursively and materially. While reading the city through water flows has received considerable academic attention, a cross-reading of the different chapters collated in this volume suggests that retracing the city through fine-grained accounts of how water trajectories operate might offer valuable insights, not only to urban theory but also to the making of cities.

Visions and interventions to reconfigure urban water trajectories are confronted with changing paradigms, ideologies and values. This opens questions as to what principles should be pursued: should current and future trajectories be financially viable, environmentally sustainable, resilient to climate change and socially just? The actions and decisions of state and non-state actors – public and private utilities, independent entrepreneurs, disaster risk and water committees and ordinary citizens – respond to different priorities. Urban water actors pursue alternative visions and trajectories, whether they are about expanding infrastructural networks, enforcing cost recovery systems, securing a livelihood, minimising the impact of floods and droughts or accessing drinking water at an affordable cost. Living in the midst of change, actors and observers often suffer from split vision – we look for either context specific challenges or universal planning aspirations but are unable to see them both at the same time.

This book offers a number of insights to refocus and sharpen our vision, enhancing our ability to grasp the multiple ways in which water flows produce cities and urban life. In conclusion we examine how a detailed and interlinked consideration of time, space and relational politics might offer a fruitful path to understand how urban water trajectories work and could be transformed.

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Tracing Trajectories Through Time

A first insight concerns the value of engaging in long term explorations of how cities and water have been imagined, manipulated and transformed over time. This reveals unexpected continuities and discontinuities that cannot be explained as the outcome of a single dominant approach to the governance and management of urban water in any particular period.

As argued in the introduction, for over two centuries the provision of water and sanitation in urban areas appears to have been pursued across the world through a single universalising technocratic vision. However, far from following a universal and engineering-led linear trajectory, many of the accounts examined throughout this volume reveal that urban water trajectories are driven by a variety of processes and decisions that often live outside sectoral water policies and institutions and need to be traced over long periods.

By providing a historical perspective various chapters across the book help us to understand how trajectories have changed in different contexts and what triggered such change, for better or for worse. Urban water trajectories might be closely associated with public health and environmental crises which in turn legitimised the reign of modern engineering in London (Chap. 2 by Jones); with the proliferation of persisting informal practices emerging through the interstices left by colonial segregation policies in Jakarta (Chap. 13 by Putri) or with the pre-modern blue infrastructural legacies of southern Indian cities that might offer past imaginations of the future (Chap. 4 by Sundaresan, Allen and Johnson).

Furthermore, while past engineering-led visions have exhibited unlimited faith on the capacity of modern hydraulic bureaucracies (Molle et al. 2009) to deliver a blue revolution in cities, the contributions in Sect. 2 reveal that availability of new and suitable technology is often not the defining factor driving more sustainable urban water trajectories, as its uptake at scale relies on economic considerations, social acceptance, supporting policies and political will.

Taking a long term perspective to examine how different visions have been framed and materialised in specific contexts reveals that across colonial, post-colonial, industrial or post-industrial trajectories, the development of urban infrastructure configures the making and unmaking of urban nature, economic paths, spatial patterns and densities, land values, livelihoods, human life and for many the activation or alienation of their right to the city.

The various chapters across this volume confirm the fluidity of urban water trajectories but also highlight the malleability and changing nature underpinning their governance. For instance, Disco (Chap. 1) explores the water metabolism of Amsterdam from the twelfth century until present and reveals the ephemerality of successive water regimes, as each regime was based on specific values attributed to water and hence was the outcome of latent or overt social conflicts. Thus a long term perspective suggests that what we regard as unsustainable or oppressive water regimes today, might not last forever, allowing us to imagine how such regimes might be transformed.

Interrogating Trajectories Spatially and at Multiple Scales

A second insight refers to the importance of interrogating how urban water trajectories are shaped and reshaped at multiple scales, with what consequences, where and for whom. Several chapters in this volume provide an appreciation of the spatiality of urban water trajectories, taking us from the scale of the urban region to that of the household.

Changing dominant trajectories in cities and urban areas is challenging and takes time. But the chapters in this book demonstrate how change can be triggered, providing examples of different drivers (technology, main actors, natural/environmental circumstances or change) operating at different scales. For instance, in Chap. 2, Jones takes us through a fascinating exploration of the construction of purpose-built laboratories for water quality examination in London in 1938. The building itself represents the inauguration of a new conception of 'modern' urban water systems and of the communicative construction of a new interplay between water producers and urban consumers.

In Chap. 7, Hofmann leads us across the different scales through which ordinary men and women travel in and out of water poverty in Dar es Salaam. Travelling from the scale of the household, to that of the settlement and the city as a whole reveals how individual trajectories in and out of water poverty are shaped by a nested set of relations that enhance or limit people's mobility by making possible the accumulation of assets, information and social relations as well as accessing opportunities and entitlements that originate outside the settlement.

Focusing on the kampung – a socio-spatial entity formed outside the enclaves of state-led planned settlements in the colonial Jakarta or Batavia – Putri (Chap. 13) shows how the examination of conflicting processes of territorialisation in domestic water management offers a productive path to ground discussion on how citizenship is actually claimed in the spatial and social interstices of modern sanitation planning enforced throughout the colonial and post-colonial periods.

Water policies and visions contain embedded spatial assumptions and aspirations. Hurlimann, Wilson and Keele (Chap. 4) examine how spatial relations are conceived in the crafting of water policies aimed at promoting sustainable water regimes. Their comparison of London and Melbourne shows how spatial and economic considerations are deeply blended and how water is often used as a strategic instrument to enhance the economic productivity of a city.

Shifting the attention from policy visions to the actual spatial processes that structure urban water trajectories, White (Chap. 11) builds a compelling case on the value of engaging on a spatial examination of how urban water transitions actually work. He argues that rather than focusing on any prescriptive notion of how a water sensitive city might look like, it is worthwhile to interrogate how the speed and scale of land use change facilitates or hinders differing flows of finance, regeneration opportunities or free development space, which in turn explains path dependence and how institutional, cultural and technological norms may resist policy attempts to transform existing water trajectories.

The spatiality of changing water trajectories are captured not just through the analysis of the actual materialisation of such trajectories consolidated through land use and infrastructure development trends, but also by interrogating the type of spatial knowledge that informs participatory debates and negotiations on what should be changed in the first place. Miranda, Pfeffer and Baud (Chap. 6) show how iterative mapping processes might reveal uneven geographies of water-related vulnerabilities and inequalities in and around Lima, and in turn enable a cross-boundary social construction of knowledge that can support more effectively a shift from sectoral to integrated spatial planning.

An in-depth exploration of the spatiality of both the actual processes of material change taking place in a city and of the knowledges and competing visions deployed to reorient existing water trajectories allows a more nuanced assessment of the actual options, choices and opportunities available to confront the social and environmental injustices currently reproduced by such trajectories at different scales.

Untangling Trajectories as the Outcome of Relational Politics

A third insight takes us to reconsider urban water trajectories as the product of relational politics effected through intersecting processes, meanings and practices, from those shaping wider social contracts among the state, the market and ordinary citizens, to those regulating everyday life.

Outlining a path to read the making of cities through relational urban politics, Edgar Pieterse (2008, p.3) reminds us that: '[i]nstitutions are not merely containers of political intent, but rather mediate in a fundamental sense how interactions between diverse political actors (and agendas) are structured and channelled'. This compels us to explore the entangled dynamics of state and non-state actors beyond mainstream accounts that award monolithic power to different governmentality ideologies and practices, whether those associated to the Welfarist state or to market-led urbanisation. While there is ample evidence that formal liberal democratic norms and institutional procedures drive the production and reproduction of structural inequalities and infrastructural archipelagos that characterise capitalist urbanisation, we should exert caution in attributing overriding power to wider structural forces and institutions.

In recent decades, water has been used as an entry point to reveal how neoliberal and neo-corporatist ideology came to dominate the governance of urban infrastructure and services. It is in this line that Ioris (Chap. 12) invites us to explore how the uncritical adoption of visions of world-class and globally integrated cities adopted in Glasgow and Lima has been accompanied by the appropriation of the notions of public participation and decentralisation by the same agencies that in the past promoted highly centralised, disjointed and politically asymmetric administration.

But while other forms of political engagement through contestation and direct action might be crowded out by wider water governance reforms, collective agency is never annihilated but constantly reconfigured through familiar and unfamiliar

practices. Reading through the interstices of water politics offers the lens to identify how water trajectories are shaped through complex networks populated by a multitude of actors, ideologies and practices that transcend the governmentality of the state and the market and challenge homogenising assumptions. In Chap. 3, Sundaresan, Allen and Johnson show that we can only make sense of the successive networks configuring and reconfiguring the blue infrastructure of a city by reading these networks in the light of transforming political relations of governance rather than from the notion of an indifferent and incapacitated state or the disappearance of traditional community management institutions.

The various contributions in Sect. 3 reveal that the right to water and sanitation does not equate to one particular trajectory or governance model but has been embedded in different narratives and practices, ranging from community mobilisation to initiatives driven by profit-seeking agendas. The emergence of new actors or in some cases acknowledgement of 'alternative stakeholders' has widened the spectrum in the governance debate from the more traditional public-private dichotomy.

Alternative stakeholders are playing key roles in shaping urban water trajectories and their formal acknowledgement is increasing. This includes collective arrangements and practices to provide services which operate in the absence of formal provision (see Chaps. 8 and 9) but also more and more involvement of citizens in the decision-making about and acceptability of future options, as discussed in Chaps. 5 and 6. Keatman's analysis of the broad spectrum of independent private providers operating in areas of the city where networked infrastructure is unavailable asks us to reflect on the grey zones between formal and informal provision and the many opportunities to extend services for the poor that exist here, depending on how alternative business services are recognised and supported.

Examining the experiences of Berlin and Buenos Aires, Lobina (Chap. 10) shows us how remunicipalisation can sow a seed for more democratic and just urban water trajectories but also warns us that whether this is achieved depends on the actual political conditions and networks that drive the process. Similarly, Walnycki examines the potential of community participation and ownership in managing decentralised systems in partnership with the state in Cochabamba, but also critically engages with the limitations of service co-production, highlighting the role of democratic laws and government practices in actually endorsing or alienating people's rights to urban water and sanitation. As argued by Allen (2012) state-citizen service co-production can equally be motivated by instrumental objectives that emerge out of the limited (e.g. political, financial, and regulatory) capacity of the state to provide universal services or out of a political project, in which co-production is intentionally (and not by default) conceived as a way of transforming governance within the realm of participatory democracy.

Framing water and sanitation rights as part of the wider right to the city can be useful in revealing existing injustices, legitimising existing struggles and claims to enhance advocacy, accountability and support. However, the contributions in Sect. 3 show how vagueness in such framing might also make it difficult to operationalise such rights locally, leading in some cases to the appropriation of a rights-based approach by differing and often contradictory agendas. The acknowledgement of

sanitation as a distinct right in 2015 has the potential to impact urban water trajectories in the future. Recognising the distinct features of sanitation requires challenging predominant conceptualisations that automatically tie trajectories of improved sanitation with the expansion of water-borne systems. As argued by Wilcox, Bell and Nasari (Chap. 5), in an era of increasing water stress, we ought to think about more sustainable ways to manage this renewable, yet finite, resource. If taken seriously, this could significantly influence the trajectories of water and sanitation infrastructure and services in cities. But the ingenuity in finding suitable options cannot be limited to technical solutions and needs to consider the context specific web of political relations that either activate or curtail such choice.

Tracing Trajectories

The contributions to this book offer a nuanced and complex perspective on past, present and future urban water trajectories. Each of the chapters tells a context specific story and emphasises particular aspects that offer important insights to guide future water trajectories. Tracing water trajectories involves far more than tracking down a city infrastructure and the governance arrangements that support its production and maintenance. While the latter might present the city in a normative and functional way, many contributions in this book demonstrate that urban water trajectories are fundamentally entangled and crafted by multiple actors and deviations from engineering-led approaches.

Tracing water trajectories reveals not only that urbanism is historically, spatially and politically relational but that detailed readings of the forms and politics of such trajectories hold fundamental clues about how water shapes urban form, nature, people and rights and the balance between path dependence and active steering of future urban change. Urban water trajectories embody pipes, channels, rivers, tanks, symbolic meanings and rituals, as well as individual and collective needs, choices and life aspirations. Above all urban water trajectories embody not just the human metabolism of nature but the political production of water flows embedded in the making and potential transformation of cities.

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