Water Governance - Concepts, Methods, and Practice

Francine van den Brandeler

Scalar Mismatches in Metropolitan Water Governance

A Comparative Study of São Paulo and Mexico City

Springer

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This book series aims at providing a platform for developing an integrated perspective on major advances in the field of water governance. Contributions will build bridges across established fields of expertise, across disciplinary perspectives, across levels from global to local and across geographical regions. Topics to be covered include conceptual and methodological advances capturing the complexity of water governance systems, institutional settings, actor constellations, diagnostic approaches, and comparative studies of governance systems. The book series encompasses monographs, textbooks and edited, coordinated volumes addressing one theme from different perspectives. The book series will address mainly a wider scientific audience, but will also provide valuable knowledge to interested practitioners. The sustainable management of fresh water resources and the ecosystem services that they provide is one of the key challenges of the 21st century. Many water related problems can be attributed to governance failure at multiple levels of governance rather than to the resource base itself. At the same time our knowledge on water governance systems and conditions for success of water governance reform is still quite limited. The notion of water governance aims at capturing the complexity of processes that determine the delivery of water related services for societal needs and that provide the context within which water management operates. Water governance is a fast growing field of scholarly expertise which has largely developed over the past decade. The number of publications in peer reviewed journals has increased from less than 20 in the year 2000 to nearly 400 in the year 2013. The increasing popularity of the term in science and policy has not lead to conceptual convergence but rather to an increasing vagueness and competing interpretations of how the concept should be understood, studied, and analyzed; which disciplines are involved; and what methodological approaches are most suitable for the study and analysis of water governance. The time seems to be ripe for comprehensive synthesis and integration.

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Contents

Abbreviations

ANA	Agência Nacional de Água (National Water Agency)
APRM	Áreas de Proteção e Recuperação dos Mananciais (Areas of Protection and Recovery of Springs)
ARSESP	Agência Reguladora de Saneamento e Energia do Estado de São Paulo (Regulating Agency for Sanitation and Energy)
ATB	Alto-Tietê Basin
BESS	Biodiversity and ecosystem services
CBH-AT	Comitê de Bacia Hidrografica do Alto-Tietê (Alto-Tietê River Basin Committee)
CETESB	Companhia Ambiental do Estado de São Paulo (São Paulo State Environment Agency)
CHR	Conselho Estadual de Recursos Hídricos (State Council on Hydrological Resources)
CNHR	Conselho Nacional de Recursos Hídricos (National Council on Hydrological Resources)
CODEGRAN	Conselho Deliberativo da Grande São Paulo (Deliberative Council of Greater São Paulo)
COFEHIDRO	Conselho do Fundo Estadual de Recursos Hidricos (Council for the State Fund for Water Resources)
CONAFOR	Comisíon Nacional Florestal (National Forestry Commission)
CONAGUA	Comisíon Nacional De Água (National Water Commission)
CORENA	Mexico City's Natural Resources Commission
CSO	Civil society organization
DAEE	Departamento de Águas e Energia Elétrica (Department of Water and Electricity)
EMAE	Empresa Metropolitana de Águas e Energia (Metropolitan Company of Water and Electricity)
EMPLASA	Empresa Paulista de Planejamento Metropolitano S.A. (São Paulo Company of Metropolitan Planning)

FABHAT	Fundação da Agência da Bacia Hidrografica do Alto-Tietê (Foundation for the Agency of the Alto-Tietê Basin Committee)
FEHIDRO	Fundo Estadual de Recursos Hídricos (State Fund for Water Resources)
FIESP	Federação das Indústrias do Estado de São Paulo (Federation of Industries of the State of São Paulo)
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
IDB	Inter-American Development Bank
INECC	Instituto Nacional de Ecología y Cambio Climático (National Institute for Ecology and Climate Change)
IPT	Instituto de Pesquisa Tecnológica (Institute for Technological Research)
ITB	Instituto Trata Brasil
IWRM	Integrated Water Resources Management
MASL	Metres above sea level
MMP-ATB	Macro-drainage Master Plan of the Alto-Tietê Basin
MRSP	Metropolitan Region of São Paulo
MVMC	Metropolitan Valley of Mexico City
PES	Payment for ecosystem services
PLANASA	Plano Nacional de Saneamento (National Basic Sanitation Plan)
SAAE	Serviço Autonomo de Agua e Esgoto (Autonomous Water and Sanitation Service)
SABESP	Companhia de Saneamento Básico do Estado de São Paulo (Company of Basic Sanitation of São Paulo State)
SACMEX	Sistema de Aguas de la Ciudad de Mexico (Water Systems of Mexico City)
SDG	Sustainable Development Goal
SEMARNAT	Ministry for the Environment and Natural Resources
SIGRH	Sistema de Informações sobre o Gerenciamento de Recursos Hídricos (System of Information on the Management of Hydrological Resources)
SIMA	Secretaria de Infraestrutura e Meio Ambiente do Estado de São Paulo (São Paulo State Environmental Secretariat)
SINGREH	Sistema Nacional De Gerenciamento De Recursos Hídricos (National Hydrological Resources Management System)
SNIS	Sistema Nacional de Informações sobre Saneamento (National Sanitation Information System)
SNSA	Secretaria Nacional de Saneamento Ambiental (National Secretariat for Environmental Sanitation)
SSRH	Secretaria de Saneamento e Recursos Hídricos do Estado de São Paulo (São Paulo State Sanitation and Water Resources Secretariat)
UGRHI	Unidades de Gerenciamento de Recursos Hídricos (Units of Management of Hydrological Resources)
USP	Universidade de São Paulo (University of São Paulo)

VMB	Valley of Mexico Basin
Wat&San	Water and sanitation
WRM	Water resources management

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Chapter 1
Introduction

1.1 Introduction

Large cities have heavy impacts on their rural hinterlands, while also depending on these and the natural resources they provide. Between 2013 and 2015, a major drought brought the metropolitan region of São Paulo to the edge. Reservoirs outside the city were running so low that bars and restaurants all over the city shut doors or started using plastic cups because they had no water to rinse dishes. Household taps ran dry, especially in the outskirts, and protests ensued. Rains eventually brought water to parched reservoirs but, by late 2021, much of the South and Southeast of Brazil—including São Paulo—faced the worst drought since these extreme weather events began to be recorded in 1910. In 2018, the city of Cape Town made international news headlines for months as it was battling a severe water shortage and heading closer to 'Day Zero', the day that municipal water supplies would be shut off (Alexander 2019). The reallocation of water earmarked for agriculture to urban residents helped mitigate the looming disaster. In 2003, a dam that supplies water to Mexico City through an inter-basin water transfer flooded 300 ha of fields cultivated by the Mazahua indigenous community (Marcos and Fernández 2016). The Federal government did not respond adequately to their claims, leading to peaceful but long and highly mediatized protests by Mazahua women for compensation and access to drinking water.[1]

Such examples illustrate the rising challenges in terms of water quantity, quality and climate change adaptation for cities and their rural hinterlands. These tensions are triggered by a combination of population growth, urbanization, economic growth, consumption patterns, anthropogenic climate change, land use and other driving forces at multiple levels (Vörösmarty et al. 2000; Elmqvist et al. 2013; Nobre and Marengo 2016; UN-HABITAT 2016). Water challenges are particularly severe in

[1] Despite living near the large dam, local Mazahua communities were not connected to the public water supply network.

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megacities of the Global South, marked by stark inequalities within the urban agglomeration and between the city and its rural hinterlands, and where the urbanization process is unfolding at an accelerated pace (Elmqvist et al. 2013; Azzam et al. 2014). Although the world's 100 largest cities occupy less than 1% of the planet's land area, the basins that provide their water resources cover more than 12% of it (ARUP 2018). Estimates indicate that cities with populations larger than 750,000 people draw water from almost half of the global land surface and transport it over a cumulative distance of 27,000 km (McDonald et al. 2014).

This book examines the tensions between cities and their river basins through interactions between metropolitan governance regimes with integrated basin management regimes. More specifically, it explores the role that institutions play in urban water challenges, how effective existing policy instruments are in addressing these challenges within metropolitan regions and how more sustainable and inclusive institutions could be designed for this purpose. It does so by focusing on the cases of São Paulo in Brazil and Mexico City, in Mexico—two major megacities facing a wide range of water-related challenges (see Sect. 2.2.2).

This introductory chapter presents the growing worldwide tensions between water use at urban and river basin scales, their theoretical underpinnings, the gap in scholarly knowledge, and their policy implications (see Sect. 1.2). It then introduces the ensuing research questions that this book aims to answer, as well as its focus and limits (see Sect. 1.3), provides a background on the nature of water (see Sect. 1.4), discusses the position of the researcher (see Sect. 1.5) and, finally, the overall structure of the book (see Sect. 1.6).

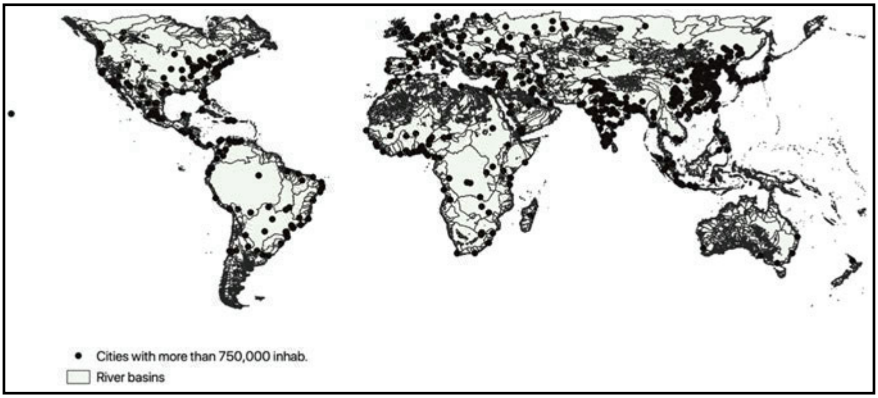
1.2 Water Challenges and Metropolitan Regions

1.2.1 Rising Water Challenges in an Urbanizing World

Today, around 56.2% of the global population is urban (UN-DESA 2018).[2] As this number rises in the coming decades, the burden cities impose on their river basins is likely to intensify, even if in an uneven manner (see Map 1.1). The Global South will lead this urban growth. Asia and Africa will add 2.5 billion urban residents by 2050 (see Fig. 1.1) (UN-DESA 2018). Latin America, already one of the world's most urbanized regions, should see urban populations increase from 81% in 2015 to 88% by 2050 (see Fig. 1.2) (UN-DESA 2018). By comparison, 82% of Northern America's population lived in urban areas in 2018 (UN-DESA 2018).

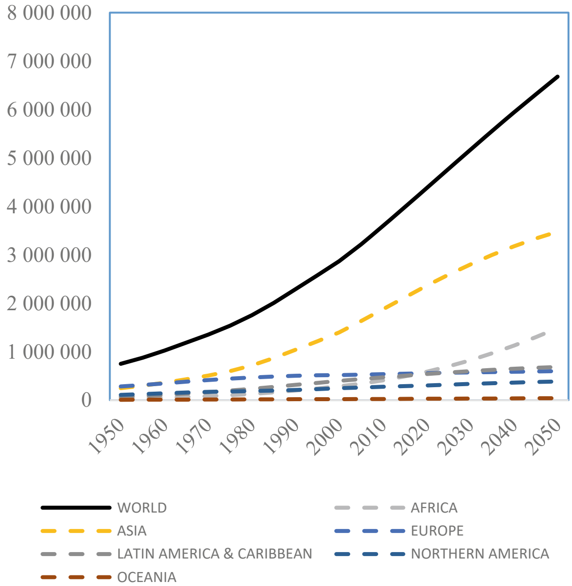
As the global urban population rises, so does the number of cities of various sizes. More and more people are living in metropolitan regions, characterized by a contiguous urban area often governed by multiple political jurisdictions (see Box 1.1). In 1950, 177 cities had more than 500,000 inhabitants. This increased to 1067 by

[2] Recent research suggests that urbanization levels are much higher, due to the fact that countries self-report their demographic statistics and use very different standards (Scruggs 2018).



Map 1.1 Large cities and basins around the world in 2015. *Source* Author

Fig. 1.1 Global expansion of urban population, 1950–2050 (thousands)



2015 and it is expected to further rise to 1416 by 2030 (see Table 1.1) (UN-DESA 2018). Megacities, the focus of this book, are defined as cities of 10 million inhabitants or more; they have increased from 2 in 1950 to 29 in 2015 and possibly 43 in 2030 (UN-DESA 2018). Urban settlements with less than 300,000 inhabitants will remain the largest in number and in total population. Nevertheless, the population of larger cities is increasingly predominant both in relative and in absolute terms. In 1950, less than 10% of the global population lived in cities larger than 500,000 inhabitants; by 2015 this population had increased to more than 27%, and it is projected to reach more than 33% by 2030 (see Fig. 1.3) (UN-DESA 2018). This recent, yet

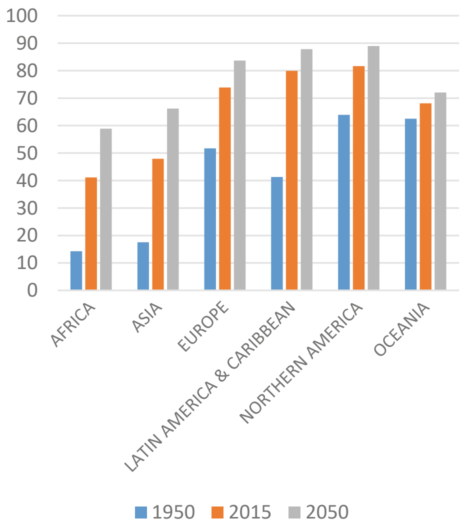


Fig. 1.2 Urban population per region (percentage)

Table 1.1 Evolution of the number of urban settlements per population size

Population size	Number of urban settlements		
	1950	2015	2030
10 million or more	2	29	43
5–10 million	5	45	66
1–5 million	69	439	597
500,000–1 million	101	554	710
300,000–500,000	129	707	827

Source Based on raw data from UN-DESA (2018)

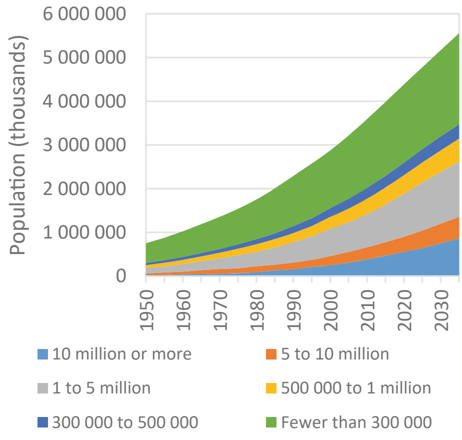


Fig. 1.3 Evolution of population per size classes of urban settlements

accelerated, worldwide transformation of the natural environment through urbanization is a characteristic of the 'Anthropocene'.[3]

While agriculture represents 70% of global water use, large urban agglomerations can have disproportionate impacts on their river basins. As cities around the world grow, so does their demand for goods and services, including resources such as water, food and energy, which come largely from surrounding areas (Jenerette and Larsen 2006). Besides population growth, the economic development that often follows urbanization further increases per capita water use in cities (McDonald et al. 2014). Urban water demand is expected to increase by 80% by 2050 while total available freshwater remains more or less constant (Flörke et al. 2018). This demand is unevenly distributed across the world's river basins. Between 1.6 and 2.4 billion people live in river basins that experience water scarcity (Gosling and Arnell 2016). In quantitative terms, 'chronic water shortages' take place when an area's annual water supply drops below 1000 m^3 per person, and 'absolute water scarcity' takes place below 500 m^3 per person (FAO 2012).[4] Managing water resources across large cities and their river basins has led to increasing competition, tensions and conflicts (Varis et al. 2006; Tortajada 2008). Despite the far-reaching impacts of these cities, and their potential to influence basin management, cities invest very little in their basins (ARUP 2018).

Box 1.1 Definitions of Large Cities

There are multiple terms to refer to cities but no internationally-recognized definitions with standardized criteria for determining the boundaries of any given urban area (Slack 2007; Knieling 2014; United Nations 2016b). 'City proper' is used to define a city according to an administrative boundary (United Nations 2016b). Terms associated with large, multi-jurisdictional urban areas include metropolis, metropolitan area, metropolitan region, megacity, urban agglomeration, and more. Definitions generally refer to a large urban core with adjacent urban and rural areas that are socially and economically integrated with the core (Slack 2007). The key terms are:

Urban Agglomeration: This definition is based on physical characteristics as it considers the extent of the contiguous urban area, or built-up area, as the limits of the city's boundaries (United Nations 2016b).

[3] The term 'anthropocene' is a geologic term for an epoch that starts when human activities began to have a significant global impact on the Earth's ecosystem (Crutzen and Stoermer 2000).

[4] Population growth and climate variability and change may lead to as many as 3.1 billion people (37% of the global population) living in water scarce river basins by 2050 (Gosling and Arnell 2016).

Functional Urban Areas: Urban area defined by a method that relies on settlement patterns and commuting flows rather than administrative borders (OECD 2012).

Metropolitan Regions: The term 'metropolitan region' is used by international institutions (OECD, World Bank, etc.) and European authors (Herrschel and Newman 2002; Salet et al. 2003; Sellers et al. 2013) to describe highly urbanized, city-regional areas characterized by high population densities and the concentration and interconnectedness of economic, political and cultural activities (Knieling 2014; United Nations 2016b). These cities are typically composed of multiple jurisdictions with independent political authorities. Minimum population thresholds for the city core are not necessarily very high (i.e. 50,000 or 100,000 in some cases), but adjacent areas of lower density are connected to the core and under its influence (United Nations 2012; Knieling 2014).

Megacities: The term 'megacity' has been defined by the United Nations as an urban agglomeration of at least 10 million inhabitants (United Nations 2012).

Metacities: UN-Habitat introduced the term 'metacity' to describe "massive conurbations of more than 20 million people" (UN-Habitat (United Nations Human Settlements Programme) 2006).

Megalopolis: This term refers to a clustered network of cities. There is no consensus on population size, with definitions ranging between 10 million (Doxiadis 1970) and 25 million (Gottmann and Harper 1990).

The definition of a city's boundaries has implications for population assessments (United Nations 2016b). Although the two case studies in this study—São Paulo and Mexico City are 'megacities', this study favours the terms metropolitan region or area as these are the terms used by the relevant authorities of each jurisdiction.

Rapid urbanization and land use changes have also caused water quality deterioration through drastic interferences in ecosystems and the hydrological cycle (Azzam et al. 2014). Deteriorating water quality poses significant risks to human and environmental health (OECD 2015b). Estimates indicate that around one third of all rivers in Latin America, Africa and Asia are affected by severe pathogen pollution, although it is not clear how many people are at risk of coming into contact with polluted waters as current estimates only account for rural populations (UNEP 2018). Water quality in urban rivers is often heavily impacted by point source pollution, such as untreated wastewater discharge, and this is worsened by high population density and the concentration of polluting activities (Vlachos and Braga 2001; Elmqvist et al. 2013). Diffuse pollution from agriculture (e.g. fertilizers and pesticides) and urban sources (e.g. runoff from sealed surfaces and roads) also affects urban areas and is particularly challenging to regulate (Martinez-Santos et al. 2014). Water contamination by large and megacities aggravates issues such as regional water stress and unequal access to water resources (Varis et al. 2006). In addition, treating water to meet adequate drinking water standards can represent a considerable cost for some countries (OECD 2015b). However, inaction is also costly, as contaminated water bodies can lead to outbreaks of waterborne diseases and negatively impact both urban residents and communities and the environment far downstream (Vlachos and Braga 2001; OECD 2015b).

Extreme weather events can cause floods, landslides and droughts with devastating effects on urban and rural settlements. Many large urban agglomerations are located in the Global South and have limited coping capacities (Kraas et al. 2014). As cities grow, they tend to expand into risk-prone areas as available land becomes scarcer and more expensive (UCLG 2016). In 2000, about 30% of global urban land was in high-frequency flood zones. By 2030, this will rise to 40% (Güneralp et al. 2015). These hazards can be part of seasonal variations (e.g. monsoons) and climate variability, but climate change is expected to aggravate their frequency and intensity by causing changes in hydrological patterns, with more evaporation and melting through warming, and more frequent and intensive extreme weather events (Engel et al. 2011). Large cities are particularly vulnerable to climate change, as they are often located in coastal areas, flood-prone areas or areas suffering from water scarcity and droughts (Biswas 2004; Varis et al. 2006; Hansjürgens and Heinrichs 2014). In addition, water-related risks are compounded by human factors such as population density, socio-economic inequality, poor urban planning and the environmental impact of land use changes (e.g. erosion from deforestation, rapid urbanization) (Rietveld et al. 2016).

1.2.2 The Policy Challenge: Implementing IWRM Is Key

There have been many discussions within global policy circles on water-related challenges since the UN Conference on the Human Environment in 1997, including special attention paid to Agenda 21 adopted in 1992 (see Conti 2017; Obani 2018 for details). In 2015, within the context of Agenda 2030, the UN General Assembly adopted water-related goals within its Sustainable Development Goals (UNGA 2015). These Goals highlight areas of priority for the global community to work on. Goals 6 (Ensure availability and sustainable management of water and sanitation for all), 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and 13 (Take urgent action to combat climate change and its impacts), and their associated targets and indicators, are relevant for this research. These goals are linked to water quantity, water quality and climate change adaptation in multiple ways (see Table 1.2).

SDG target 6.5 promotes the implementation of IWRM (Integrated Water Resources Management) at all levels, implicitly recognizing it as the most appropriate management approach to the world's diverse water-related challenges and as necessary to attain all other SDG 6 targets (UNEP 2018). The suggestion that this implementation should take place "at all levels" highlights the multi-scalar nature of these challenges. IWRM is deemed critical for the 2030 SDG agenda as a way of allocating water resources efficiently, equitably and sustainably and coordinating sustainable development in the global context of increasing water scarcity and pollution. Progress on SDG 6.5 is measured by two indicators: a score of 0–100 on the degree of IWRM implementation and the proportion of transboundary basins with cooperation agreements.[5] Nonetheless a 2018 self-assessment survey answered by 172 countries as part of a UN Progress Report on SDG 6, indicated that around 60% were unlikely to implement IWRM by 2030 (UNEP 2018). A 2021 UNEP report on progress on SDG 6 indicators showed that some countries made progress but that overall the world was not on track to achieve target 6.5 (UNEP 2021). Survey from the 2018 results further revealed that sub-national levels lag even further behind and emphasized the need for coordination across levels to ensure the flow of resources to where they are most needed and effective. The survey results mention links with

Table 1.2 The SDGs and targets and their links to water quantity, water quality and climate change adaptation

<table>
<tr><th>Water quantity</th><th>Water quality</th><th>Climate change adaptation</th></tr>
<tr><td colspan="2">6.1 Access to drinking water
6.2 Access to sanitation</td><td>11.5 Reduce effects of water-related disasters</td></tr>
<tr><td colspan="3">11.1 Access to housing, basic services and slum upgrading</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">6.3 Reduce water contamination
11.6 Reduce cities' environmental impact, including through waste management</td><td>11.B Increase the number of cities with integrated policies and plans for inclusion, resource efficiency, climate change adaptation and disaster resilience. Develop holistic multilevel disaster risk management</td></tr>
<tr><td>13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters
13.2 Integrate climate change measures into national policies, strategies and planning
13.3 Improve education, awareness-raising and human/institutional capacity on climate change adaptation, impact reduction and early warning</td></tr>
</table>

(continued)

[5] Indicator 6.5.2 on transboundary agreements concerns basins and aquifers shared by at least two countries.