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Editorial

The Challenges of Water Management and Governance in Cities

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Received: 30 May 2019; Accepted: 3 June 2019; Published: 5 June 2019

Abstract: Combined impacts of sea-level rise, river flooding, increased frequency and magnitude of extreme rainfall, heatwaves, water scarcity, water pollution, ageing or lacking infrastructures for water, wastewater and solid waste in rapidly urbanising regions in the world call for improved water management and governance capacity in cities to accelerate the transition to water-wise cities. The sixteen contributions to this Special Issue create further awareness and present solutions on integrated approaches, advanced water management practices and water governance strategies. It is concluded that cities require a long-term strategy and a multilevel water governance approach. Research has shown how important it is to involve the civil society and private parties early on in this process to create success. Collaboration among cities and regions by sharing best practices for rapid implementation are crucial to cope with nearly all Sustainable Development Goals.

Keywords: water governance; urban water management; resilience; sustainable development goals

1. Introduction

Global population growth is urban growth and, therefore, most of the water-related challenges and solutions can be found in cities. Unless water management and water governance processes are significantly improved within a decade or so, cities are likely to face serious and prolonged water insecurity, urban floods, and/or heat stress, which may result in social instability and, ultimately, massive migration. Aging water infrastructures are among the most expensive infrastructures in cities and a relevant challenge in order to address Sustainable Development Goal (SDG) 6: clean water and sanitation, SDG 11: sustainable cities and communities, and SDG 13: climate action. In fact, many of the SDGs are water-related, directly or indirectly, as shown in Figure 1.

The choice of good governance arrangements has important consequences for economic performance, for the well-being of citizens, and for the quality of life in urban areas. The better governance arrangements work in coordinating policies across jurisdictions and policy fields, the better the outcomes. Rapidly-changing global conditions will make future water governance more complex than ever before in human history, and expectations are that water governance and water management will change more during the next 20 years compared to the past 100 years.

To address these challenges, approaches need to be developed for a directed transition to more sustainable, resilient urban water services, including all stakeholders. In this Special Issue of *Water*, the focus is on practical concepts and tools for water management and water governance in cities. Sixteen peer-reviewed papers were selected for this Special Issue. We have grouped these papers into four categories:

- Introduction to urban water challenges;
- Integrated assessment methods;
- Water management practices; and
- Water governance strategies.

Figure 1. The water-centric 17 Sustainable Development Goals [1].

This Special Issue starts with two policy papers of the international organisations UNESCO and OECD, presenting a summary of their most recent work on policy solutions for sustainable water resources management in urban areas. Both organisations stress the importance of integrated methodologies to assess the urban water challenges across a range of temporal and spatial scales.

The following set of papers present such integrated assessment methods and their application for sustainable water resources management, water-sensitive urban design, urban water reuse, and sustainable wastewater management systems. These papers address the importance of enhancing governance capacity to implement systems for water management in cities.

The third group includes papers that present water management practices to increase water security under climate change conditions. Experiences with stormwater management, urban drainage systems, rainwater harvesting, and flood risk control are analysed and lessons learned are shared.

The urgency of the challenges related to urbanisation and climate change calls for adaptive water governance. In the final group of papers, multi-actor governance strategies are presented to take care of flood resilience, regional water supply and urban watershed management.

The following section summarises the contributions according to this categorisation.

2. Contributed Papers

2.1. Introduction to Urban Water Challenges

Makarigakis and Jiminez-Cisneros [1] provide an overview of the global urban water challenges. To achieve water security, UNESCO is developing tools for science-based decision making, promotes international cooperation through networking, enhances the science policy interface and facilitates education and capacity development.

The OECD developed a water governance indicator framework that cities can use to identify whether water governance conditions are in place and function or need improvement. The framework is composed of 36 indicators, measuring the what (policy framework), the who (institutions in charge) and the how (co-ordination tools for water policies). Romano and Akhmouch [2] report that the OECD framework can provide a global picture on the water governance system, rather than focusing on specific dimensions (e.g., transparency) or specific functions (e.g., water supply and sanitation). They advocate an institutional framework that encompasses accessible information and adequate capacity, sufficient funding and transparency and integrity, meaningful stakeholder engagement and coherence across sectoral policies.

2.1. Integrated Assessment Methods

The second group of papers present integrated assessment methods and their application for a variety of urban water management practices.

Kim et al. [3] examined the status of integrated water resources management of Seoul using the city blueprint approach. which consists of three different frameworks: (1) the trends and pressures framework, (2) the city blueprint framework and (3) the water governance capacity framework. The results indicate that nutrient recovery from wastewater, stormwater separation, and operation cost recovery of water and sanitation services are priority areas for Seoul. Furthermore, the local sense of urgency, behavioural internalisation, consumer willingness to pay and financial continuation are identified as barriers limiting Seoul's governance capacity.

Following the recent drought period, the City of Cape Town is restructuring its policy to include climate change adaptation strategies. Madonsela et al. [4] describe an evaluation of the water governance processes required to implement water-sensitive urban design in Cape Town. The analysis revealed that smart monitoring, community knowledge and experimentation with alternative water management technologies are important when considering uncertainties and complexities in the governance of urban water challenges.

The transformation to widespread application of water-reuse systems requires major changes in the way water is governed. Through the systematic assessment of the city of Sabadell (Spain), Šteflová et al. [5] identified the main barriers, opportunities and transferable lessons that can enhance governance capacity to implement systems for non-potable reuse of treated wastewater in cities. It was found that continuous learning, the availability and quality of information, the level of knowledge, and strong agents of change are the main capacity-building priorities. On the other hand, awareness, multilevel network potential and implementing capacity are already well-established.

Benavides et al. [6] developed a sustainability assessment method for wastewater management in Latin America that is multi-scalar (considering several territorial scales or spatial boundaries in one same study) and multidimensional (considering the different dimension of sustainability). This approach allowed making visible issues that are not shown by single scale analysis, namely, the interconnections of the technical system (waste water treatment) with ecological systems (watershed) and social systems (public administration, community dynamics, social perception).

Lahmouri et al. [7] analysed greenhouse gas (GHG) emissions and compared possible water reclamation with resource recovery scenarios in the town of Leh in India: a centralised scheme, a partly centralised combined with a decentralised scheme, and a household-level approach. Potential sources of reduction of GHG emissions through sludge and biogas utilisation have been identified and quantified to seize their ability to mitigate the carbon footprint of the water and wastewater sector. The study showed that decentralising wastewater management has the least carbon footprint during both construction and operation phases. These results have implications for cities worldwide.

2.2. Water Management Practices

This group of papers looks at urban water management practices that deal with the consequences of climate change such as increased precipitation and flood risks.

Zhang et al. [8] present the concept of a sponge city in Beijing, which allows storm water to be managed with natural infiltration, natural retention and detention, and natural cleaning facilities. It is based on natural and ecological laws and provides "elasticity" in adaptation to environmental changes and response to natural disasters.

One of the crucial elements in the sizing of a stormwater reservoir is determination of duration time and intensity of rainfall. The outcome is, however, affected by significant uncertainty of runoff modelling. Szelag et al. [9] analysed the effect of the uncertainty of a rainfall–runoff model, showing that the desired capacities of the stormwater reservoir were overestimated when uncertainty was neglected.

Haghighatafshar et al. [10] have aligned the engineering of drainage systems with urban planning and design. They introduce a conceptual model of mesoscale sustainable drainage systems (SuDS) that complies with hydraulic, hydrologic and social–ecological functions.

Implementing rainwater harvesting could contribute to the protection against damage caused by increasing precipitation frequency and intensity. Hofman-Claris et al. [11] calculated the total costs of ownership for decentralised drinking water supply from harvested rainwater. In the Netherlands, the amount of rainwater that can be harvested in the city district only covers about 50% of the demand, and the application of rainwater harvesting for drinking water production is currently not economically feasible.

Nicklin et al. [12] assessed the cost of inaction in relation to pluvial flood damages in Rotterdam and Leicester, concluding that investment in flood protection is an economically beneficial approach for cities.

2.3. Water Governance Strategies

The fourth group of papers present governance strategies dealing with urban water challenges through an interdisciplinary, collaborative and network approach.

Based on international comparative research on flood risk governance, Driessen et al. [13] derived key governance strategies that secure the necessary capacities to resist, to absorb and recover, and to transform and adapt. Taking diversification and alignment of flood risk management approaches as an important starting point, adaptive flood risk governance also requires a delicate balancing act between legal certainty and flexibility.

Strategic placement of green infrastructure has the potential to maximise water quality benefits and ecosystem services. Shifflett et al. [14] examined the factors that influence a multi-stakeholder watershed approach to planning, implementing and evaluating green infrastructure techniques in Cincinnati. Green infrastructure planning benefitted from governance strategies that include stakeholder engagement and collaboration.

For effective water governance, the coordination of multiple actors across different institutional levels is important. In a Swiss region, Lieberherr et al. [15] observed the importance of reputational power, i.e., a higher degree of coordination took place when the actors responsible for water supply regarded potential coordination partners as important. Likewise, democratic legitimacy is important, i.e., the stronger the region's capacity to steer, the stronger the coordination.

Tosun et al. [16] looked into transnational city networks on climate change adaptation and showed how these networks embraced goals related to urban water management. The main impact of city networks is to provide a forum for validating and optimising the design of policies and measures and to exchange experiences regarding their implementation.

3. Conclusions

Water challenges are becoming ever more urgent in a world of unprecedented urbanisation and population growth, depleting resources and increasing climate change impacts. Combined impacts of sea-level rise, river flooding, increased frequency and magnitude of extreme rainfall, heatwaves, water scarcity, water pollution, ageing or lacking infrastructures for water, wastewater and solid waste in rapidly urbanising regions in the world call for improved water management and governance capacity in cities to accelerate the transition to water-wise cities.

Cities and their hinterlands face many challenges. In many places, good water governance is the main bottleneck. Cities require a long-term strategy and a multilevel water governance approach. Research has shown how important it is to involve the civil society and private parties early on in this process to create success. Collaboration among cities and regions by sharing best practices for rapid implementation is crucial not only to cope with SDG6 but also with many of the other SDGs.

Integrated solutions are needed, such as water-sensitive design, including rainwater harvesting, recycling, reuse, pollution prevention and other innovative urban water approaches. The contributors to this Special Issue provide a series of papers to create further awareness and solutions by presenting examples of integrated approaches, advanced water management practices and water governance strategies.

Acknowledgements: The authors of this paper, who served as guest editors of this Special Issue, wish to thank the journal editors, all authors submitting papers to this Special Issue, and the many referees who contributed to paper revision and improvement of all published papers.

Author contributions: Kees van Leeuwen conceived and led the development of the Special Issue and this paper; Jan Hofman, Peter Driessen and Jos Frijns each contributed substantially to the writing of this paper.

Conflicts of Interest: The authors declare no conflict of interest.

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