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Research, part of a Special Feature on [Deeper Water: Exploring Barriers and Opportunities for the Emergence of Adaptive Water Governance](#)

A tale of two cities: evidence from the Global South on established versus emerging cities' approaches to adaptive and sustainable water governance

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ABSTRACT. The call for adaptive governance approaches to guide the sustainable transformation of urban water management systems is growing amongst scholars and policy professionals. Responding to this call, the Global North (GN) has focused significant evidence-based research on issues of scale, capacity, and institutional arrangements to support such transformations, whereas evidence from the Global South remains nascent. This paper contributes to the growing body of knowledge from the Global South, discussing how adaptive governance operates under different local contexts and conditions. Following empirical investigations in two cities in Bangladesh, which involved 58 semi-structured interviews, 17 oral histories, and secondary data analysis, and drawing on the adaptive capacity and attributes framework, we examined how scale, capacity, and institutional hybridization might deliver the conditions necessary for guiding a sustainable transformation in water governance. The research revealed that a large-scale urban system such as Dhaka is currently experiencing “lock-in” due to ongoing investments in large-scale infrastructure, inappropriate transfer of technology from GN contexts, bureaucratic complexity, and general resistance to change. In contrast, the relatively smaller urban system represented by the secondary city Mymensingh was found to be more open, flexible, showcasing key enabling factors that might support sustainable growth. Overall, this study sheds light on the role of adaptive governance in the context of system scales and capacity (i.e., institutional / organizational / individual) and reveals how capacity development is linked to key enabling attributes including multi-level and polycentric institutions, participatory approaches, networking, bridging organizations, and leadership. Collectively these findings offer insights into how adaptive attributes can inform sustainable transformation processes

Key Words: *adaptive governance; Bangladesh; Global South; urban water management; water governance*

INTRODUCTION

Urban water systems are wicked, complex, and uncertain, operating against the backdrop of vast environmental degradation, rapid urbanization and climate change impacts (e.g., Milley et al. 2008, Hurlbert and Gupta 2016, Larsen et al. 2016). The complex challenges of urban water systems create barriers to achieving the targets defined by the sustainable development goals (SDGs; Milly et al. 2008, Larsen et al. 2016). To achieve the SDGs and address such complex water system barriers, scholars and water professionals are calling for a shift from conventional urban water management toward approaches that support cities' ability and capacity to adapt to changing circumstances, while maintaining their critical role in ensuring economic, social, and environmental well-being (Larsen et al. 2016, Pahl-Wostl 2017, Romano and Akhmouch 2019). Developing a city's capacity and adaptive ability further requires transformational change whereby urban water governance becomes more integrated and sustainable as key pillars of adaptive water governance (AWG; Brown et al. 2009a, Huitema et al. 2009, Cosens 2015, Larsen et al. 2016, Yasmin et al. 2018, 2020). Cosens (2015:6) suggests that AWG is “appropriate when the system is complex (for example, lies within multiple jurisdictions), the system faces change with a degree of uncertainty (for example, climate change) and the system is approaching a potential threshold or regime shift, as evidenced by increasing conflict over resources, increasing scarcity.” This understanding of AWG has predominantly emerged within the Global North context and incorporates multi-sectoral and multi-purpose long-term initiatives with broad participation and flexible management systems within polycentric / hybrid governance systems aimed at delivering sustainable urban water management (see, e.g., Brown et al. 2009b, Pahl-Wostl et al. 2012, Chaffin and Gosnell 2015,

DeCaro et al. 2017). Although the concept of AWG has been broadly accepted, questions remain in relation to improving, organizing, and/or promoting collaboration and coordination within a polycentric governance system; how to foster trust and ensure democratic legitimacy; how to promote experimental activities and learn from them, among others (Huitema et al. 2009). Although empirical research has begun to explore these questions and identify relevant attributes for operationalizing AWG for sustainable transformation, these are typically within Global North countries. Meanwhile, exploring the suitability and applicability of AWG within the diverse socio-institutional and political contexts of the Global South remains nascent and requires further evidence-based perspectives (Geels 2011, Wieczorek 2018).

Establishing AWG requires exploring concepts and pluralist research approaches from environmental and adaptive governance, along with sustainable transition scholarship to assist with unpacking complex and dynamic system changes and identifying those practices that are effective in practice (Biesbroek et al. 2014, Cosens 2015, Luederitz et al. 2017). Sustainable transition scholarship seeks to unravel different system change processes by examining historical and contemporary practices at different levels of implementation: large or small, international or regional or grassroots innovations (Raven and Geels 2010). On the other hand, adaptive governance scholarship has largely examined the dynamics and governance of resource systems within the social-ecological domain and focuses on the interactions between nature and society. Adaptive governance seeks to improve the capacity of a system by promoting learning feedback from different management strategies that are already being implemented on the ground (Folke et al. 2005, Chaffin et

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al. 2014). Adaptive governance and sustainable transitions are both popular approaches to studying social-ecological and technical system dynamics and capacity in the Global North respectively, and their application within the Global South context is growing (Geels 2011, Karpouzoglou et al. 2016, Wiczorek 2018, Yasmin et al. 2020). In addition, bodies of work have highlighted capacity, scale, and institutions as critical elements to understanding sustainable changes (Karpouzoglou et al. 2016, Wiczorek 2018, Yasmin et al. 2020).

A recent review on implementation of various environmental governance approaches in the Global South, which focused on adaptive governance principles, emphasized the need to understand the enablers of change and the emerging governance alternatives (i.e., hybridized and polycentric approaches) that increase or limit capacity to support positive change and developed a guidance framework within which to evaluate current capacity (Yasmin et al. 2020). In a similar Global South context (Bangladesh), Yasmin et al. (2018) utilized the multi-level perspective (MLP) and hydro-social contract (HSC) concepts to examine the water resource developmental trajectory and actor engagements at different scales of implementation (i.e., landscape as broader economic and environmental growth, regime as national or regional approach and narrative) to guide implementation or adoption of different approaches and niches (i.e., innovative approaches that are not mainstreamed and largely occur at small scale). Further, the authors highlighted that these developmental trajectories are highly controlled by societal factors, including the need to reduce health risks and enhance flood protection (Yasmin et al. 2018). Yasmin et al. (2018) further demonstrated that this trajectory in Bangladesh was initiated by the colonial administration from the inception of an urban water system and therefore the normative underpinning of an urban water governance regime largely reflects the European model of conventional water management strategies (i.e., technocratic command and control). However, the contemporary influence of decentralization of the management system and participatory approaches across different scales (national/regional/local/small or mega cities/specific project or mainstreamed) led to a change in values regarding environmental protection. These diverse approaches, largely driven by international schemes (e.g., integrated water resources management [IWRM]/Millennium Development Goals/SDGs), and further redefined urban water management goals, provide a window of opportunity to rethink governance approaches (Yasmin et al. 2018). Following these shifts in the governance regime, the authors further highlighted subsequent changes at the institutional level that influenced existing norms and formal organizational culture in practicing innovative, experimental, and alternative options (e.g., rainwater harvesting, sanitation value chains, water safety plans). However, the previous research could not determine whether these organizations and the involved actors operating at different scales have also built the capacity to accept these innovations and alternative options in order to drive the changes needed for a permanent governance transition.

RESEARCH AIM, OBJECTIVES, AND THEORETICAL FRAMING

Building on the background described above and focusing on the core variables of capacity and (operating) scales, this paper seeks to understand whether the organizations and actors involved in

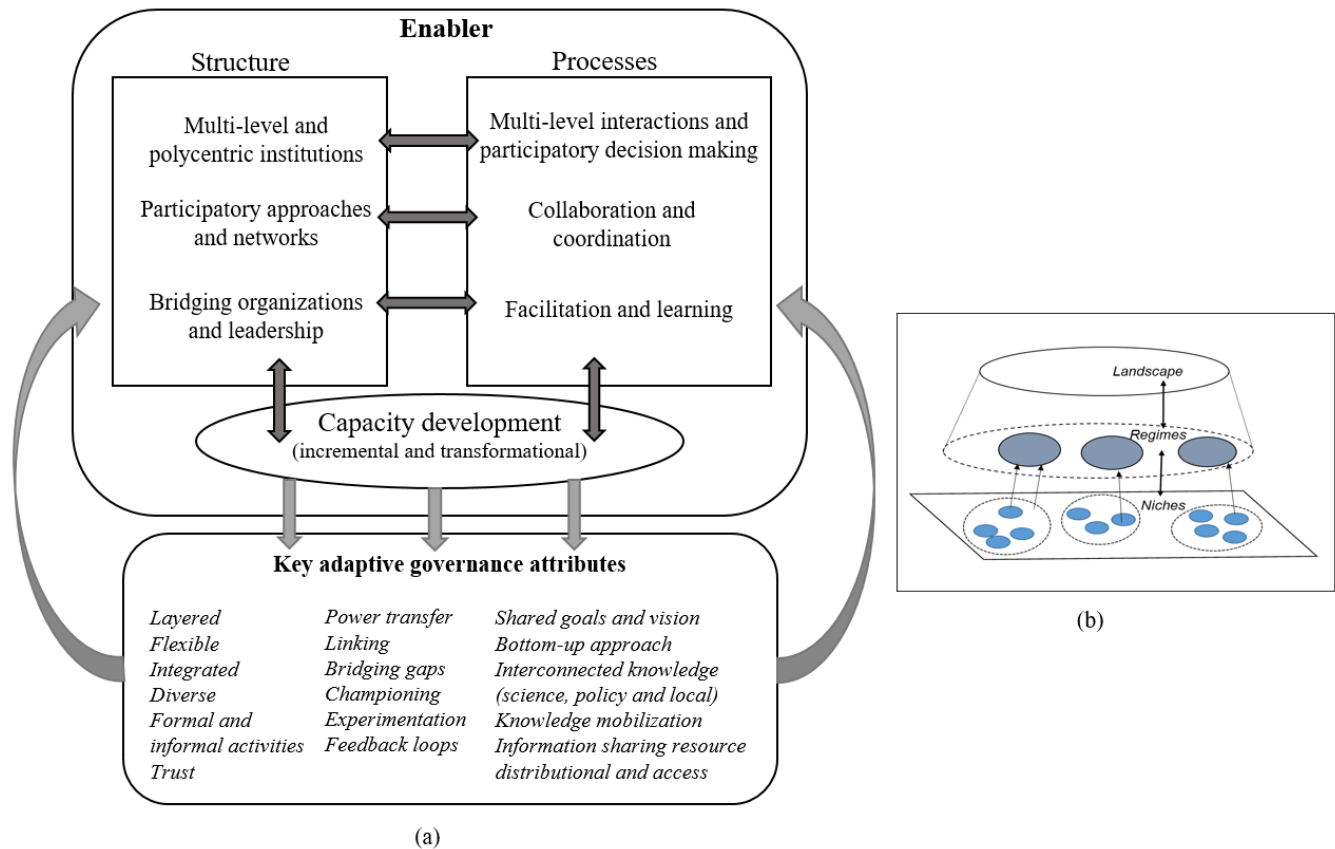
water governance at different levels have developed the necessary capacity to accept and adapt to the innovation and changes necessary to guide sustainable transformation. To achieve this aim, we first unpack the contemporary barriers and opportunities within two exemplar urban water systems, one large-scale and one small-scale. Then, we assess the “capacity” context in relation to delivering the necessary adaptive attributes for a water governance transition to deliver sustainable outcomes. To achieve the aim and objectives, we utilize a guidance framework known as the adaptive capacity and attribute (ACA) framework (Yasmin et al. 2020) to unpack the complex urban water system in Bangladesh, a Global South country, and to shed light on a nascent form of adaptive water governance (AWG) for sustainable urban transformation. The ACA framework explains the capacity of the involved individuals and/or groups for improving inter- and intra-organizational activities through three interrelated enablers: multi-level and polycentric institutions, participatory approaches and networks, and bridging organization and leadership. The ACA framework defines multi-level and polycentric institutions as a combination of vertical governance scales, i.e., national, regional, and local, with horizontal and diverse institutions aiming to facilitate broader participation, such as hybridized governance structures. Participatory and network approaches facilitate the involvement of local actors and integration of their knowledge to inform decision making, support bottom-up approaches, and enable social learning to drive sustainable outcomes. The ACA framework emphasizes bridging organizations and leadership as the main facilitators of collaboration and learning. These enablers are critical for providing a platform for the delivery of adaptive attributes, such as a layered and flexible management system, shared goals and vision, formal and informal activities (see Fig. 1-a) necessary for developing capacity of the water governance system, in this case for the urban context.

For this study, we define urban water governance as comprising institutions, organizations, and stakeholders at multiple levels of implementation that offer strategies for managing, regulating, and provisioning water services within an urban boundary. In addition to applying the ACA framework, we further utilized the MLP framework (Berkhout et al. 2010, Lawhon and Murphy 2012) as shown in Figure 1-b and the HSC concept (a social contract between the government and citizens for service delivery, see details in Meissner and Turton 2003) from the sustainable transition scholarship.

RESEARCH METHODS

We used a pluralist research lens with a pragmatist research philosophy (see Creswell 2013) grounded with empirical investigations that take place in real-world settings allowing scope for collecting both qualitative and descriptive data. This research utilizes qualitative social research techniques to develop insights into the contemporary city-scale governance strategies and actor engagements that influence innovation and transition processes in the existing urban water systems. This is very timely and is crucial to increase our understanding on the potential for adaptive water governance (AWG) to guide sustainable changes. A single case study approach examined urban water management systems in Bangladesh and was explored through two embedded units of analysis: (i) an emerging urban water system, Mymensingh, and (ii) a well-established urban water system, Dhaka (Yin 2013).

Fig. 1. (a) Adaptive capacity and attributes (ACA) framework adapted from Yasmin et al. 2020. (b) Multi-level perspective (MLP) by Rip and Kemp 1998, Rotmans et al. 2001, Berkhout et al. 2010.



Bangladesh was selected because it has a clear vision for economic development alongside urban sustainability within Dhaka and across emerging urban centers (Government of the People's Republic of Bangladesh 2012, 2018). Following the classification of the Bangladesh Bureau of Statistics (BBS 2011), the mega city Dhaka was selected as the larger unit of study given its political, cultural, and economic importance, while the city of Mymensingh, representing a smaller unit of analysis was selected because it is a rapidly growing urban settlement that is exploring infrastructure and governance options to support a broader vision of sustainable urban development (Government of the People's Republic of Bangladesh 2012).

The Dhaka case involved examining the changes in urban water governance practices and associated approaches over a 250-year period, whereas the smaller Mymensingh case focused on contemporary multi-scale strategies aimed at improving local governance capacity to deliver sustainable infrastructure services, including water and sanitation after its establishment in 1893 (ADB 2015). Data collection occurred across multiple field site visits, initially four months (April to August) in 2016 and then final data collection over two months (February and March) in 2017. Using a purposeful sampling strategy and the snowballing method, interviewees working within and adjacent to the urban water systems were approached for an interview (Creswell 2013). In total, 53 interviews were conducted with leading urban water

practitioners to examine how contemporary urban water governance approaches have shifted in Dhaka and Mymensingh (Tables 1 and 2). Interviewees were asked about their involvement with the industry; their perceptions of management priorities and how these have changed over time; what drove or inhibited those changes; experiences with collaborative management and participatory approaches; and finally, the strengths and weaknesses of the contemporary water management system. In addition, media analysis of newspaper reports (e.g., The Guardian and the Observer, Dhaka Tribune, Bangladesh Daily Star) from 1878 to 2016, along with relevant secondary documentation (e.g., policy documents, industry reports and legislation) were analyzed to further capture the changing socio-political and institutional contexts within these two cities (Table 2). Validation interviews and workshops were conducted with participants from both cities, involving representatives from key stakeholder groups. The multiple sources of evidence were analyzed and triangulated to corroborate and/or contrast findings (Yin 2013).

SUSTAINABLE WATER GOVERNANCE IN ESTABLISHED VERSUS EMERGING CITIES

The research data collected through oral histories and media analysis identified significant shifts within the water governance regime (here water governance regime consists of all relevant actors and institutions, networks and systems that are directly

Table 1. Key information on Dhaka and Mymensingh.

| Key topics | Dhaka City | Mymensingh City |
|--------------------------------------|--|---|
| City area | 306.4 km ² | 82 km ² |
| Population | 18 million (2016) (https://worldpopulationreview.com/world-cities/dhaka-population) | 407,798 (approximately; Government of the People's Republic of Bangladesh 2015) |
| Wards | 75 wards and more than 5000 slums (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2014) | 21 wards (Pourashava report 1972, <i>unpublished report</i>) and 95 slum settlements scattered across the city (BBS 2011). |
| Riverbank City classification | Located on the eastern banks of the Buriganga River Mega city (BBS 2011) | Located on the bank of old Brahmaputra River Mymensingh Pourashava (municipality) is classified as "A," based on revenue collection of BDT 6 million (US\$70,878.42 at a conversion rate of BDT 1 = USD 0.012). |
| Responsible ministry | Ministry of Local Government, Rural Development and Co-operatives, (MoLGRD & C) | |
| Key state-led agency and departments | Dhaka Water and Sewerage Authority (DWASA) under the Local Government Engineering Department (LGED) | Mymensingh Pourashava under the Local Government Engineering Department (LGED) with support from the Department of Public Health Engineering (DPHE). |
| Key development partners | United Nations Development Program and organizations (e.g., UNICEF, UNFP), World Health Organization (WHO), Asian Development Bank (ADB), World Bank (WB), Department for International Development, UK (DFID), Danish International Development Agency (DANIDA), Japan International Cooperation Agency (JICA), Inter-American Development Bank (IDB), Swiss Agency for Development and Cooperation (SDC), and many other international and national development organizations. | |
| Water supply | Dhaka Water and Sewerage Authority (DWASA) is currently capable of producing 265 crores liters of water daily (as against of the daily demand of 250–255 crores liters) through deep tube-well (896), water treatment plants (5), water line (3870 km), water connections (392,400) and street hydrants (1643). (Source: DWASA annual report 2020–2021, <i>unpublished report</i>) | As of 2017, Mymensingh Pourashava had the capacity to supply one third of its total water needs via piped water, covering approximately 15% of households. To supplement water supplies, households typically draw from individual or shared tube-wells and street hydrants, increasing water coverage to 46% of the population including slum communities. (Source: Government of the People's Republic of Bangladesh 2015). |
| Sanitation | Sewerage network: > 25% (remaining covered by Septic Tank/pit and ventilated latrine) Sewer line 934 km. Sewerage lift station: 26 Sewerage treatment plant: 1 (Source: DWASA annual report 2020–2021, <i>unpublished report</i>) | approximately 93% of the Mymensingh Pourashava population uses some form of latrine including septic tanks, ventilated and pit latrines. (Source: Government of the People's Republic of Bangladesh 2015). |

involved in shaping or evolving urban water systems in Bangladesh, guided by the definition by Pahl-Wostl 2007) that shaped Dhaka, the long-established city, along with other Bangladeshi cities largely following Dhaka's trend (see Figs. 2–8). The socio-political and environmental factors, such as greater economic development, improved environmental conditions, and sustainable urban growth, have played a crucial, influential role for the shifts presented in Figures 5–8. Dhaka remained the center of all development until recently and still operates through a traditional centralized system of control. Despite policies to adopt adaptive and sustainable approaches, the contemporary state-led approaches and interventions appear to be unable to lead the necessary transformational change in Dhaka (data shown in Fig. 5).

On the other hand, the research data (in-depth interviews and media analysis with key focus to Mymensingh) shows tremendous improvements and shifts in societal norms and organizational culture in the smaller urban system: Mymensingh (the secondary city) (Fig. 6). The research data further identified Mymensingh city as shifting toward a decentralization of the local government administration and adoption of inclusive and participatory water management strategies (Fig. 6) alongside its centralized top-down government led administration (Pourashava, another term for municipality, is part of local government bodies to oversee city development activities). Together, this centralized and decentralized system (project-based actor clusters at town, ward, and community levels for participatory decision making) is forming a hybridized and polycentric governance platform enabling smaller urban systems to experience institutional reform and to engage with new modes of governance practice (Figs. 3

and 4). This hybridized and polycentric governance structure is acknowledged by environmental governance and transition scholars as being important to delivering sustainable outcomes (e.g., Koiman and Jentoft 2009, Pahl-Wostl 2009, 2017, Pahl-Wostl et al. 2010, van de Meene et al. 2011). Therefore, the formation of this hybridized governance structure in Mymensingh Pourashava appears to be an important step toward a governance transition for sustainable development. Here, the regulatory environment, comprising the Zilla Parishad Act (2000) and the Pourashava Act (2009), was found to be instrumental in enabling devolution of management rights and power-sharing for decision making and mobilizing resources. This seeded an opportunity to implement innovative interventions resulting in a spectrum of hybridized governance structures within the Mymensingh Pourashava. This was an outcome of the implementation of innovative interventions, such as the Urban Governance and Infrastructure Improvement Project (UGIIP; ADB 2012, 2015) and the Mymensingh Strategic Development Plan (MSDP) project that we analyzed in detail using our frameworks. Further, the hybridized governance structure offers a platform for the multi-level interaction of the diverse actor clusters (e.g., state and non-state actors), which are elaborated later in this paper.

Comparing the shifts in governance regime in both cities, captured through analyzing relevant policies, industry literature, and project documents, subsequent changes have been observed at the policy and institutional levels that influenced the existing norms and formal organizational culture in practicing innovation, experimental and alternative options. For instance, Bangladesh's SDG progress report (Government of the People's Republic of

Table 2. Summary of data collection campaigns in Dhaka and Mymensingh.

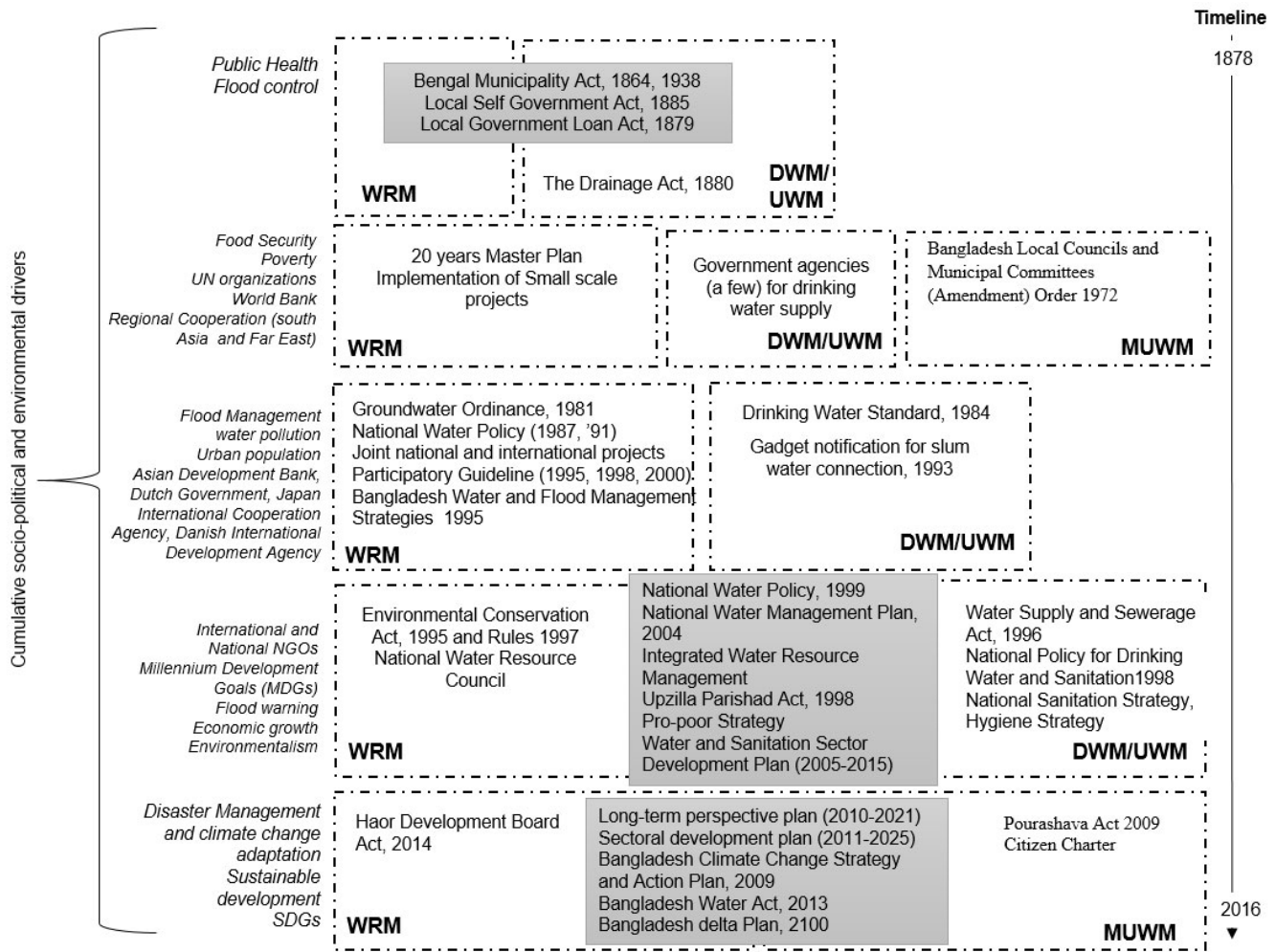
| Data and Interviewee characteristics | Bangladesh urban water management with key focus on Dhaka (DUWM) | Mymensingh Urban Water Management (MUWM) |
|--------------------------------------|--|---|
| Primary data | <p>Oral history collection (n = 17) and media analysis (1878 to 2016);</p> <p>The interview schedule includes a list of open-ended questions and indicative probes used to explore interviewees' recollections;</p> | <p>Face-to-face formal interviews (n = 36); Informal group discussions (n = 22) and media analysis (1878 to 2016);</p> <p>The two urban water management projects were selected for their unique project strategies and implementation approaches and being "new-to-context" in Bangladesh, including emphasizing improved governance and facilitating bottom-up implementation;</p> <p>- Project 1: Second Urban Governance and Infrastructure Improvement Sector Project (UGIIP-II) funded by the Asian Development Bank (ADB) commenced in 2011, building on the lessons learned from the original project (UGIIP-I, 2003–2010), which aimed to provide infrastructure development and capacity building training to Pourashava staff in selected secondary cities of Bangladesh (ADB 2015).</p> <p>- Project 2: the Mymensingh Strategic Development Plan (Government of the People's Republic of Bangladesh 2015) is one of several long-term initiatives undertaken by the Bangladeshi Government, led by the Urban Development Directorate (UDD) and funded by the United Nations Development Programme (Government of the People's Republic of Bangladesh 2015). This long-term project aims to ensure basic services are delivered to urban communities, by improving community resilience through increasing formal and informal participation and collaboration within and between government agencies, with non-government organizations, and broader civil society.</p> <p>Informal group discussions typically included three or four individuals (in most cases these were people involved in the primary semi-structured interviews) engaging in facilitated discussions with the researcher regarding patterns and trends in the sector.</p> |
| Secondary data | <p>Interviews were audio recorded, conducted in private room, and ranged from one to two hours. Interviews not recorded because of interviewee preference, detailed notes were taken.</p> <p>Relevant scientific publications and policy material and national reports; organizational literature (i.e., government agencies and peak industry reports; committee meeting minutes and reports, workshop presentation documents); industry and professional association literature and scientific literature.</p> | |
| Interviewee characteristics | <p>Retired and higher level (director/sectoral experts) government officials, NGO representatives, and policy activists in different organizations involved in water management for the last 18 years, with seven individuals each having more than 30 years' experience. This includes academics (n = 4), national level consultants (n = 3), government professionals (n = 5), and NGO professionals (n = 5)</p> | <p>Among the 36, 14 participants were Mymensingh Pourashava and council staff involved in management and implementation activities within the Pourashava boundary, e.g., the mayor and a Pourashava representative. The remaining participants (n = 22) were from different organizations, such as community committee members, NGO workers, academics based in Mymensingh, project personnel (government and non-government) based in Dhaka, and civil society activists linked with municipality activities.</p> |

Bangladesh 2018) provided examples, including rainwater harvesting, sanitation value chains, and water safety plans, of the innovative and alternative approaches that will guide the county's SDG targets. Figures 2 and 3 further represent this policy change and highlight the growing complexity of actors and organizations along the timeline that represent key governance shifts regarding responsibility for the delivery of urban water related services. In the context of the growing complexity of the engaged actors' and their constellations, Figure 5 further elaborates how this has evolved over the years. As mentioned in the research methods, analysis of this actor constellation was inspired by theories that include the "hydro-social contract (HSC)" (Turton and Ohlsson 1999, Meissner and Turton 2003) and "hydro-political constellations" (Cooper 2011). These theories inform the involvement of government and citizens in a linear relation to provide services through to a more complex involvement of other actors, such as civil society and NGOs. Figure 3 showcases, for both the Dhaka and Mymensingh city contexts, the shifts from a simple linear relation to a more complex involvement of actors and organizations. In Figure 3, the arrow refers to the involvement of the organizations for the delivery of water and water-related services to the citizen. Now the question arises as to whether these organizations, involved actors, and policy adjustments have also built the ongoing capacity needed to accept and implement the innovations and alternative options, reported by the key national

documents and international organization-led interventions, and to drive the changes needed for a governance transition to establish sustainable urban water management.

During the interviews (oral histories), urban water professionals and experts expressed their frustration regarding the water management authorities' practices and interventions. They described that the major actors and organizations (e.g., Dhaka Water Supply and Sewerage Authority, Water Development Board, Pourashava management council) are largely working in silos and resisting innovations and alternative options and tend to rely on the conventional state-led interventions for their water management strategies. However, the research data found inequalities in urban development in Bangladesh. Dhaka's water management system is found to be far more advanced than those of other Bangladeshi cities and the relevant organizations and actors were found to have built some level of adaptive capacity to deliver basic services. For example, looking specifically at the Dhaka Water Supply and Sewerage Authority, the research data identified some on-the-ground innovation, alternative technologies, and strategies that have been applied in Dhaka, largely after 2006 (Fig. 5). However, given the size of this city with a population over 18 million (as of 2016), the increasing complexity in renewal and development of its urban infrastructure, and the scale of its population expansion—on average 3.5% growth (PRB 2018) and

Fig. 2. Transforming policies, legislation, and guiding documents for water resource development in Bangladesh. (WRM = Water Resource Management, DWM = Dhaka city Water Management, MUWM = Mymensingh Urban Water Management.)

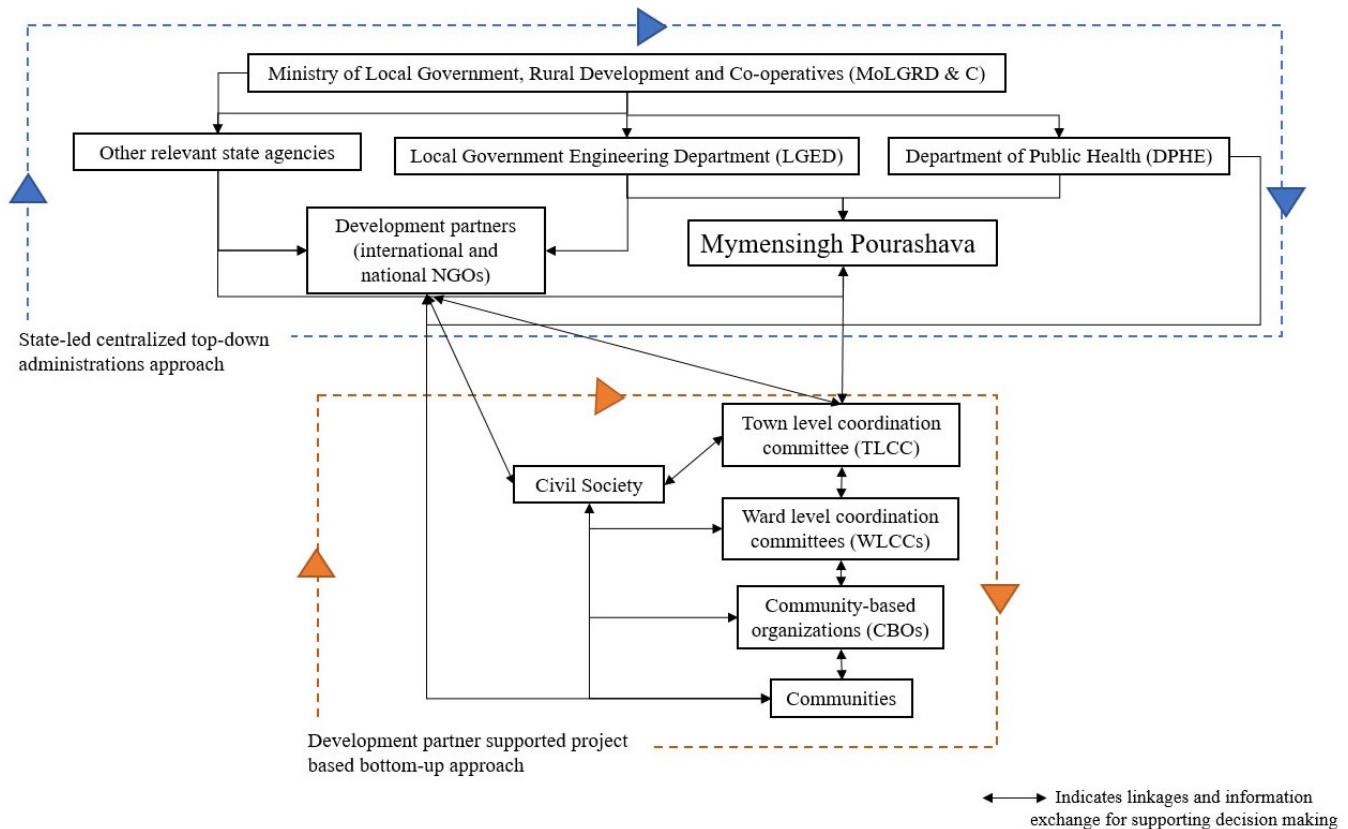


its pace of economic development, 7.9% in 2017/2018, (Government of the People’s Republic of Bangladesh 2012)—the challenges in managing Dhaka’s water management are significant. It is, therefore, doubtful whether current management capacity is sufficient to prepare such a large-scale and highly complex urban water system transition to implement sustainable urban water management practices. This finding aligns with other studies that show Bangladesh’s water governance system is facing increasing gaps between “official policies” and “actual implementation” (Gain and Schwab 2012:838); and those policies have failed to increase capacity for adaptation (Rouillard et al. 2014). In the context of Dhaka, this study confirms previous scholars’ findings of fragmented service delivery “falling behind the required standards and lacking capacity to expand” (Moinuddin 2010:59); and a lack of organizational and management capacity to address issues of power and inequality in service delivery (Moinuddin 2013, Rouillard et al. 2014, Hossain and Ahmed 2015). Comparing Dhaka with Mymensingh city through the lens of the attributes of adaptive water governance and sustainable trajectory development, it can be

inferred that Dhaka’s water management system is not on a sustainable pathway. This view aligns with other scholars who argue that to adapt to the way Dhaka is urbanizing, the governance and management of service provision of water, sanitation, and waste disposal need to develop in line with adaptive measures related to policy framing, appropriate infrastructure development, and improvements in social capital (see, e.g., Rana 2009, Swapan et al. 2017).

On the other hand, the emerging hybridized governance structure in Mymensingh was found to be in a transition phase, where new institutions and engaged actors are starting to provide innovative governance services along with the traditional centralized structure (state-led initiatives that do not consider the local context). Here, different layers of actors and agencies (national / central / city-scale / local scale) operate under an institutional hierarchy with some administrative decentralization to transfer decision making and financial autonomy to local actors by embedding them into the Pourashava’s management system with other relevant actors. In general, Pourashava management

Fig. 3. Identified emerging context of hybridized governance structure in Mymensingh.



consists of elected members and administrative staff responsible together for conducting city-building activities in Mymensingh, including water management, generating taxes, solid waste management, cleaning and maintenance of development works, such as roads and streetlights (Government of the People’s Republic of Bangladesh 2009). Transition scholars argue that this hybridized governance structure produces less uniform regimes in comparison to the Global North, where old technology and a relevant management approach can co-exist with alternative solutions and deliver the same services, which do not always influence transition processes but offer better opportunities for innovation (Hansen et al. 2018, Wiczorek 2018). Further, environmental governance scholars argue that a hybridized governance system can create a platform for institutional activities involving a diverse range of actors that can drive sustainable change (Pahl-Wostl 2009, van de Meene et al. 2011, Berkes and Ross 2013). Adaptive water governance scholars reviewing Global South cases also emphasize the need to examine governance strategies that build institutional and actor capacity in order to support a sustainable transition (Yasmin et al. 2020).

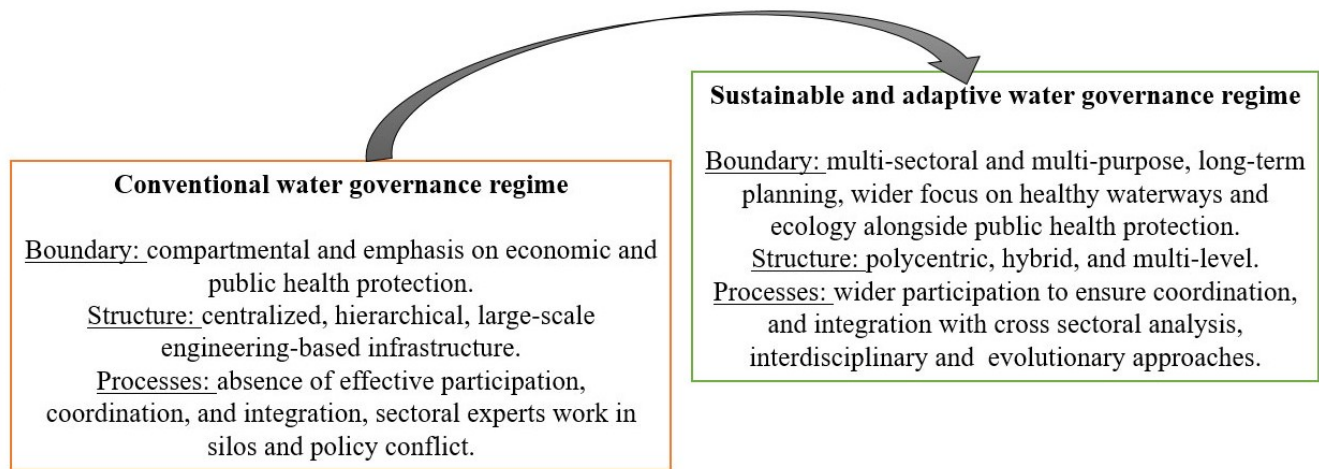
Thus, the Mymensingh case enabled us to analyze how a hybridized governance structure is supporting the creation of platforms (shown in Fig. 4) and delivering attributes (as presented in Fig. 6) that are essential to building adaptive capacities of institutions and actors (individual/group/communities) and thus, to transform the existing system to deliver sustainable practices.

The insights generated by the Mymensingh case also add to the understanding of broader environmental governance and more specifically adaptive water governance at the secondary city scale, which is a critically under-researched area (Jaglin et al. 2011, de Noronha and Vaz 2015, Tutusaus and Schwartz 2018). Additionally, understanding of institutional and actor capacity to develop a sustainable urban water governance system in a secondary city context enriches urban governance knowledge and literature on environmental leapfrogging, which argues that less technologically advanced and less complex urban water systems (e.g., those in medium and small cities) have leverage in urban transformation (Jaglin et al. 2011, de Noronha and Vaz 2015, Tutusaus and Schwartz 2018).

ENABLING ATTRIBUTES AND CAPACITY FOR ADAPTIVE WATER GOVERNANCE

Overall, this research found that sustainable governance transitions within the Global South contexts depend on institutional and actor capacity and intervention scales to recognize and implement innovative governance strategies (Bakkour et al. 2015, Kuzdas et al. 2015, Sowman and Raemaekers 2018). The following sections shed further light on these capacity issues and discuss how these attributes provide scope for a new governance mode to emerge and can drive a sustainable transformation.

Fig. 4. Attributes of conventional and sustainable water governance regime. Adapted from Brown et al. 2009b, Keath and Brown 2009, Pahl-Wostl et al. 2010, Yasmin et al. 2018.



Participation and collaboration

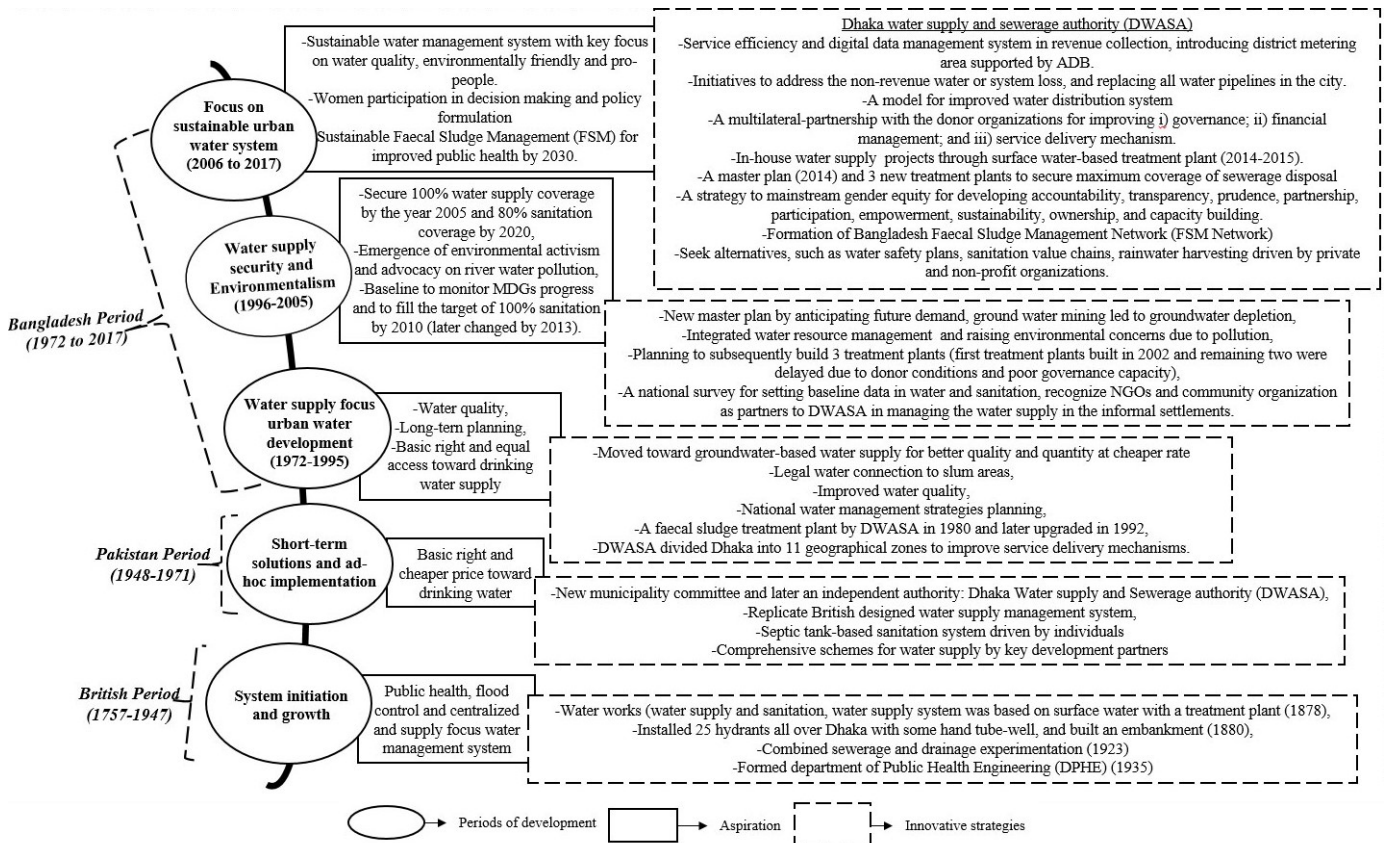
The interview and media analysis data collected from Mymensingh city highlight the existence of diverse actor clusters (such as town- and ward-level coordination committees, small community groups for raising awareness) and their interaction for implementing projects including the UGIIP and the MSDP project activities, along with other Pourashava activities (development and maintenance including water supply and sewerage) across multiple levels of implementation in the city of Mymensingh (Figs. 3 and 4). They provide insights into the emergence of new institutional structures, which infer some characteristics of a polycentric system by favoring devolution of power and shared management authority, by increasing non-state actor capacity and engagement in specific policy issues (Huitema et al. 2009, Crona and Parker 2012, Newig and Koontz 2014). For example, the Mymensingh city mayor described how they call for an emergency meeting (witnessed by the lead author) for the town level coordination committee to discuss the on-going drainage building activities wherein a few citizens raised concerns that existing sewerage facilities are clogging during heavy rain and require action. This example was noted as being aligned with formation of a polycentric system that can deliver strategies to reform governance practices and become inclusive and participatory (Celliers et al. 2013, Srinivasan et al. 2013). While closely observing some of the town-level coordination meetings during the field visits, we further found that these committees are useful for promoting or organizing participatory decision making and further favor good governance principles, such as citizen water rights, state accountability, and transparency in resource delivery. All these aspects are important for adopting an adaptive water governance approach (Huitema et al. 2009, Cosens 2015, Hurlbert and Gupta 2016).

The identified spectrum of hybridized governance structures, which is showing some polycentric features in Mymensingh, is enabling change toward providing sustainable outcomes. Further, the hybridized governance structure in Mymensingh, implemented through these town- and ward-level coordination

activities, exhibits a shared management authority in which different actors (state and non-state) are involved in the Pourashava's management activities through participatory decision making and resource mobilization. This confirms a subsequent power devolution (national/regional actor to local actor and community) that is also significant for supporting legitimacy, transparency, and conflict resolution (see, e.g., Satumanatpan et al. 2014, Regmi et al. 2016, Azhoni et al. 2017). As shown in Figure 6, the production of an annual report card and display of a citizen's charter in the Pourashava premises represent examples of increasing visibility of governance activities, highlighting improved levels of accountability and legitimacy. Such processes of strengthening accountability and legitimacy are needed for successful implementation of local-scale adaptation strategies in a Global South context (Conway and Mustelin 2014). Further, the hybridized governance spectrum of Mymensingh city is also seen as connected and interactive, forming a new network configuration that is multi-actor and multi-level based (Figs. 3 and 4). The activities of the multi-actor and multi-level networks observed through this study have identified the potential to overcome some of the challenges indicated by adaptive water governance scholars, including those in the Global South, such as coordination gaps, and lack of strategies to improve the capacity of the relevant actors for effective participation (DeCaro et al. 2017, Huitema et al. 2009, Yasmin et al. 2020).

This participatory approach and the formation of multi-actor networks are acting as enablers as indicated by the ACA framework, and our analysis further reveals that the multi-actor networks also act as a knowledge source and support the shared management system by offering valid information, developing consensus regarding policy implementation, and generating new information and data. For example, a member of the ward level committee (Interviewee) mentioned their voluntary participation in a drainage project, which resulted in adjusted design specifications based on their experience of that locality (ward). Likewise, another member from a local community group

Fig. 5. A timeline to showcase changing aspirations and key innovative strategies adopted by Dhaka (particular focus on Dhaka Water Supply and Sewerage Authority [DWASA]) to develop an urban water management system.



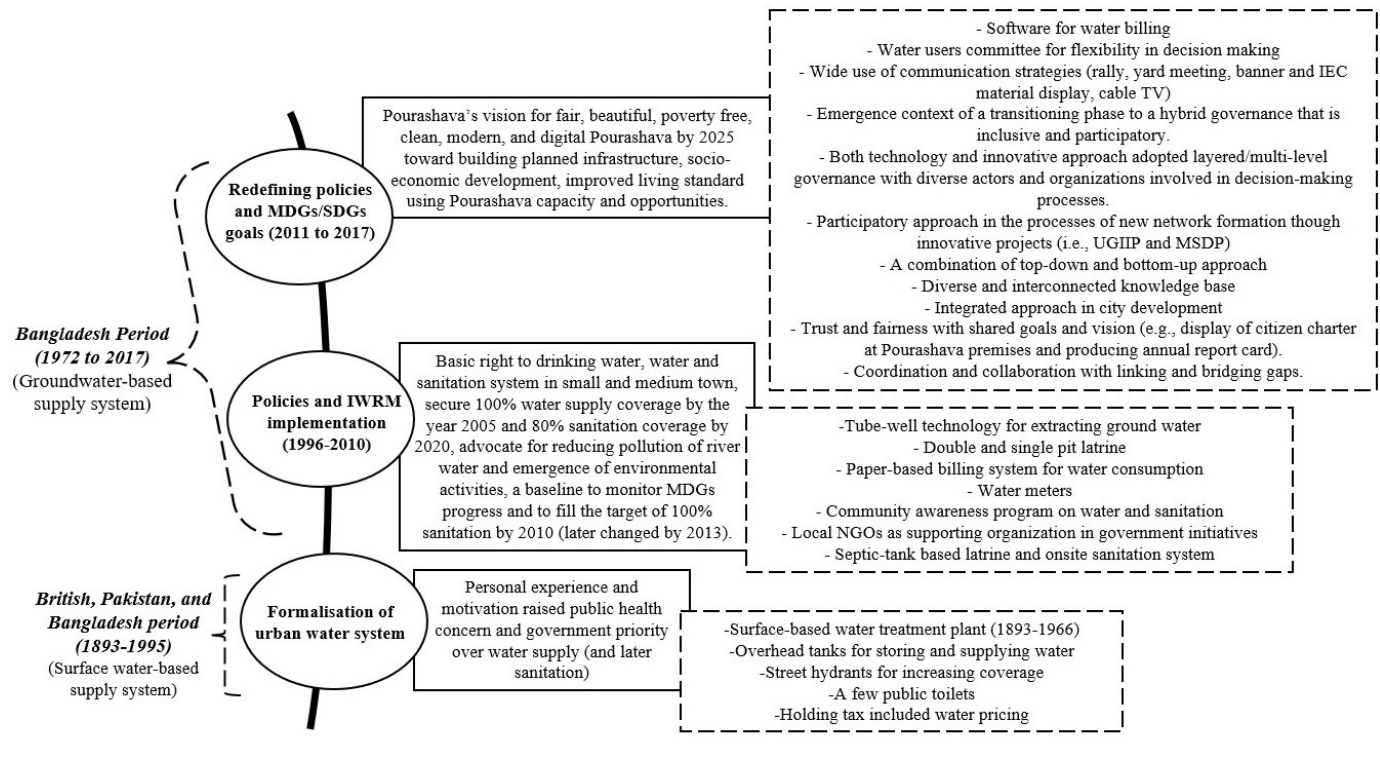
responsible for water management activities (also identified as a social and environmental activist for that locality) expressed confidence during their interview when explaining how, through a series of group meetings facilitated by the mayor and Pourashava management staff, they had learnt about the unfolding plans for future urban water management in Mymensingh city. This process of knowledge generation and transfer is changing communities' perceptions and reveals an awareness and sensitivity to the issues of environmental change and livability. Thus, such participatory approaches are regarded as important for developing communities' organizational capacity and resilience, with a similar observation found by other Global South scholars (see, e.g., Bahauddin et al. 2016, Panditharatne 2016). Although this research revealed that emerging multi-level networks in the city of Mymensingh are facilitating active participation and collaboration, the investigation of network centrality and cohesion was beyond the scope of this research. Such actor clusters and/or collaborative teams can provide an arena where social capital is enhanced, and concerns are reformulated, to generate innovation and new modes of governance (see, e.g., Folke et al. 2005, Pahl-Wostl 2009, Cinner et al. 2012, Huntjens et al. 2012, Sharma-Wallace et al. 2018). The "production of manure from solid waste through the coordinated activities of NGOs, research institutions and farmers" is an example of successful collaboration and innovation provided by the interviewees. This innovation example demonstrates the value

of facilitating cross-scale learning, shared visioning, and a move to increase communities' organizational capacity, all attributes that were identified as important for improving capacity for driving sustainable resource management in the Global South context and outlined in the ACA framework (Yasmin et al. 2020).

However, in contrast to the shared management system, network formation and improving communities' capacities in Mymensingh city, the interviewees (oral histories participants) identified Dhaka's experiences to be more rigid and operating through isolated state organizations with less opportunity for community involvement in authorizing and mobilizing resources. Analysis of the research data through the lens of a hydro-social contract (HSC) as presented in Figure 3 showed changing actor dynamics and complexities, however, the contemporary policies and implementation strategies failed to address these actors' complexities, nor do they support reforming the implicit social contract identified by scholars as necessary for sustainable urban water transitions (see, e.g., Lundqvist et al. 2001, Brown et al. 2009a, Poustie et al. 2016).

Furthermore, our interview participants and analysis of the secondary sources also captured different modes of co-existing partnerships or alliances to support urban water governance systems in Dhaka. Enablers, such as a partnership approach and/or networks, could not foster the capacity needed for effective participation and collaboration. Interviewees recognized Dhaka

Fig. 6. A timeline to showcase changing aspirations and key innovative strategies adopted by Mymensingh to develop an urban water management system.



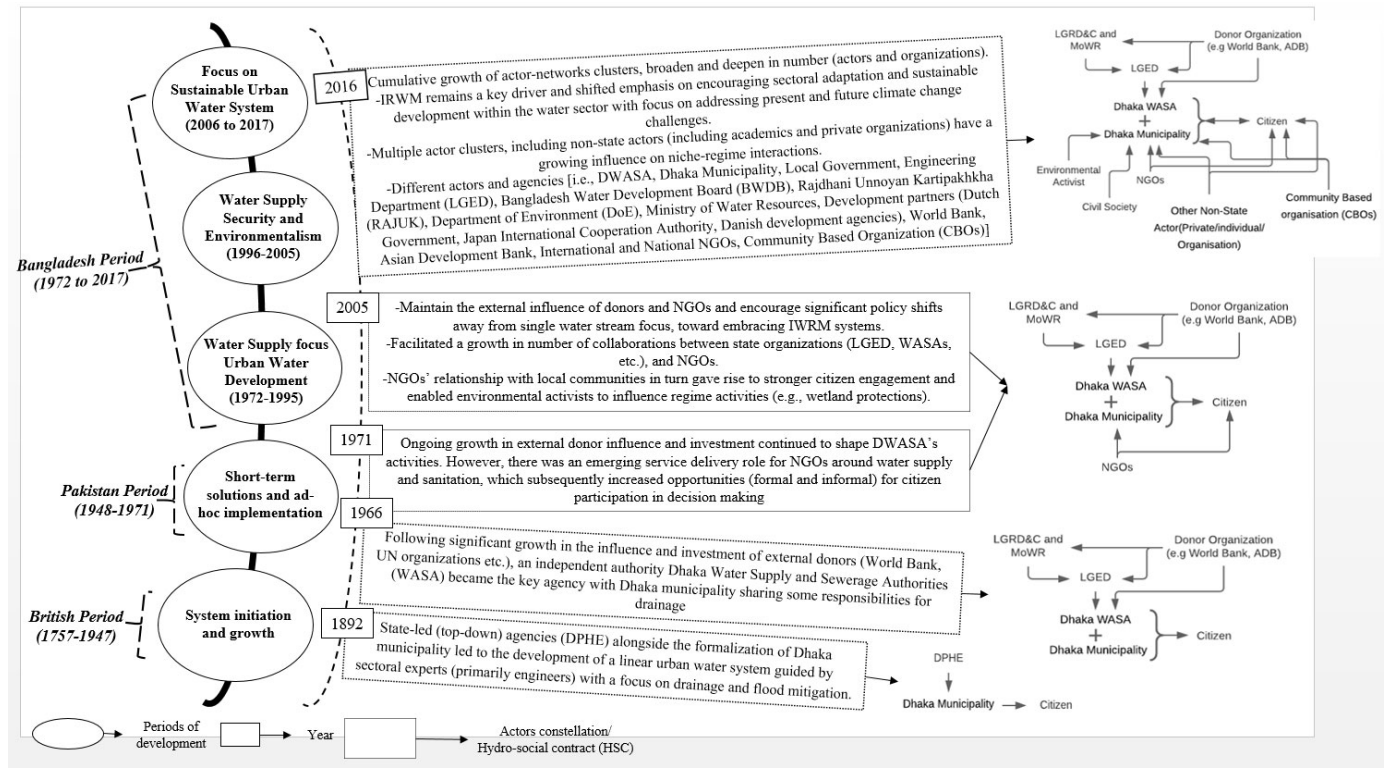
Water Supply and Sanitation Authority (DWASA), the major water supply institution, is functioning unilaterally, reflecting the influence of hierarchical and market mechanisms on water management activities that typically lead to bureaucracy and path dependency (refers to the present decisions dependent on the previous decisions/experiences). Although the inclusiveness and participatory approaches have long been advocated through national policies (e.g., adoption of IWRM in national water policy in 1999 and formulation of participatory guidelines for water management in 2000), the interviewees described the lack of periodic updates of policies and strategic planning have allowed the relevant authorities to operate within the conventional system, which is a barrier to implementing sustainable practices. Research data (e.g., collected through the oral histories from the professionals and experts of urban water management) confirmed similar observations concerning other water management authorities across Dhaka. The relevant organizations in Dhaka are far from realizing the capacity required to address the diversity, density, and complexity of agency/actor engagement and partnership arrangements (Figs. 1 and 2).

On the other hand, the hybridized governance spectrum in Mymensingh seems to enable a platform for improving capacity, in particular, the capacity to engage in collaborative and networking activities that connect different actors and organizations (intra/inter). The dominant disciplinary context of the majority of water professionals in Dhaka (e.g., backgrounds in either engineering or hydrology) shaped the more technocratic and science-based urban water governance regimes in Bangladesh, which was disassociated

from the socio-cultural aspect of water, and was missing from the policy development and water management. Although recent changes in the regime approach in Bangladesh, as outlined by Yasmin et al. (2018), enabled other professionals including economists and social scientists, to build a participatory and multi-disciplinary team to develop policies and undertake strategic planning, the implementation activities in Dhaka have not reflected these changes. However, the implementation approaches of the MSDP showed that the Pourashava is already seeking expertise from different professionals to support their activities (Figure 3 and 4). While it was beyond the scope of this research to determine the outcomes of the MSDP project, it is reasonable to infer that management actors of the Pourashava have developed the capacity to recognize the important contributions diverse professionals can provide if they are to secure a sustainable urban water system.

For the Bangladeshi city context, Yasmin et al. (2018) reported gaps in the capacity to engage in networks, partnerships, or in coordination across relevant organizations for the delivery of urban water services. For example, by analyzing annual reports, industry and peer reviewed journals, the authors identified coordination issues between Dhaka Water Supply and Sewerage Authority (DWASA) and the two city corporations in stormwater management, such as ambiguity in defining shared responsibilities among the relevant agencies, and a lack of organizational interest in participatory and active engagement as part of coordinated effort. Thirty-nine organizations are involved in water management activities in Dhaka, and this capacity gap for coordination spanning across different organizations creates a “dynamic but messy” (Bird

Fig. 7. A timeline for showcasing key governance shifts and the growing complexity of the actor constellation for Dhaka in urban water development (some content is adapted and further expanded from Yasmin et al., 2018). LGRD&C = Local Government, Rural Development and Cooperation, LGED = Local Government Engineering Division, MoWR = Ministry of Water Resources, DPHE = Department of Public Health and Engineering, UDD = Urban Development Directorate, MoH&PW = Ministry of Housing and Power Works, TLCC = Town Level Coordination Committee, WLCC = Word Coordination Committee Level.



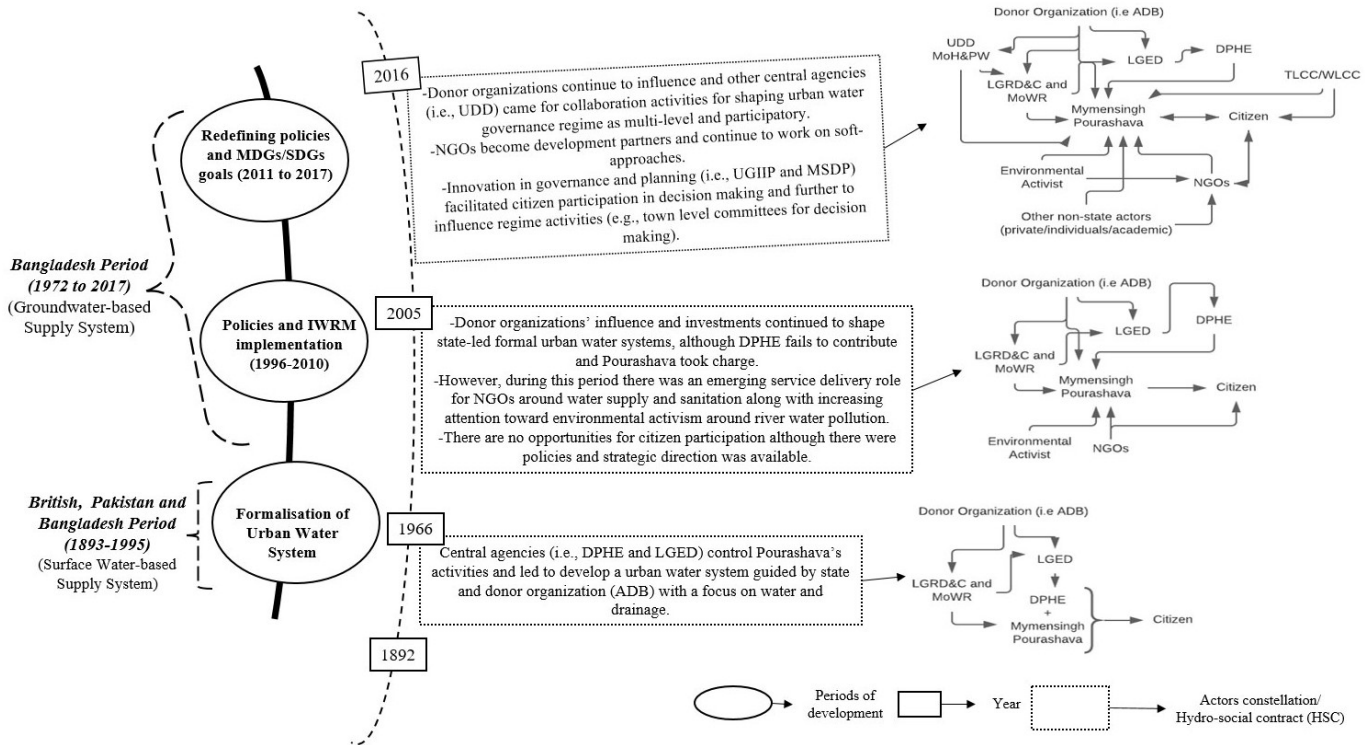
et al. 2018:7) situation in Dhaka. In contrast, the Mymensingh Pourashava's emerging hybridized governance structure, with a polycentric institutional setting and multi-actor networks offers diverse actor involvement and thus provides opportunities for reducing coordination gaps at both the organization and implementation levels. This coordination gap across relevant organizations and actors has been identified by scholars as a major obstacle for achieving a sustainable management approach in both Global North and Global South (Mugabi et al. 2007, Huitema et al. 2009, Moynuddin 2010, 2013, Farrelly et al. 2012, Cosens 2015).

The administrative capacity and the regulatory environment appear relatively promising for both Dhaka and Mymensingh, where a number of long-term plans were adopted that include innovation and experimentation around infrastructural development, resolving water supply security, drainage and sewage system development, and disaster proofing. Although these administrative and regulatory changes are occurring, major issues associated with water quality, inequality, and access to water continue to be overlooked in key policies and strategic planning, despite their importance for delivering sustainable urban water practices in Bangladesh.

Leading sustainable initiatives

As identified earlier in Figures 3 and 4, the actor clusters at town, ward, and community levels in Mymensingh Pourashava were found to act as bridging organizations and to act upon activities that improve coordination and formation of new multi-actor and multi-level networks. Here, coordination and networking activities refers to periodic meetings organized by the actor clusters to strengthen linkages across different implementation scales (town, ward, and community levels) and are starting to involve actors that were not connected before. The series of group meetings and other activities organized by these actor clusters are an impetus to knowledge generation and transfer. These activities are further increasing community capacity and increasing resource mobilization. The involvement of actor clusters and the guidance they provide to support state-led interventions, is further building trust in state actors and organizations (here Pourashava). These bridging organizations and relevant functions are noted in the ACA framework as enablers for delivering adaptive attributes, as also indicated by Global South studies as being critical in supporting innovative solutions, alternative trajectory development, and managing environmental problems in an adaptive manner (Folke et al. 2005, Clark and Semmahsak 2013, Butler et al. 2014, Newig and Koontz 2014, Azhoni et al. 2017).

Fig. 8. A timeline for showcasing key governance shifts and growing complexity of the actor constellation for Mymensingh in urban water development. LGRD&C = Local Government, Rural Development and Cooperation, LGED = Local Government Engineering Division, MoWR = Ministry of Water Resources, DPHE = Department of Public Health and Engineering, UDD = Urban Development Directorate, MoH&PW = Ministry of Housing and Power Works, TLCC = Town Level Coordination Committee, WLCC = Word Coordination Committee Level.



Beyond actor clusters, this research also revealed how a specific project, for example the MDSP can bridge by connecting local actors to a national context and national actors to a local context. The MSDP project developed and delivered a plan to guide Mymensingh City's growth along a sustainable trajectory, which is proposed by local communities and identifies critical and emerging environmental problems. This research regards the MSDP project as an experiment in initiating bottom-up learning approaches to city planning and starting to integrate with other relevant project implementations (such as UGIIP-II). The MSDP plan also offered a platform for integrating science, policy, and local knowledge to guide the city to a shared vision for a sustainable future. Our research indicates that the activities of the actor clusters, (formed through UGIIP project implementation) and MSDP project guidance, are a step toward sustainable governance transitioning in Mymensingh. However, these are largely project-dependent and guided by objectives and strategies designed by transnational actors/organizations. Although state actors are involved in the implementation, the leadership provided by these transnational actors (i.e., ADB, UNDP) also guides these local-scale initiatives to achieve a global outcome. If such actors and organizations were not involved, it has to be questioned whether positive indications would remain. This is very typical of the developing countries context, where some tensions and cynicism remain around donor invested projects, in the sense that these are often isolated and

unfortunately remain one-off endeavors (Hansen and Nygaard 2013, Hansen et al. 2018). There are also tensions around too much dependency on donor invested projects, which could lead to further impediments to achieving or sustaining the expected outcomes (Hansen and Nygaard 2013). For Bangladesh, the leadership provided by transnational actors has been significant in leading and shaping urban water sector development (for details see Yasmin et al. 2018). However, there are plenty of examples in Bangladesh that were repeatedly pointed out by the interviewees (experts and professionals) of unsuitable programs and the transfer of inappropriate technology and management tools (typically from the Global North and South contexts), which has led to developments that are either regarded as unsustainable or failed because of transnational actors withdrawing their support. The example of "groundwater source for drinking water supply by tube-well" was one of them, which led to the exposure of a large number of Bangladeshi people to arsenic related diseases (Hossain 2006). Another key example mentioned by the interviewees is the "green revolution of 1990s and after" in Bangladesh, which required extensive use of pesticides and fertilizers in addition to machinery and irrigation schemes. This use of pesticides and chemical fertilizers led to severe environmental hazards and river water pollution that is still very critical in Bangladesh (Ferdous et al. 2021). Although the challenging political and international relationships in this space of transnational actors and their

connectivity to support transition requires further examination, it is clear that through the ACA framework, the leadership role of transnational actors is found critical in designing and implementing projects that can guide cities to a sustainable future.

This study found that the ADB-funded UGIIP adopted a relatively non-traditional implementation approach, providing a longer project time frame. In Mymensingh, Phase-I started from 2003 and Phase-III was about to commence during this research period (2017). The iteration process of this project implies that the platforms it is creating are further supporting learning processes. The actor clusters and hybridized governance structure are basically an outcome of this project implementation, which mainstreamed into Pourashava's activities for supporting decision making and implementation processes. What is unique about the activities by these actor clusters is that some of the community leaders are trying to continue these group meetings even if there is no project support available. The motivation for continuing these activities by the actor clusters, especially the town-level coordination committee (TLCC), is coming from this democratic sense that developed in Bangladeshi people through a long struggle (British and Pakistan ruling) for independence. This is reflected in the statement from the interviewees' that the TLCC is their mini parliament where they feel confident and empowered to raise their voices regarding their preferences to support the Pourashava's activities.

Indeed, the interviewees (members of the Mymensingh town- and ward-level coordination committee) suggested that although there was relatively slower progress in actor cluster activities in Mymensingh during the research data collection period (2016–2017), the mayor of Mymensingh was using his political and social influence (as a successful businessman) to encourage the activities of the TLCC to continue. The importance of individual's ability to lead initiatives was emphasized within a number of Global South studies (Kuzdas et al. 2015, Hurlbert and Gupta 2016) further indicating this local leaders' contributions and efforts might bring "positive governance outcomes" (Ahammad et al. 2014, Kuzdas et al. 2015:264). This importance of frontrunners/leaders as individuals or as a group is also acknowledged in Global North literature (Huitema et al. 2009, Farrelly and Brown 2011, Chaffin et al. 2019). However, what is emerging from this research is that often, too much dependency on one individual can create a power struggle or dominant tendency in other actors rather than supporting a participatory or inclusive decision-making and implementation approach. This might also raise conflict and further indicate opportunities for misuse of power. The power issues captured by this study would benefit from further investigation to understand the tensions in relation to dominant individual influence in decision-making processes. This use and abuse of power has been gaining the attention of scholars with regard to natural resource management (Wittmayer et al. 2014), environmental governance (Newig and Koontz 2014), and improving urban transformative capacity (Chaffin et al. 2016, Wolfram 2016).

For Mymensingh, although a majority of interviewees expressed their gratitude and trust in the mayor's ability to lead sustainable initiatives, a few expressed criticism and frustration explaining this leadership failed to translate across the political spectrum, excluding other potential key individuals (those having a different

political view to the mayor) from the decision-making processes. Our research data revealed that leadership capacities, in the form of individuals, groups, or organizations (e.g., Pourashava) at the local level, are emerging and might drive sustainable growth. However, there is limited scope for regional and national level actors to lead policy implementation and to connect with local scale implementation. This capacity gap between regional and national level actors is critical for cross-scale interactions and further developing vertical linkages. The transition and adaptive water governance scholarship continue to emphasize the need for vertical linkages and cross-scale interactions for driving sustainable change (Bai et al. 2009, Huitema et al. 2009, Naster 2014, Cosens 2015, Kuzdas et al. 2015, Azhoni et al. 2017). The findings from the research explain that these regional and national level actors are rigid, bureaucratic, and have a critical view on innovation and experimentation. Some examples provided by the interviewees in particular, when explaining their involvement and contribution to Mymensingh city planning as part of the MSDP experiment, demonstrated that increasing local involvement and learning is vital. Some of the Pourashava staff expressed their frustration regarding other state organizations and their lack of capacity in understanding alternative options and or experimentation. This has been confirmed also in the case of Dhaka, where state organizations are not capable of designing, implementing, and supporting interventions that can lead to development of a sustainable trajectory. This further infers that these disconnected regional and national level actors might become a barrier to driving further sustainable transition in Bangladesh despite capacity increasing at the local scale.

Experimentation and social learning

The scholars reviewing Global South cases have noted that although these cities have strong imperatives and uniqueness, innovation and experimentation for sustainability are not occurring because of capacity gaps at different scales of implementation (Nagendra et al. 2018). The findings presented through the ACA framework in this study now can infer that the context is changing. The hybridized governance structure in Mymensingh is offering an interactive platform for a range of actors to provide governance services, which Global North literature suggests can improve the capacity to embrace experimentation and learning (Huitema et al. 2009, Farrelly and Brown 2011, Pahl-Wostl et al. 2012, Luederitz et al. 2017). Although the UGIIP implementation signifies the emergence of the hybridized governance structure and assists in improving institutional and actors' capacity in this space, the MSDP is conceived as an experimental, multi-actor platform and further offers a pathway for bottom-up city planning. The MSDP project used this hybridized governance structure to involve the relevant communities in identifying their urban development-related problems and possible solutions, and then outlined a 20-year plan by utilizing bottom-up thinking. This approach stands in contrast to the generic understanding of transition scholars reviewing the Global South context and explains that innovations in this space are often confined to a single experiment or aimed at a set of specific goals set by donor agencies, rather than using innovation as a platform for further experimentation (Hansen et al. 2018).

The research data from the Mymensingh city have identified the UGIIP as an example of a continuous learning effort starting from 2003 to increase governance capacity at a local scale,

including building infrastructure for developing the urban water system. The MSDP on the other hand, refers to an experiment that has this bottom-up thinking (local community voice) feeding into national policy processes toward sustainable city development. UGIIP is being implemented in phases (as of the research period in 2017, the evaluation of Phase II was being completed to start Phase III). A new phase implementation depends on the evaluation and feedback from the earlier phase to improve the outcome. The UGIIP project revealed some scope for further learning processes, including, for example, influencing governance norms, values, and protocols, all well-acknowledged features. Moreover, the research finds that the MSDP project is developing a bottom-up approach to planning, with a “learning-by-doing” strategy. This is new in planning and city development approaches in Bangladesh. This experiment is also driving a shift in norms and in people’s conception of resilience and sustainable thinking. The MSDP project activities were underway during the data collection period (2016–2017) for this study, which inhibits the researcher’s ability to determine how successful the project was. Yet, at the time of this research, the Pourashava had started to use the draft plan as a guide for developing the city in a sustainable manner. However, this research suggests that there might be great scope for exploring further to understand double and triple-loop learning scopes in Bangladesh to drive a sustainable outcome. This suggests that MSDP as a missed opportunity that could be better strengthened moving forward if such governance approaches were considered through the lens of experimentation (e.g., Bos and Brown 2012). Dhaka, on the other hand, was found to rely on conventional governance systems, largely on a project-to-project basis and/or through isolated implementation by the relevant organizations struggling with coordination, which largely supports single-loop learning processes. As outlined earlier, the empirical data did not reveal any significant improvement around adaptive and sustainable initiatives in Dhaka over the time period evaluated, suggesting water governance in Dhaka has limited scope for double and triple-loop learning.

Overall, the emergence of learning processes in a particular context, capacity, or actor (an individual, a group in wider social units, or communities of practice) is required for a change in governance approach if sustainable growth is to occur (Reed et al. 2010). The insights generated from the Mymensingh city indicate that the spectrum of hybridized governance is enabling a platform for social learning processes that can improve capacity to practice joint initiatives/collaboration by involving diverse stakeholder participation in achieving the goals of governance.

ADAPTIVE WATER GOVERNANCE FOR SUSTAINABLE TRANSFORMATION

The previous section highlights capacities present (and/or absent) for the emergence and implementation of adaptive governance strategies in urban Bangladesh. The ACA framework, featuring adaptive attributes and capacity, has been useful to understand the contemporary capacity and governance contexts between two Bangladeshi cities. This study highlights the spectrum of the hybridized and polycentric governance structures, which are creating capacity platforms for effective participation and collaboration, for developing bridging functions and leadership capacity and more often to support experimentation and learning to occur. These findings extend environmental and urban

scholars’ views on hybridized structures for governance transformation by revealing how new multi-scale strategies and institutional structures are encouraging and supporting activities that are useful for increasing relevant capacity at a local scale. This finding also addresses concern raised by the adaptation scholars’ regarding the newly employed institutional settings in the Global North and South, which have yet to provide evidence regarding their effectiveness (Huitema et al. 2009, Huntjens et al. 2012, Conway and Mustelin 2014, Cosens 2015).

This research finds that leadership from individuals, groups, and communities is critical for a transition; therefore, there is a need to nurture this capacity through incentives and relevant training. Local actors are active and supportive of sustainable initiatives; however, regional and central/national state actors are less active or are affected by a missing link in the governance regime, which delays and sometimes becomes a barrier to a sustainable outcome. This study suggests that a mix of top-down and bottom-up initiatives will be important for improving capacity and to rectify missing links. Bridging organizations and their functions provide opportunities for collaboration, new network formation, and coordination. Informal dynamics or shadow systems (such as supporting activities by the town-, ward-, and community-level coordination committee in decision making with the formal Pourashava administration) formed a unique governance structure and have been found to offer critical space for social interaction and to drive innovation and experimentation (Figs. 2 and 3). In Bangladesh’s urban water system, such informal dynamics provide governance services where state-led interventions or relevant government organizations have failed to deliver essential services. For example, NGOs and private organizations are starting to build septic tank-based sanitation systems where government organizations focus on water supply rather than sanitation services. Sustainable transition and adaptive water governance scholarship recognizes the importance of informal institutions; however, it also notes that these institutions need to be integrated into or embedded within the formal institutions (Huitema et al. 2009, Loorback and Rotmans 2010, DeCaro et al. 2017, Cosens et al. 2018). We have seen in the broader Bangladesh context (particularly in Dhaka) that more often than not these informal institutions have failed to integrate with or to complement the formal system. By contrast, in Mymensingh, as we have seen, informal groups can complement government efforts in resource management, such as the active participation of actor clusters in the Pourashava’s implementation processes and collective efforts led by private organizations and NGOs to produce organic manure from recycling waste.

The findings from this research (Figs. 2 and 3) further note that in the Global South context, relevant policy, strategic investment and guidance are necessary to support continuation of such hybridized forms of governance and to support a sustainable transition. Governance transition also demands that state and transnational actors lead initiatives toward a shared goal of sustainability. This can be achieved through redefining the social contract for water, which appears to be shifting toward a participatory approach with an increasing focus on environmental protection, while the state is still considered the major responsible authority. The revised social contract should reflect increasing non-state actor involvement in critical decision making, such as resource distribution and access, and inequality.

This would provide opportunities for redistribution of power and integration of knowledge (i.e., scientific, policy, and local). In addition to environmental concerns, the revised social contract should consider critical phenomena such as communities' concern for livability and environmental well-being. To achieve millennium development goals' (MGDs) target, Bangladesh unlike other countries from the Global South, implemented projects that are isolated and furthermore might have compromised environmental issues (developing toilets without thinking about the fecal waste management), which are now becoming major impediments in achieving the SDGs. Thus, the insights generated through this research, in light of urban water systems, regarding the need to build capacity for delivering adaptive attributes and to further thinking about reforming the social contract for the delivery of water and water-related services might bring about the changes needed to achieve a sustainable future for Bangladesh.

Overall, this research reveals an integrative and holistic view of the range of adaptive attributes and capacity contexts that may be necessary for promoting adaptive water governance scholarship. For a sustainable future, there are still many opportunities emerging that might need further detailed empirical research to foster a capacity for driving sustainable transition in the Global South context. This research also sheds light on small-scale urban water systems and their leverage for implementing adaptive and transformative capacity and governance. This understanding adds to the concept of environmental leapfrogging (Watson and Sauter 2011, Poustie et al. 2016) and provides an empirical illustration of how adaptive water governance principles are guiding the processes so that this leapfrogging might be achieved.

CONCLUSION

The insights generated through this paper highlighted adaptive governance principles in capacity development to support a water governance transformation for advancing sustainable urban water governance practices in Bangladesh. The capacity context also shed light on the enablers and critical adaptive attributes identified through the ACA and MLP frameworks and indicates the interdependencies of these enablers and attributes. This study observed different starting lines and capacity contexts at different city scales that are guiding the development of a sustainable trajectory in management of Bangladesh's urban water systems. The large-scale urban water system of Dhaka was found to be facing complex governance challenges, entrapped as it is in technological and bureaucratic dependencies.

This study shows that Dhaka's water governance regime is lacking in all the aspects of capacity needed for effective participation, collaboration, leading sustainable initiatives, supporting experimentation and reflective learning. The social contract for water service delivery is still dominated by state authorization, with limited scope for wider participation. It is evident that Dhaka (and other cities in Bangladesh following the Dhaka model) is not yet on a sustainable trajectory. The way Dhaka is progressing might require more time to address the underlying governance challenges, to redefine the social contract, and to increase the capacities needed to deliver adaptive attributes, such as Dhaka Water Supply and Sewerage Authority (DWASA) and water development board for transforming the urban water system into

a sustainable one. In examining the case of Mymensingh, and in particular, its hybridized governance structure, the research showed that this small-scale urban system is offering better opportunities for initiating a governance transition than the larger urban water system. All aspects of capacity in Mymensingh city were found to be promising, in particular the context of hybridized governance structure, which acts as a platform for encouraging participatory decision making, networking activities, and reflective learning from the local context, which all are critical for implementing an adaptive water governance approach.

Our research also identified the potential for the delivery of critical adaptive attributes needed to develop adaptive capacity. One can infer that Mymensingh City will progress relatively faster on a sustainable pathway than other Bangladesh megacities such as Dhaka. Yet critical elements are required to guide a change if the hybridized governance system is to continue. These include continued strategic and financial investment from the government and a transition of governance structure and policies approaches to develop the small-scale urban system; a redefining of the social contract to redistribute power; improving the leadership capacity of individuals and networks; providing space for bridging organizations to perform and to mediate decisions and disagreements; facilitating informal dynamics or shadow systems; and supporting further experimentation and innovation to foster social learning processes.

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Data Availability:

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

LITERATURE CITED

- Ahammad, R., M. K. Hossain, and P. Husnain. 2014. Governance of forest conservation and cobenefits for Bangladesh under changing climate. *Journal of Forestry Research* 25(1):29-36. <https://doi.org/10.1007/s11676-014-0430-9>
- Asian Development Bank (ADB). 2012. The urban governance and infrastructure improvement project in Bangladesh. Publication No. ARM124937. ADB, Manila, Philippines. <https://www.adb.org/sites/default/files/publication/29976/urban-governance-infrastructure-project-bangladesh.pdf>
- Asian Development Bank (ADB). 2015. Strengthening municipal governance through performance-based budget allocation in Bangladesh. ADB, Manila, Philippines. <https://www.adb.org/>

[sites/default/files/publication/177452/strengthening-municipal-governance-bangladesh.pdf](#)

Azhoni, A., I. Holman, and S. Jude. 2017. Contextual and interdependent causes of climate change adaptation barriers: insights from water management institutions in Himachal Pradesh, India. *Science of the Total Environment* 576:817-828. <https://doi.org/10.1016/j.scitotenv.2016.10.151>

Bahauddin, K. M., N. Rahman, and M. T. Hasnine. 2016. Environmental reviews and case studies: public perception, knowledge, and participation in climate change adaptation governance in the coastal region of Bangladesh using the social ecological inventory (SEI) tool. *Environmental Practice* 18 (1):32-43. <https://doi.org/10.1017/S1466046615000393>

Bai, X., A. J. Wiczorek, S. Kaneko, S. Lisson, and A. Contreras. 2009. Enabling sustainability transitions in Asia: the importance of vertical and horizontal linkages. *Technological Forecasting and Social Change* 76:255-266. <https://doi.org/10.1016/j.techfore.2008.03.022>

Bakkour, D., G. Enjolras, J. C. Thouret, R. Kast, E. T. W. Mei, and B. Prihatminingtyas. 2015. The adaptive governance of natural disaster systems: insights from the 2010 mount Merapi eruption in Indonesia. *International Journal of Disaster Risk Reduction* 13:167-188. <https://doi.org/10.1016/j.ijdrr.2015.05.006>

Bangladesh Bureau of Statistics (BBS). 2011. Statistical yearbook of Bangladesh. Statistics Division, Ministry of Planning, Dhaka, Government of the People's Republic of Bangladesh. <http://203.112.218.65:8008/WebTestApplication/userfiles/Image/LatestReports/YB2011.pdf>

Bangladesh Bureau of Statistics and UNICEF Bangladesh. 2014. Bangladesh multiple indicator cluster survey 2012–2013. Progotir Pathay: final report. Bangladesh Bureau of Statistics (BBS) and UNICEF Bangladesh, Dhaka, Bangladesh. <https://www.unicef.org/bangladesh/media/1021/file/Mics2013.pdf>

Bangladesh Water Act. 2013. Water resource and planning organization. Dhaka, Bangladesh: Government of Bangladesh. <https://www.bwdb.gov.bd/archive/pdf/321.pdf>

Berkes, F., and H. Ross. 2013. Community resilience: toward an integrated approach. *Society & Natural Resources* 26(1):5-20. <https://doi.org/10.1080/08941920.2012.736605>

Berkhout, F., G. Verbong, A. J. Wiczorek, R. Raven, L. Lebel, and X. Bai. 2010. Sustainability experiments in Asia: innovations shaping alternative development pathways? *Environmental Science & Policy* 13(4):261-271. <https://doi.org/10.1016/j.envsci.2010.03.010>

Biesbroek, G. R., C. J. Termeer, J. E. Klostermann, and P. Kabat. 2014. Analytical lenses on barriers in the governance of climate change adaptation. *Mitigation and Adaptation Strategies for Global Change* 19(7):1011-1032. <https://doi.org/10.1007/s11027-013-9457-z>

Bird, J., Y. Li, H. Z. Rahman, M. Rama, and A. J. Venables. 2018. Dhaka: dynamic but Messy. In *Toward Great Dhaka: a new urban development paradigm eastward*. The World Bank, Washington, D.C., USA. https://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-1238-5_ch1

Bos, J. J., and R. R. Brown. 2012. Governance experimentation and factors of success in socio-technical transitions in the urban water sector. *Technological Forecasting and Social Change* 79 (7):1340-1353. <https://doi.org/10.1016/j.techfore.2012.04.006>

Brown, R., M. Farrelly, and N. Keath. 2009a. Practitioner perceptions of social and institutional barriers to advancing a diverse water source approach in Australia. *International Journal of Water Resources Development* 25(1):15-28. <https://doi.org/10.1080/07900620802586090>

Brown, R. R., N. Keath, and T. H. Wong. 2009b. Urban water management in cities: historical, current and future regimes. *Water Science and Technology* 59(5):847-855. <https://doi.org/10.2166/wst.2009.029>

Butler, J. R. A., W. Suadnya, K. Puspadi, Y. Sutaryono, R. M. Wise, T. D. Skewes, D. Kirono, E. L. Bohensky, T. Handayani, P. Habibi, et al. 2014. Framing the application of adaptation pathways for rural livelihoods and global change in eastern Indonesian islands. *Global Environmental Change* 28:368-382. <https://doi.org/10.1016/j.gloenvcha.2013.12.004>

Celliers, L., S. Rosendo, I. Coetzee, and G. Daniels. 2013. Pathways of integrated coastal management from national policy to local implementation: enabling climate change adaptation. *Marine Policy* 39:72-86. <https://doi.org/10.1016/j.marpol.2012.10.005>

Chaffin, B. C., T. M. Floyd, and S. L. Albro. 2019. Leadership in informal stormwater governance networks. *PloS ONE* 14(10): e0222434. <https://doi.org/10.1371/journal.pone.0222434>

Chaffin, B. C., A. S. Garmestani, L. H. Gunderson, M. H. Benson, D. G. Angeler, C. A. Arnold, B. Cosens, R. K. Craig, J. B. Ruhl, and C. R. Allen. 2016. Transformative environmental governance. *Annual Review of Environment and Resources* 41:399-423. <https://doi.org/10.1146/annurev-environ-110615-085817>

Chaffin, B. C., and H. Gosnell. 2015. Measuring success of adaptive management projects. Pages 85-105 in C. R. Allen and A. S. Garmestani, editors. *Adaptive management of social-ecological systems*. Springer, Dordrecht, The Netherlands. https://doi.org/10.1007/978-94-017-9682-8_6

Chaffin, B. C., H. Gosnell, and B. A. Cosens. 2014. A decade of adaptive governance scholarship: synthesis and future directions. *Ecology and Society* 19(3):56. <https://doi.org/10.5751/ES-06824-190356>

Cinner, J. E., T. M. Daw, T. R. McClanahan, N. Muthiga, C. Abunge, S. Hamed, B. Mwaka, A. Rabearisoa, A. Wamukota, E. Fisher, and N. Jiddawi. 2012. Transitions toward co-management: the process of marine resource management devolution in three east African countries. *Global Environmental Change* 22 (3):651-658. <https://doi.org/10.1016/j.gloenvcha.2012.03.002>

Clark, J. R., and C. Semmahasak. 2013. Evaluating adaptive governance approaches to sustainable water management in north-west Thailand. *Environmental Management* 51(4):882-896. <https://doi.org/10.1007/s00267-012-9993-4>

Conway, D., and J. Mustelin. 2014. Strategies for improving adaptation practice in developing countries. *Nature Climate Change* 4(5):339-342. <https://doi.org/10.1038/nclimate2199>

- Cooper, R. V. 2011. Promoting and contesting hydropower development: actors and narratives in the Lower Mekong Basin's hydropolitical constellation. Dissertation. Newcastle University, Newcastle, UK.
- Cosens, B. 2015. Application of the adaptive water governance project to management of the Lake Eyre basin and its connections to the Great Artesian Basin. Goyder Institute for Water Research, Adelaide, Australia. http://www.goyderinstitute.org/_r89/media/system/attrib/file/80/FU%20LEB%20GAP%20Report-WEB.pdf
- Cosens, B. A., L. Gunderson, and B. C. Chaffin. 2018. Introduction to the special feature practicing panarchy: assessing legal flexibility, ecological resilience, and adaptive governance in regional water systems experiencing rapid environmental change. *Ecology and Society* 23(1):4. <https://doi.org/10.5751/ES-09524-230104>
- Creswell, J. W. 2013. Research design: qualitative, quantitative, and mixed methods approaches. SAGE, Los Angeles, California, USA.
- Crona, B. I., and J. N. Parker. 2012. Learning in support of governance: theories, methods, and a framework to assess how bridging organizations contribute to adaptive resource governance. *Ecology and Society* 17(1):32. <https://doi.org/10.5751/ES-04534-170132>
- DeCaro, D. A., B. C. Chaffin, E. Schlager, A. S. Garmestani, and J. B. Ruhl. 2017. Legal and institutional foundations of adaptive environmental governance. *Ecology and Society* 22(1):32. <https://doi.org/10.5751/ES-09036-220132>
- de Noronha, T., and E. Vaz. 2015. Framing urban habitats: the small and medium towns in the peripheries. *Habitat International* 45:147-155. <https://doi.org/10.1016/j.habitatint.2014.06.025>
- Farrelly, M., and R. Brown. 2011. Rethinking urban water management: experimentation as a way forward? *Global Environmental Change* 21(2):721-732. <https://doi.org/10.1016/j.gloenvcha.2011.01.007>
- Farrelly, M. A., J. Rijke, and R. R. Brown. 2012. Exploring operational attributes of governance for change. In *WSUD 2012: Water sensitive urban design; building the water sensitive community*; 7th international conference on water sensitive urban design. Engineers Australia.
- Ferdous, Z., F. Zulfiqar, A. Datta, A. K. Hasan, and A. Sarker. 2021. Potential and challenges of organic agriculture in Bangladesh: a review. *Journal of Crop Improvement* 35 (3):403-426. <https://doi.org/10.1080/15427528.2020.1824951>
- Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441-473. <https://doi.org/10.1146/annurev.energy.30.050504.144511>
- Gain, A. K., and M. Schwab. 2012. An assessment of water governance trends: the case of Bangladesh. *Water Policy* 14 (5):821-840. <https://doi.org/10.2166/wp.2012.143>
- Geels, F. 2011. The role of cities in technological transitions. Pages 13-28 in H. Bulkeley, V. Castán Broto, M. Hodson, and S. Marvin, editors. *Cities and low carbon transitions*. Routledge, London, UK.
- Government of the People's Republic of Bangladesh. 2009. Pourashava Act 2009. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. <https://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/10/112/PaurashavaAct2009.doc>
- Government of the People's Republic of Bangladesh. 2012. Perspective plan of Bangladesh 2010–2021. General Economics Division, Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. https://bangladesh.gov.bd/sites/default/files/files/bangladesh.gov.bd/page/6dca6a2a_9857_4656_bcef_139584b7f160/Perspective-Plan-of-Bangladesh.pdf
- Government of the People's Republic of Bangladesh. 2015. Mymensingh Strategic Development Plan (MSDP) 2011–2031. Ministry of Housing and Public Works, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. http://udd.portal.gov.bd/sites/default/files/files/udd.portal.gov.bd/publications/c02c0a00_4471_4763_8659_7e04028b0cb5/MSDP%20Monograph.pdf
- Government of the People's Republic of Bangladesh. 2018. Sustainable Development Goals: Bangladesh progress report 2018. General Economics Division, Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. <https://www.undp.org/sites/g/files/zskgke326/files/migration/bd/259fbc056dceb28d6dbba088c50b310c9f83ea13082196a8922ce43f6fd956b8.pdf>
- Hansen, U. E., and I. Nygaard. 2013. Transnational linkages and sustainable transitions in emerging countries: exploring the role of donor interventions in niche development. *Environmental Innovation and Societal Transitions* 8:1-19. <https://doi.org/10.1016/j.eist.2013.07.001>
- Hansen, U. E., I. Nygaard, H. Romijn, A. Wiczorek, L. M. Kamp, and L. Klerkx. 2018. Sustainability transitions in developing countries: stocktaking, new contributions and a research agenda. *Environmental Science & Policy* 84:198-203. <https://doi.org/10.1016/j.envsci.2017.11.009>
- Hossain, K. Z., and S. A. Ahmed. 2015. Non-conventional public-private partnerships for water supply to urban slums. *Urban Water Journal* 12(7):570-580. <https://doi.org/10.1080/1573062X-2014.923473>
- Hossain, M. F. 2006. Arsenic contamination in Bangladesh—an overview. *Agriculture, Ecosystems & Environment* 113(1-4):1-16. <https://doi.org/10.1016/j.agee.2005.08.034>
- Huitema, D., E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, and R. Yalcin. 2009. Adaptive water governance: assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda. *Ecology and Society* 14(1):26. <https://doi.org/10.5751/ES-02827-140126>
- Huntjens, P., L. Lebel, C. Pahl-Wostl, J. Camkin, R. Schulze, and N. Kranz. 2012. Institutional design propositions for the governance of adaptation to climate change in the water sector. *Global Environmental Change* 22(1):67-81. <https://doi.org/10.1016/j.gloenvcha.2011.09.015>
- Hurlbert, M., and J. Gupta. 2016. Adaptive governance, uncertainty, and risk: policy framing and responses to climate

- change, drought, and flood. *Risk Analysis* 36(2):339-356. <https://doi.org/10.1111/risa.12510>
- Jaglin, S., C. Repussard, and A. Belbéoc'h. 2011. Decentralisation and governance of drinking water services in small West African towns and villages (Benin, Mali, Senegal): the arduous process of building local governments. *Canadian Journal of Development Studies/Revue canadienne d'études du développement* 32 (2):119-138. <https://doi.org/10.1080/02255189.2011.596021>
- Karpouzoglou, T., A. Dewulf, and J. Clark. 2016. Advancing adaptive governance of social-ecological systems through theoretical multiplicity. *Environmental Science & Policy* 57:1-9. <https://doi.org/10.1016/j.envsci.2015.11.011>
- Keath, N. A., and R. R. Brown. 2009. Extreme events: being prepared for the pitfalls with progressing sustainable urban water management. *Water Science and Technology* 59(7):1271-1280. <https://doi.org/10.2166/wst.2009.136>
- Kuzdas, C., A. Wiek, B. Warner, R. Vignola, and R. Morataya. 2015. Integrated and participatory analysis of water governance regimes: the case of the Costa Rican dry tropics. *World Development* 66:254-268. <https://doi.org/10.1016/j.worlddev.2014.08.018>
- Larsen, T. A., S. Hoffmann, C. Lüthi, B. Truffer, and M. Maurer. 2016. Emerging solutions to the water challenges of an urbanizing world. *Science* 352(6288):928-933. <https://doi.org/10.1126/science.aad8641>
- Lawhon, M., and J. T. Murphy. 2012. Socio-technical regimes and sustainability transitions: insights from political ecology. *Progress in Human Geography* 36(3):354-378. <https://doi.org/10.1177/0309132511427960>
- Loorbach, D., and J. Rotmans. 2010. The practice of transition management: examples and lessons from four distinct cases. *Futures* 42(3):237-246. <https://doi.org/10.1016/j.futures.2009.11.009>
- Luederitz, C., N. Schöpke, A. Wiek, D. J. Lang, M. Bergmann, J. J. Bos, S. Burch, A. Davies, J. Evans, A. König, et al. 2017. Learning through evaluation—a tentative evaluative scheme for sustainability transition experiments. *Journal of Cleaner Production* 169:61-76. <https://doi.org/10.1016/j.jclepro.2016.09.005>
- Lundqvist, J., S. Narain, and A. Turton. 2001. Social, institutional and regulatory issues. Pages 344-398 in Č. Maksimović and J. A. Tejada-Guibert, editors. *Frontiers in urban water management: deadlock or hope*. IWA, London, UK.
- Meissner, R., and A. R. Turton. 2003. The hydrosocial contract theory and the Lesotho Highlands Water Project. *Water Policy* 5 (2):115-126. <https://doi.org/10.2166/wp.2003.0007>
- Milly, P. C. D., J. Betancourt, M. Falkenmark, R. M. Hirsch, Z. W. Kundzewicz, D. P. Lettenmaier, and R. J. Stouffer. 2008. Stationarity is dead: whither water management? *Science* 319 (5863):573-574. <https://doi.org/10.1126/science.1151915>
- Moinuddin, G. 2010. Metropolitan government and improvement potentials of urban basic services governance in Dhaka City, Bangladesh: rhetoric or reality? *Theoretical and Empirical Researches in Urban Management* 5(5(14)):59-81.
- Moinuddin, G. 2013. Urban basic utilities management under fragmented governance: an oratory on its contribution in cities of developing world. *Theoretical & Empirical Researches in Urban Management* 8(4):85-106.
- Mugabi, J., S. Kayaga, and C. Njiru. 2007. Strategic planning for water utilities in developing countries. *Utilities Policy* 15:1-8. <https://doi.org/10.1016/j.jup.2006.10.001>
- Nagendra, H., X. Bai, E. S. Brondizio, and S. Lwasa. 2018. The urban south and the predicament of global sustainability. *Nature Sustainability* 1:341-349. <https://doi.org/10.1038/s41893-018-0101-5>
- Nastar, M. 2014. What drives the urban water regime? An analysis of water governance arrangements in Hyderabad, India. *Ecology and Society* 19(2):57. <https://doi.org/10.5751/ES-06570-190257>
- Newig, J., and T. M. Koontz. 2014. Multi-level governance, policy implementation and participation: the EU's mandated participatory planning approach to implementing environmental policy. *Journal of European Public Policy* 21(2):248-267. <https://doi.org/10.1080/13501763.2013.834070>
- Pahl-Wostl, C. 2007. Transitions towards adaptive management of water facing climate and global change. Pages 49-62 in E. Craswell, M. Bonnell, D. Bossio, S. Demuth, and N. Giesen, editors. *Water Resources Management*. Springer, Dordrecht, The Netherlands. https://doi.org/10.1007/978-1-4020-5591-1_4
- Pahl-Wostl, C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19 (3):354-365. <https://doi.org/10.1016/j.gloenvcha.2009.06.001>
- Pahl-Wostl, C. 2017. An evolutionary perspective on water governance: from understanding to transformation. *Water Resources Management* 31(10):2917-2932. <https://doi.org/10.1007/s11269-017-1727-1>
- Pahl-Wostl, C., G. Holtz, B. Kastens, and C. Knieper. 2010. Analyzing complex water governance regimes: the management and transition framework. *Environmental Science & Policy* 13 (7):571-581. <https://doi.org/10.1016/j.envsci.2010.08.006>
- Pahl-Wostl, C., L. Lebel, C. Knieper, and E. Nikitina. 2012. From applying panaceas to mastering complexity: toward adaptive water governance in river basins. *Environmental Science and Policy* 23:24-34. <https://doi.org/10.1016/j.envsci.2012.07.014>
- Panditharatne, C. 2016. Institutional barriers in adapting to climate change: a case study in Sri Lanka. *Ocean & Coastal Management* 130:73-78. <https://doi.org/10.1016/j.ocecoaman.2016.06.003>
- Population Reference Bureau (PRB). 2018. 2018 World population data sheet. PRB, Washington, D.C., USA. <https://www.prb.org/wp-content/uploads/2018/08/2018-World-Population-data-sheet.pdf>
- Poustie, M. S., N. Frantzeskaki, and R. R. Brown. 2016. A transition scenario for leapfrogging to a sustainable urban water future in Port Vila, Vanuatu. *Technological Forecasting and Social Change* 105:129-139. <https://doi.org/10.1016/j.techfore.2015.12.008>

- Rana, M. P. 2009. Sustainable city in the Global North and South: goal or principle? *Management of Environmental Quality* 20 (5):506-521. <https://doi.org/10.1108/14777830910981195>
- Raven, R. P. J. M., and F. W. Geels. 2010. Socio-cognitive evolution in niche development: comparative analysis of biogas development in Denmark and the Netherlands (1973-2004). *Technovation* 30(2):87-99. <https://doi.org/10.1016/j.technovation.2009.08.006>
- Reed, M. S., A. C. Evely, G. Cundill, I. Fazey, J. Glass, A. Laing, J. Newig, B. Parrish, C. Prell, C. Raymond, and L. C. Stringer. 2010. What is social learning? *Ecology and Society* 15(4):r1. <https://doi.org/10.5751/ES-03564-1504r01>
- Regmi, B. R., C. Star, and W. Leal Filho. 2016. Effectiveness of the local adaptation plan of action to support climate change adaptation in Nepal. *Mitigation and Adaptation Strategies for Global Change* 21(3):461-478. <https://doi.org/10.1007/s11027-014-9610-3>
- Rip, A., and R. Kemp. 1998. Technological change. Chapter 6 in S. Rayner and E. L. Malone, editors. *Human choice and climate change*. Battelle, Columbus, Ohio, USA.
- Romano, O., and A. Akhmouch. 2019. Water governance in cities: current trends and future challenges. *Water* 11(3):500. <https://doi.org/10.3390/w11030500>
- Rotmans, J., R. Kemp, and M. Van Asselt. 2001. More evolution than revolution: transition management in public policy. *Foresight* 3(1):15-31. <https://doi.org/10.1108/14636680110803003>
- Rouillard, J. J., D. Benson, and A. K. Gain. 2014. Evaluating IWRM implementation success: are water policies in Bangladesh enhancing adaptive capacity to climate change impacts? *International Journal of Water Resources Development* 30 (3):515-527. <https://doi.org/10.1080/07900627.2014.910756>
- Satumanatpan, S., P. Senawongse, W. Thansuporn, and H. Kirkman. 2014. Enhancing management effectiveness of environmental protected areas, Thailand. *Ocean & Coastal Management* 89:1-10. <https://doi.org/10.1016/j.ocecoaman.2013.12.001>
- Sharma-Wallace, L., S. J. Velarde, and A. Wreford. 2018. Adaptive governance good practice: show me the evidence! *Journal of Environmental Management* 222:174-184. <https://doi.org/10.1016/j.jenvman.2018.05.067>
- Sowman, M., and S. Raemaekers. 2018. Socio-ecological vulnerability assessment in coastal communities in the BCLME region. *Journal of Marine Systems* 188:160-171. <https://doi.org/10.1016/j.jmarsys.2018.01.008>
- Srinivasan, V., K. C. Seto, R. Emerson, and S. M. Gorelick. 2013. The impact of urbanization on water vulnerability: a coupled human-environment system approach for Chennai, India. *Global Environmental Change* 23(1):229-239. <https://doi.org/10.1016/j.gloenvcha.2012.10.002>
- Swapan, M. S. H., A. U. Zaman, T. Ahsan, and F. Ahmed. 2017. Transforming urban dichotomies and challenges of South Asian megacities: rethinking sustainable growth of Dhaka, Bangladesh. *Urban Science* 1(4):31. <https://doi.org/10.3390/urbansci1040031>
- Turton, A. R., and L. Ohlsson. 1999. Water scarcity and social adaptive capacity: Towards an understanding of the social dynamics of managing water scarcity in developing countries. Paper presented at the Stockholm Water Symposium 9-12 August, Stockholm, Sweden.
- Tutusaus, M., and K. Schwartz. 2018. Water services in small towns in developing countries: at the tail end of development. *Water Policy* 20(S1):1-11. <https://doi.org/10.2166/wp.2018.001>
- Van de Meene, S. J., R. R. Brown, and M. A. Farrelly. 2011. Towards understanding governance for sustainable urban water management. *Global Environmental Change* 21(3):1117-1127. <https://doi.org/10.1016/j.gloenvcha.2011.04.003>
- Watson, J., and R. Sauter. 2011. Sustainable innovation through leapfrogging: a review of the evidence. *International Journal of Technology and Globalisation* 5(3-4):170-189. <https://doi.org/10.1504/IJTG.2011.039763>
- Wieczorek, A. J. 2018. Sustainability transitions in developing countries: major insights and their implications for research and policy. *Environmental Science & Policy* 84:204-216. <https://doi.org/10.1016/j.envsci.2017.08.008>
- Wittmayer, J. M., N. Schäpke, F. van Steenberg, and I. Omann. 2014. Making sense of sustainability transitions locally: how action research contributes to addressing societal challenges. *Critical Policy Studies* 8(4):465-485. <https://doi.org/10.1080/194-60171.2014.957336>
- Wolfram, M. 2016. Conceptualizing urban transformative capacity: a framework for research and policy. *Cities* 51:121-130. <https://doi.org/10.1016/j.cities.2015.11.011>
- Yasmin, T., M. A. Farrelly, and B. C. Rogers. 2018. Evolution of water governance in Bangladesh: an urban perspective. *World Development* 109:386-400. <https://doi.org/10.1016/j.worlddev.2018.05.003>
- Yasmin, T., M. Farrelly, and B. C. Rogers. 2020. Adaptive governance: a catalyst for advancing sustainable urban transformation in the global South. *International Journal of Water Resources Development* 36(5):818-838. <https://doi.org/10.1080/07900627.2019.1611548>
- Yin, R. K. 2013. Validity and generalization in future case study evaluations. *Evaluation* 19(3):321-332. <https://doi.org/10.4135/9781473915480.n48>