

Transforming urban water governance through social (triple-loop) learning

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Abstract

The sustainable development of cities is threatened by a worldwide water crisis. Improved social learning is urgently needed to transform urban water governance and make it more integrated and adaptive. However, empirical studies remain few and fragmented. Therefore, the aim of this paper is to analyse how social learning has supported or inhibited sustainable transformations in urban water governance. On the basis of multiple case studies conducted in urban, flood-prone areas in Colombia, the Philippines, South Africa, India, and Sweden, we study learning processes related to different aspects of water management and governance. Our results show that transformations in water governance are often triggered by crises, whereas other potentials for transformation are not tapped into. Furthermore, learning is often inhibited by “lock-ins” created by powerful actors. We conclude that there is a need for more proactive design of governance structures for triple-loop learning that take into account the identified barriers and supporting principles.

KEYWORDS

climate change adaptation, disaster risk reduction, flood risk, integrated water resources management, social learning, transformation, urban water services, water governance

1 | INTRODUCTION

The sustainable development of cities is threatened by a worldwide water crisis, which is largely attributed to a failure in water governance (Intergovernmental Panel on Climate Change [IPCC], 2012; World Economic Forum, 2017). Associated risks include flooding, drought, and degradation of water resources and associated ecosystems (Howard & Bartram, 2010). These risks are often linked to urban development itself, as rapid, unplanned sprawl contributes to increased disaster risk and water stress

(Wamsler, 2014). Issues such as climate change and migration make the situation even more worrying (IPCC, 2012; World Economic Forum, 2017).

Consequently, scholars, government agencies, and practitioners are increasingly highlighting the need to transform¹ water governance in

¹As used here, the term “transformation” is distinct from the term “transition” used in sociotechnical systems. The former focuses on changes in the management paradigm (Pahl-Wostl, Becker, Knieper, & Sendzimir, 2013), whereas the latter focuses on changes in modes of production and consumption (Markard, Raven, & Truffer, 2012).

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ways that will make it more integrated and adaptive (Blackmore et al., 2016). Such a transformation—and associated actions—is widely promoted by different management models (Sayers et al., 2015) and international policy agendas, notably the Sustainable Development Goals set by the United Nations Development Programme (UN General Assembly, 2015). *Integration* refers to the management of complex, interconnected ecosystems, by improving the integration between relevant actors and sectors (Roy, Barr, & Venema, 2011). Through *adaptation*, actors can plan and implement different options across levels and scales (Blackmore et al., 2016). This is required for the management of the water ecosystem to remain consistent with changing conditions (Milly et al., 2008).

Although social learning is claimed to be key for supporting water governance transformation and related processes of adaptation and integration, empirical evidence is lacking (Blackmore et al., 2016). Social learning occurs through interactions between actors within social networks and manifests in a change in understanding that becomes established within wider societal units or communities of practice (Reed et al., 2010). It is thus seen as a key way to identify interlinkages between the water crisis and the water governance (Pahl-Wostl et al., 2013). The ultimate aim is that the system of institutions becomes more integrated and adaptable, notably with respect to formal and informal rules, laws, regulations, policies, social norms, actor networks, and organizations (Chaffin, Gosnell, & Cosens, 2014). However, we lack an understanding of how social learning processes can be designed and supported (Blackmore et al., 2016; Medema, Wals, & Adamowski, 2014). Such knowledge is key for complementing current approaches to transformation, which mostly rely on engineering-based concepts (Brown, Keath, & Wong, 2009; Koop et al., 2017; Smith et al., 2013). Related empirical studies are thus urgently needed.

Against this background, this paper aims to examine how social learning can support or inhibit sustainable transformations in urban water governance, that is, the adoption of a more integrated and adaptive paradigm. On the basis of a case study approach to access in-depth, context-dependent knowledge for theory development (Flyvbjerg, 2006; Yin, 2009), we identify empirical evidence of three types of so-called “learning loops,” namely, single-, double-, and triple-loop learning (Figure 1 and Section 2). Differences between them relate to the type of effort and depth of learning. Although single- and double-loop learning only plays an indirect role in transformation, triple-loop learning is directly related to it, as it involves changes to existing governance structures and shifts in norms and values (Medema et al., 2014).

This paper presents the analytical framework (Section 2), the methodology (Section 3), and the results (Section 4) of our multiple case studies (Yin, 2009) drawn from five flood-prone urban areas in four continents: Cali (Colombia), Gorakhpur (India), Durban (South Africa), Kristianstad (Sweden), and Cebu City (the Philippines). In Section 5, we discuss the identified transformational elements of social (triple-loop) learning. Finally, we conclude with some policy recommendations and avenues for future research.

2 | ANALYTICAL FRAMEWORK

In the context of the collaborative management of natural resources and socioecological systems, social learning is seen as a promising

concept for solving complex problems, such as the water crisis (Pahl-Wostl et al., 2013). The focus is on stable learning outcomes that enable the build-up of capacities, action, and behavioural change in the long term (Johannessen & Hahn, 2013).

Our analysis is based on the so-called *learning loop* framework (Argyris & Schön, 1996; Kolb, 1984), which includes multiple, iterative cycles. A social learning cycle starts when a group's perspective is inconsistent with their experience, which triggers a critical review (Kolb, 1984, Figure 1). In the context of water governance, this can be related to different ways of assessing the risk of water crisis issues (e.g., floods), notably the potential for harm or the consequences.² The assessment of risk can be based on perceived vulnerabilities³ of urban water services, in relation to both internal issues (e.g., maintenance and lack of investment) and external issues (e.g., natural hazards, urban planning, and land use, and the interaction between rapid onset and slow onset hazards). It also relates to the perceived resilience of the local context. To varying degrees, represented by the three learning loops, social learning can play an important role in detecting and correcting errors, as described below (Argyris & Schön, 1996).

1. *Single-loop learning* is based on error detection and correction in the context of established actions (Hargrove, 2002). Of the three types of loops, this form of learning is by far the most common, and it is both encouraged and easily adopted (Argyris & Schön, 1974). Single-loop learning focuses on the question: Are we doing what we do right? Learning outcomes include, for example, improving the construction of a dyke (IPCC, 2012). Risk perception is part of the learning process in that it helps to identify risk and assess whether it is acceptable or not (Samuels & Gouldby, 2009).
2. *Double-loop learning* is also based on error detection and correction, but the difference is that it concerns new situations that are difficult to fit into existing patterns and schemes. Instead, learners must overcome current limitations (reframing) and understand or accept something that is significantly new or different (Illeris, 2009). Double-loop learning thus relates to the question: Are we doing the right things? Learning outcomes concern, for example, changes in the organization's knowledge base, new objectives, or new policies (Argyris & Schön, 1996). For example, new knowledge may lead to the insight that building only one dyke is no longer enough (Johannessen & Hahn, 2013). This new knowledge may come from collaborating partners who have a different perception of risk, such as the need to prepare for more extreme weather (Johannessen & Hahn, 2013).
3. *Triple-loop learning* is concerned with reflecting on and discovering why we learn the way we learn; for example, what are the guiding norms, values, and paradigms (Medema et al., 2014). Triple-loop learning thus addresses the question: How do we decide what is right? This includes understanding who needs to contribute to making the right decisions and whether they have the opportunity

²*Consequences* are impacts such as economic, social, or environmental damage, or improvements that may result from a flood, for example (Samuels & Gouldby, 2009).

³*Vulnerability* is a characteristic of a system that describes its potential to be harmed (Samuels & Gouldby, 2009).

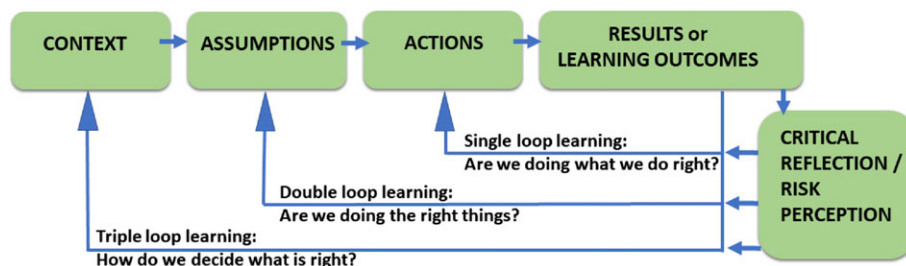


FIGURE 1 The three loops of learning (Argyris & Schön, 1996) adapted to include risk perception and critical reflection (adapted from Kolb, 1984) [Colour figure can be viewed at wileyonlinelibrary.com]

and competence to participate (Medema et al., 2014). Learning outcomes include changes to defining principles—for example, underlying governance protocols and structures or new learning strategies (Armitage, Marschke, & Plummer, 2008). The Netherlands provides one of the best-known examples of triple-loop learning in its adoption of new thinking around making space for rivers (Huntjens et al., 2011). Risk perception becomes concerned with the risks inherent in the context and determining the dominant framings (e.g., who participates, with what assumptions).

3 | METHODOLOGY

We adopted a multiple case study design (Yin, 2009) to study social learning processes related to different aspects of water management and governance as our unit of analysis. The research was carried out in the context of the *WASH & RESCUE* (Water, Sanitation and Hygiene in RESilient Cities and Urban areas adapting to Extreme waters) project.

The selection of cases was guided by two rationales: First, they provided in-depth, concrete, context-dependent knowledge that offered an opportunity for theory development regarding the research aim (Flyvbjerg, 2006). Thus, they were not selected for their statistical representativeness but for their potential to illustrate the diversity of urban water challenges and associated learning processes. Notably, this included the ability to collect empirical data at river basin level, the natural unit of analysis for the hydrological cycle. A second consideration was access to key data and informants.

Data were collected from November 2013 to November 2016 from two sources: a literature review and semistructured interviews (Kvale & Brinkmann, 2009). Interviews followed a protocol that addressed perceptions of (a) general vulnerabilities in the urban water services system and associated management practices; (b) the relationship between system vulnerability and social factors (including learning); (c) risk assessment mechanisms; (d) system resilience, notably the ability of the organization to reduce risk, respond to pressures and build adaptive capacity; (e) existing water management collaborations; and (f) associated learning processes, for example, changes in understanding the water crisis or failures in water governance and their causes (cf. appendix 4 in Johannessen, 2017). All interviews were recorded and transcribed.

Purposive and snowball sampling was used to select interviewees, which ensured that stakeholders represented a wide range

of perspectives, key competences, and knowledge (Kvale & Brinkmann, 2009). The final sample consisted of a total of 70 people, who included researchers, politicians, and municipal staff (e.g., city council members, city planners, environmental inspectors, and water and sanitation specialists), private sector actors (e.g., water and wastewater operators, land developers), and members of civil society. The number of interviews ranged between 7 and 17 for each case study (see Table 1). Interviewees were added until a saturation point was reached where no additional insights emerged, and the same names were repeatedly mentioned (Guetterman, 2015). Interviews were held in English, Swedish, and Spanish. Three of the researchers were native speakers, resident in their respective countries, and could act as translators (Cali, Durban, and Kristianstad). In three cases, the ongoing work of the Stockholm Environment Institute and associated local partners provided access to key informants (Durban, Gorakhpur, and Kristianstad). In Gorakhpur (India), the Environmental Action Group supported the fieldwork and assisted in identifying interviewees. In Cebu (the Philippines), the United Nations Office for Disaster Risk Reduction assisted in identifying key informants through their Resilient Cities network.

Project reports and other publications⁴ summarizing the main findings for the single case studies were produced and shared among project members and other stakeholders at a workshop that also included case study researchers (11 participants). The aim was to discuss and compare the empirical data across the different cases and synthesize the key findings regarding social learning.

The analytical framework was developed with the help of a literature review. It combined the concept of the three loops of learning (Argyris & Schön, 1996) with the concept of the learning cycle (Kolb, 1984) and risk perception. The analysis covered the period 2016–2018 and included white and grey literature and interview transcripts.

A deductive approach was adopted in order to identify learning loops (Reed et al., 2010; Section 2). Quotations were coded using grounded theory (Glaser & Strauss, 1967) following input from and discussions with case study authors. An inductive, iterative process (Glaser & Strauss, 1967) was adopted to interpret the findings, which provided an opportunity to ground the proposed categories in the emerging data.

⁴These include unpublished reports from Durban, Cebu, Gorakhpur, Kristianstad, by this paper's authors and other publications; Hernandez Vivas (2014), Johannessen, Wamsler and Peter (2019), and Arran, Stenström and Johannessen (2015).

TABLE 1 Overview of the number and category of interviewees in each case study

Category of interviewee	Number of interviewees from the case studies				
	Cali, Colombia	Cebu, Philippines	Durban/eThekweni, South Africa	Gorakhpur, India	Kristianstad, Sweden
Persons dealing with risk (risk assessments for hazards etc.)	4		2	1	1
City-based researchers	3	2		3	
Water providers	1	2	2		
City and regional authorities (mayors, councillors, misc officials)		1	1	2	
Developers/consultants/private sector		3+		1	
City planners	1				1
National association for water					1
Technical department—groundwater, water infrastructure, stormwater, etc.	1	2+		1	1
Civil society (residents, community and user groups, nongovernmental organizations) People deriving their livelihood from the surrounding landscape (farmers, fishermen, tourist guides, etc.)	5	3+	1	4	
Community liaison officers		2	1	3	
Environmental inspectors, persons working with health, oversight and quality control of WASH services	1	1	4	1	3
Environmental actors—could also be stakeholders involved with land use planning and management within cities, and in the watershed	1	1	1		
Journalists, media				1	
Total number = 70	17	17	12	17	7

The + indicates there were more persons present in some of the interviews.

Table 2 presents the local contexts for comparing the five case studies.

4 | RESULTS

The results describe the five case studies and highlight dominant perceptions of existing water risks, evidence of social learning and barriers, and whether outcomes represent single-loop, double-loop, or triple-loop learning (cf. Table 3).

4.1 | Risk perception and awareness of urban water risks

In Cali and Kristianstad, urban water risk is mainly associated with river flooding. In Cebu, Durban, and Gorakhpur, it is associated with water resources, sanitation, and drainage in informal peri-urban areas, which are also affected by a variety of diseases, epidemics, and (anti-) social behaviour.

In Cali and Kristianstad, increasing risk perception and awareness was triggered by growing concerns regarding the safety of embankments and the potential impact of their breach due to abnormally high rainfall events. In Cali, this was related to the La Niña event in 2010–2011; in Kristianstad, it followed the floods of 2002.

In Cebu, Durban, and Gorakhpur, increasing risk awareness was not associated with an event per se but rather growing concerns regarding the state of water resources and the effects on living conditions in peri-urban areas. The principal concerns included recognizing the importance of water and sanitation infrastructure and its

maintenance, and the health risks of open defecation. In Gorakhpur, awareness of these risks was perceived by three interviewees to be very low.

4.2 | Evidence of single-, double-, and triple-loop learning and its barriers

4.2.1 | Single-loop learning

Our analyses showed in all cases that single-loop learning was related to anticipating risks. It had led to outcomes such as the reinforcement and construction of (improved) embankments in Cali and Kristianstad (Table 3) and upgrading urban water services in Durban, Gorakhpur, and Cebu.

The high incidence of single-loop (compared with double- or triple-loop) learning was reinforced by local power relations and siloed working cultures, which meant that related actions and measures that fell outside established norms were not considered or even met with resistance. For example, interviewees from Cebu's Water Institute felt they were "hitting the wall" when trying to promote Sustainable Urban Drainage Systems (SUDS) to the city's drainage department, as the department's vision was based on conventional approaches and the improvement of technical measures, notably (bigger) storm pipes, inspired by the example of Yokohama in Japan (cf. Pantaleon & Bongcac, 2013). When asked why powerful urban actors and developers could not be forced to consider sustainable solutions such as SUDS, interviewees expressed a sense of hopelessness in their ability to change practices.

TABLE 2 Overview of the local context in the case study areas

Case study	Pressures/disturbances/(hazards)	Pressures/disturbances/(water resources issues)	Urban water services
Cali, Colombia (~2.3 million inhabitants)	Floods exacerbated by La Niña. Intense rainy season affects the urban area due to flat topography, low capacity of the surface to absorb large volumes of water and increasing volume of river water.	Pollution of Cauca River. Informal settlements on the Aguablanca dike, which are being relocated; insufficient water and sanitation services.	Water sources are Cauca, Cali, Meléndez, and Pance rivers.
Cebu, Philippines (870,000 people in Cebu City and 1.4 million in Metro Cebu)	Typhoons, storms, floods, earthquakes.	Groundwater is subject to seawater intrusion, (salinization) overextraction, and contamination from human waste. Rivers are heavily polluted. The drainage system is mainly based on pipes that are blocked by siltation and garbage.	Groundwater is the main water source. Most households are not connected to sewage systems. One waste treatment plant was opened in 2014.
Durban/eThekweni, South Africa (~595,000 people in the inner city and 3.4 million people in the eThekweni Municipal Area (EMA))	Flash floods, with informal settlements being the most severely affected. Coastal erosion and associated property damage due to tidal surges and storm. Frequent droughts.	Unsanitary conditions, especially in peri-urban areas (backyard shacks: 34%; and rural households: 12%). Significant lack of basic infrastructure, worsened by high population density, lack of space and land, and poor environmental conditions. Rivers are heavily polluted.	The Umgeni river mainly supplies Durban's piped water. 63.4% of the population has access to a toilet connected to the sewer system, very susceptible to stormwater inflows. Sewage is treated by 13 wastewater treatment plants and discharged into rivers.
Gorakhpur, India (700,000–1,000,000 inhabitants)	Frequent flooding, waterlogging, drought, and other water-related problems caused by extreme precipitation.	High levels of arsenic and fluoride in groundwater. Lack of drinking water, open defecation, inadequate sanitation. Untreated wastewater discharges into nearby water bodies. Situation especially grave in the 100 slums which makes up 33% of the inhabitants. Waterlogging due to building in wetlands and flood-prone areas, and poor solid waste management.	Groundwater is the main source of drinking water. Only 22% of the urban area is connected to sewage facilities. There are two sewage treatment plants.
Kristianstad, Sweden (30,000 inner city and 80,000 municipality residents)	River flooding and difficulties in draining into the sea. Several embankments raised to protect against river floods. Intensive rainfall leads to flooding (area is low-lying and embanked).	Issues include eutrophication and brownification of river water, increasing pressure on groundwater resources, pollutants in groundwater.	All drinking water is sourced from groundwater. There is 100% access to clean water and sanitation sewage connections.

4.2.2 | Double-loop learning

In four cases, double-loop learning was triggered through a combination of circumstances (Table 3). In Cali and Kristianstad, several stakeholders noted that the risk of extreme flooding combined with political will had resulted in unexpected insights and outcomes. Double-loop learning took the form of new ways of thinking and innovation, notably integrating ecological knowledge into engineering and risk planning. In Colombia, a key mechanism was the Adaptation Fund. This national, public institution was established to help in the recovery, construction, and reconstruction of areas affected by La Niña in 2010–2011. It was designed to foster cooperation, sharing of knowledge, learning, and cross-scale coordination between local, regional, and national stakeholders. In Cali, it funded the reinforcement of the Aguablanca embankment and facilitated interactions that were focused on a concrete project with a common goal. The initiative was contrasted with the perceived difficulty of cooperation that was found in more formal planning procedures designed to address flooding. The Adaptation Fund thus helped to strengthen existing informal structures, such as technical networks, and create a community of practice with relevant competencies and an understanding of the risk (Hernández Vivas, 2014). “[...]

When information is required [...] we interact on informal basis, it speeds exchange and the information ends up being more substantial” (Public utility interviewee in Cali).

In Kristianstad, an ongoing social learning process had been initiated by a group of individuals from the municipality's technical office and rescue service. The group collaborated with other local and national actors, which led to changes in both perceptions and measures, notably protection against a 10,000-year flood rather than a 500-year flood. This involved the re-evaluation of their initial assumptions (i.e., double-loop learning) as the group realized that they needed to consider a much wider area (i.e., 10 km of embankments) rather than focus on strengthening one (1 km) embankment.

In Cebu, typhoon Yolanda (in November 2013) was perceived to have helped to move risk issues up the local policy agenda and foster double-loop learning. According to a local water expert, this was reflected in an increased focus on adaptation in the form of policy integration, whereas earlier efforts had been unsuccessful. In Durban, we found that a cholera outbreak in 2000–2001 triggered double-loop learning. This was because the outbreak highlighted the considerable gap between the promised delivery of municipal services and reality and sparked an intense debate leading to action on sanitizing rural and peri-urban settings. The crisis led the population to question

TABLE 3 Summary of the main risks perceived and some key social learning outcomes

		Social learning outcome		
		Single-loop learning	Double-loop learning	Triple-loop learning
Case study	Main risk(s) perceived	Improvement of existing practice. Underlying mental model does not change	Reframing of existing assumptions and guiding principles of actions. Underlying mental model changes.	Shift in the guiding norms, values, and paradigms. New structures developed that determine reframings, for example, changing who participates, with what assumptions.
Cali, Colombia	Riverine floods	Construction of embankments	The Adaptation Fund facilitated knowledge integration between sectors leading to a different understanding and the creation of new networks and organizations.	The Adaptation Fund provided a new structure for reframing and learning. Its design facilitated a shift from distrust towards trust between the actors, supporting a different set of social norms.
Kristianstad, Sweden		Construction of embankments and early warning systems	Spontaneous knowledge integration between sectors and levels leading to shift in understanding of the flood problematique, both in the temporal and in the spatial dimension.	Temporal institutional integration and prioritization of the flood risk issue. However, municipal flood risk planning mandate limited any actions in upstream municipalities.
Cebu, Philippines	Unsafe water resources, inadequate sanitation and drainage in informal peri-urban areas	Plans to construct bigger storm pipes. Resistance to alternatives, such as SUDS.	The typhoon Yolanda in 2013 helped to integrate climate adaptation in urban planning by prioritizing them in the policy agenda.	Microresilience planning creating an organizational and communications structure, triggering learning empowerment and behaviour change.
Durban, South Africa		1. Water management programmes implemented to address for instance access to drinking water. 2. Catchment management and pollution monitoring.	1. The cholera outbreak 2000–2001 sparked a debate between the public and the government. This led to a renewed urgency and focus to address the perceived risks. 2. Degradation of catchments catalysed the creation of organizations integrating local knowledge and experience between different stakeholders.	1. The Disaster Management Act was employed during the cholera outbreak that triggered a common effort. Reviewed national policies triggered focus on peri-urban areas sanitation backlog. 2. The monitoring improved accountability, awareness, and compliance. The authorities realized there was a gap in governance and that they needed to start working with the communities.
Gorakhpur, India		Overall approach to drainage was structural and conventional solutions dominated, with no water retention considered.	Microresilience planning initiatives helped integrate sectoral knowledge silos and identifying institutional issues.	Microresilience planning initiatives with a microgovernance model, including shared learning, which changed the nature of relationships within communities and with external institutions

existing mental models and challenge the high-profile policy of water services delivery, which stood in stark contrast to the prolonged and widespread epidemic.

In Gorakhpur, a microresilience approach to planning fostered double-loop learning as it helped to integrate sectoral knowledge silos and stimulate the cocreation of knowledge with residents. For instance, it resulted in a growing appreciation among stakeholders of the complex links between waterlogging (flood), sewage and solid waste management, and the in-filling of city lakes. At the same time, it helped to identify institutional issues and avoided the dominance of technical knowledge (cf. Reed et al., 2013).

In Durban, the degradation of catchments catalysed individuals to create non-profit organizations, such as the Duzi-uMngeni Conservation Trust and the Palmiet River Watch, focused on pollution

monitoring. Here, double-loop learning took the form of knowledge and experience brokering between public and private sector actors and local government officials.

4.2.3 | Triple-loop learning

Triple-loop learning goes beyond double-loop learning in that outcomes address the broader governance system. Identified examples include creating or redesigning guiding norms (often related to accountability) or applying and adapting structures and competencies to encourage participation, integration, and learning (e.g., microgovernance, strategies, policies, and working relationships; Table 4). For instance, in Colombia, corruption and political manoeuvring had, for a long time, created distrust in formal

TABLE 4 Triple-loop mechanisms and their outcomes

Case	Triple-loop learning mechanism/triggers	Learning outcome
Cali, Colombia	The Adaptation Fund providing accountability mechanisms and a more informal communication platform	Shifting from distrust to trust enabling a space for knowledge exchange and integration.
Cebu, Philippines	Microresilience planning providing an organizational and communication structure in the community. Learning champions supported the learning and adapted the design over time	Changing behaviour in the communities, building capacity, and increasing community cohesion.
Durban, South Africa	Microresilience planning (see above). Implementing the Disaster Management Act during an epidemic providing a framework for cooperation and coordination/communication between various actors	Changing behaviour in the communities and increasing community accountability. Changing behaviour of institutions and increasing integrated actions for a common purpose.
Gorakhpur, India	Microresilience planning (see above)	Changing nature of relationships and behaviour in the communities. Stimulating knowledge cocreation and understanding of complex linkages in the system, including institutional not only technical.
Kristianstad, Sweden	Institutional integration (informal)	Actors prioritizing the issue due to a feeling of urgency and relevance but which was lost sometime after the flood in 2002.

governmental institutions. Consequently, in Cali, the introduction of transparency mechanisms (e.g., regular audits) of the Adaptation Fund was a welcome addition. Furthermore, the technical (rather than political) nature of the project increased its credibility; this increased trust and accelerated communication that facilitated learning across different levels and scales.

In Durban, Gorakhpur, and Cebu, the so-called “microresilience” initiatives (called “Purok” in Cebu) were evidence of a more lasting transformative change, in the form of community empowerment. Such initiatives were spearheaded by actors who had responded to the failure of formal institutions to provide learning structures on certain, key issues. For example, in Gorakhpur, a local nongovernmental organization, the Gorakhpur Environmental Action Group had implemented “shared learning dialogues” as part of a broader, regional programme; this had gradually changed the nature of relationships both within communities and with external institutions (cf. Fisher et al., 2016).

In Cebu, a private–public partnership with a real estate company had led to the initiation of three urban Puroks, following the example of a former Mayor of a rural town, who had established a successful Purok. He says, “It’s a long process, of 3–4 years. / ... / There is lots of government aid for them, but the problem is that nobody is going to the government to say: we need this, we have a lack of this. And therefore, I tell them to organize. At every meeting they can discuss what is the problem in the community.” Here, organizing the community around topics such as water and sanitation and disaster risk reduction triggered capacity building, empowerment, community cohesion, and behavioural change.

In Durban, microresilience planning brought together residents and actors in monitoring river quality and improved accountability, awareness, and compliance. Each time there was a pollution incident, local individuals contacted the authorities on behalf of the community. Consequently, authorities realized there was a gap in governance and that they needed to work more with the community. This improved

the working relationship between the community, officials, and external institutions, who stated their commitment to respond to water issues as they arose.

However, the three examples given above also highlighted the problem of upscaling local initiatives to the regional level. In Gorakhpur, the microresilience initiative could not be upscaled, mainly due to a lack of integration of higher level institutions (cf. Wajih, Singh, Bartarya, & Basu, 2010). Here, formalization was seen as an essential component in the original aim to facilitate city-wide upscaling; however, the current semiformal status of the initiative has limited its influence on the political agenda. In Cebu, microresilience planning and other local water supply projects were not accompanied by a wide-scale management of water outtakes in the catchment; consequently, it has become evident that uncontrolled outtakes have eroded the water supply to the entire area.

These examples are consistent with the general challenge identified in the Cebu, Durban, and Gorakhpur case studies, namely, the lack of institutional capacity building, resulting in incoherent priorities and inadequate service delivery. Although one interviewee in Gorakhpur noted, “It needs to be recognized that building capacity in the governance system is a long-term process,” political support and resources are often short term.

In the case of Durban, the response to the cholera outbreak in 2000–2001 stopped the epidemic and aimed to prevent future events. For the first time in South African history, the Disaster Management Act of 2002 was applied to a health problem (Hemson & Dube, 2004). The initiative was mainly a response to demands from health workers. This emergency measure ensured that all relevant agencies were (temporarily) mobilized as an interdepartmental unit and their efforts could be combined. Subsequent actions focused on addressing water and sanitation problems, including changing behaviour, and a sense of urgency for action-taking, which had not been actioned previously. Interactions between the public and government officials led to a policy review; the National Sanitation Policy (2001) was drawn

up, and finally, a national strategy was developed to eliminate the sanitation backlog. This, in turn, ignited service providers to provide better services to peri-urban areas, which has transformed water governance.

However, the World Health Organization (WHO, 2004) argued that this change was rather temporary. They called the response reactive and stated that more sustained actions on the ground were needed to bring about lasting change (cf. Hemson & Dube, 2004). In practice, providing a healthy peri-urban environment involves many complex sociocultural issues that require triple-loop learning. For example, the municipality established a transit camp in a toxic, flood-prone area, which one ward councillor claimed had caused the death of over 100 children. However, polluting industries—powerful actors in the local economy—were not pressurized to provide cleaner technologies. A Disaster Manager explains, “The industries bring economic strength to the city, which it needs, so to cut short industries is not feasible. At the same time, the city does not have a solution to move 250,000 people away from that particular risk.” Other perceived barriers by Durban interviewees included cultural hierarchies, patriarchy, tribal affiliations, and a brittle social fabric that has been made vulnerable by urban immigration, poverty, unemployment, and crime.

In Kristianstad, the flood risk in 2002 had created a sense of urgency and improved the integration of water risk into overall municipal planning. In addition, a cross-sectoral dialogue between rescue services and environmental/technical departments had led risk managers to completely change their attitude regarding the value of wetlands; this, in turn, influenced the location of embankments. In this context, communication, based on trust between key champions and policymakers within the municipality, was identified as important for integration and decision making (cf. Johannessen & Hahn, 2013).

However, it is unclear whether this was a true example of triple-loop learning, which is, by definition, associated with a fundamental change in the entire mental model of the management or governance process (Keen & Mahanty, 2006). The decentralization of risk governance to the municipal level and the absence of river basin governance for flood risk has limited the involvement of all relevant actors and prevented more far-reaching learning and change.

5 | DISCUSSION

Our findings illustrate how transformation in urban water governance can be supported or inhibited by single-, double- and triple-loop learning.

The case studies show that single-loop learning may serve as a barrier to double- and triple-loop learning. In other words, people and institutions can become trapped in learning lock-ins. Sectoral specialization means that knowledge and competencies accumulate, whereas associated mental models and approaches to learning and decision making remain unquestioned. Another finding was that double-loop learning was often reactive and triggered by (the risk of) an extreme event, resulting in knowledge integration. At the same time, it often opened up opportunities for triple-loop learning, in many cases

represented by new governance structures (more on this below). The shift between double- and triple-loop learning was often fluid and sometimes blended (Fabricius & Cundill, 2014), making it difficult to differentiate between them. This suggests that the promotion of proactive (rather than reactive) double-loop learning could result in a better balance between the different learning loops (Fabricius & Cundill, 2014), as triple-loop learning may be induced by double-loop learning.

The identified examples of triple-loop learning were often found to be incomplete, and transformations were limited at both the temporal and organizational scales. For example, in Durban, the activation of the Disaster Management Act was a temporary measure that was reversed once the cholera epidemic was over. In contrast, microresilience planning in Cebu, Durban, and Gorakhpur provides evidence that triple-loop learning can be sustained over time. Here, some learning processes have been going on for decades, leading to an increase in financial and social capacity. Over time, learning champions have been able to reflect on and adapt the learning process and mentor communities after projects have ended. However, most microresilience initiatives are local and have proved difficult to upscale. This calls into question the extent of associated transformations, as integrated knowledge building is key to adaptive governance (Chaffin et al., 2014) and needs to be supported at multiple levels and scales (Keen & Mahanty, 2006; Pahl-Wostl, 2009; Pahl-Wostl et al., 2013; Wamsler, 2014).

Our results led to the emergence of three principles for supporting triple-loop learning and the transformation of water governance (Table 4):

1. the implementation of a governance structure for learning or “learning model” that support intersectoral communication and cooperation between different actors (see Section 5.1);
2. champions who can drive (participation in) learning processes (see Section 5.2); and
3. the use of an adaptive design for learning processes (see Section 5.3).

5.1 | Learning models

In this study, triple-loop learning often required the implementation of a specific governance structure to support learning processes, which filled a void for instance through

1. Providing a trusted platform—where there was previously distrust—that is, designed to improve cross-sectoral learning and bridge the formal–informal divide. The Cali example illustrates how a trusted mechanism provided added value by bypassing the communication barriers found in formal, distrusted institutions.
2. Providing a structure and a reason for interdepartmental unity, as in the Durban response to the cholera outbreak.
3. Providing a structure for empowering and involving stakeholders, by injecting capacity and mobilizing resources, in cases where capacity is low and community organization is lacking.

Microresilience planning initiatives in Gorakhpur and Cebu are examples.

Although many learning models (e.g., Tippett, Searle, Pahl-Wostl, & Rees, 2005) are linked to frameworks such as Integrated Water Resource Management, there is a consistent lack of practical integration into water resource management (Pahl-Wostl et al., 2013; Roy et al., 2011). Integration can be challenging, especially if there are trade-offs with sectoral activities (e.g., World Bank, 2011). In our case studies, better integration was found to provide added value, complementing existing structures.

Our findings thus indicate that identifying gaps in structures that hamper learning, followed by the careful design of learning interventions, might be a key to triggering transformation in practice. In addition, our results indicate that integrative structures need to be designed that can overcome challenges due to powerful actors or dominant working cultures that maintain learning lock-ins. The situation in Cebu is an example, where such lock-ins created resistance to the adoption of the new SUDS approach/paradigm.

5.2 | Learning champions

Our case studies highlighted that learning champions, in the form of technically knowledgeable individuals and organizations, often drive social learning processes. These parties can identify risks and work with different learning models to address them. They use their personal attributes and influence to navigate change processes, providing a bridge between content and decision making. This finding is consistent with earlier research (e.g., Tippett et al., 2005) that refers to such individuals as (innovation) champions or change agents (Taylor, 2009; Wamsler, 2017).

However, unlike what literature says, our data also indicate that learning champions lack comprehensive support. For example, in Kristianstad, “policy entrepreneurs” (Brouwer, 2015) would arguably be helpful to change policy and help implement river basin governance. Similarly, in Gorakhpur and Cebu, “innovation champions” (Duncan & Ford, 2005) could help to trigger learning and new thinking about alternative measures such as SUDS. Although these learning champions may be physically present, their ability to influence learning may be limited by various contextual barriers. It is known that surrounding social structures shape individual agency (Bradshaw & Boonstra, 2004). In Kristianstad, the absence of policy entrepreneurs is linked to the lack of a higher authority that is both capable and willing to take the lead in implementing river basin management for flood prevention. This example highlights how an overly decentralized (or polycentric) governance system, such as in Sweden, can prevent adaptation (Mostert, 2012). In Cebu, Durban, and Gorakhpur, the apparent absence of innovation champions is closely linked to surrounding power structures. Change needs to be supported by the legitimation and empowerment of new or existing champions (Kløcker Larsen, 2011), for example, through introducing or strengthening accountability mechanisms (de Asís, O’Leary, Ljung, & Butterworth, 2009).

5.3 | Adaptive design of the learning process

Our case studies illustrate that the continuous adaptation of the learning model (or the design of a governance structure to support learning processes) is often critical in its success, in terms of achieving sustainable learning outcomes. In many cases, the learning champion was involved in adapting the design. For example, in the microresilience planning initiative in Cebu, the facilitator tailored his interventions to the current capacity of the community, which he perceived to increase over time. Similarly, in Cebu, Gorakhpur, and Durban, learning champions used certain tactics and language to establish ownership and increase the participation of local communities.

The importance of “design for governance learning” has been highlighted elsewhere (e.g., Blackmore et al., 2016; Tippett et al., 2005). Our findings highlight the role of learning champions in this context. These people have a deep understanding of the local culture and context, which is key to building long-term, trusted relationships with communities.

6 | CONCLUSIONS

The aim of this study was to analyse how social learning has supported or inhibited sustainable transformations in urban water governance with an overall purpose to contribute to related knowledge. There is an urgent need for fundamental change in water governance based on a more adaptive and integrated paradigm if we are to find ways to better address the current water crisis.

Our study identified various ways in which single-, double-, and triple-loop learning is related to transformation. First, it showed that sectoral specialization (single-loop learning) can become a barrier when it does not question the underlying mental model (double-loop learning). Powerful actors can support such lock-ins by preventing learning on, for example, technical innovation and policy that goes beyond the dominant paradigm. Second, learning through knowledge integration (double-loop learning) was found to often be a response to (the risk of) an extreme event; this suggests that more proactive approaches and efforts need to be made to support such learning. Third, triple-loop learning (adapting the norms or structures that influence how we learn) was often found to follow double-loop learning but often only led to partial transformation.

In addition, our study found that transforming water governance can be supported through

1. Proactive experimentation with learning models that support intersectoral communication and cooperation between different actors at multiple levels.
2. Support for learning champions who can drive and adapt the design of social learning processes.
3. Mechanisms and structures that allow the design of learning processes that can be adapted to the specific context and achieve long-lasting relationships with communities.

To conclude, our findings confirm the prominent role of social learning in transforming water governance towards more sustainable

pathways. This calls for more research that addresses the underlying triggers of double- and triple-loop learning processes and links them to broader governance mechanisms and structures.

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