

**Too much, too little, too dirty: The
evolution of water risks and governance
in Guwahati, India.**



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For my family Janet Fanaian, Soroosh Fanaian, Sahba Fanaian, Farnoosh Fanaian,
and Emmra Metge. You are all an honorary part of this degree.

This thesis is also dedicated to urban rivers, the brown gods.

*“I do not know much about gods; but I think that the river
Is a strong brown god—sullen, untamed and intractable,
Patient to some degree, at first recognised as a frontier;
Useful, untrustworthy, as a conveyor of commerce;
Then only a problem confronting the builder of bridges.
The problem once solved, the brown god is almost forgotten
By the dwellers in cities—ever, however, implacable.
Keeping his seasons and rages, destroyer, reminder
Of what men choose to forget. Unhonoured, unpropitiated
By worshippers of the machine, but waiting, watching and waiting.”*

T.S. Elliot, The Dry Salvages, Nb. 3 of Four Quartets

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On a side note, I was told that the acknowledgement is the only space in the thesis where I get to write whatever I want in any creative manner. So, here is where I unleashed all my creative angst, mixed metaphors and narratives that could not be unloaded elsewhere in the thesis. I also wanted to create a whole appendix section of PhD memes, but there was no space for it. So, let me know if you are interested; I have collected more than 200 memes.

This thesis tries to shine some light on the apparent chaos of urban governance. Naively at the beginning of my DPhil journey, when I read “governance of water risks needs to be addressed to improve conditions”, I thought, yes! that is a gap I am going to address. Little did I know why many brave souls before me left this as a gap. Even after four and half years, I barely managed a sliver of what I thought I would do when I began. So be warned that governance is chaotic and complex. There is no simple one-line conclusion, and if anyone tells you there is one, be wary, be very wary.

Finally, if you are with me so far, we are golden. I hope you enjoy reading this delightful and beautiful (in my eyes) manuscript. If you want to skim through it, that is fine; there are some beautiful pictures. There is an excellent abstract if you want to get a gist of the whole thing (I spent much time trying to get it right). If the abstract inspires you, do delve into the introduction and synthesis Chapters. To those dedicated souls who will read the whole thing, you are my heroes (heart emojis for you). But please remember, this thesis is my baby and a labour of love, be gentle and kind if there are any imperfections.

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Abstract

Small and medium-sized cities of the Global South have different characteristics than large cities or the Global North. These intermediate cities have rapid urban growth rates and often lack financial and human resources to tackle water-related risks such as floods, water supply inadequacies, and river pollution. In short, the problems of “too much, too little, and too dirty”. Yet, policies and practices to address water risks are often modelled on the experiences of larger cities. In addition to a smaller pool of human resources and finances, governance challenges are compounded as decision-making powers are held up among the higher state-level actors rather than the local, thus creating a bottleneck of delays. Existing paradigms for managing urban water risk often overlook local governance dynamics, thus creating institutional mismatches and associated political and governance challenges.

Further, research and policy communities also tend to examine the governance of different water risks separately, i.e., only urban floods or water supply, rather than together. However, cities experience and govern multiple water risks. In riverine cities, water risks become complicated due to the proximity to rivers and their floodplains. Moreover, this post-colonial dive is essential as cities’ current-day political and physical infrastructure has grown in the last 50 years. Yet, there are few detailed insights into the specific urban trends arising in this era. Therefore, there is a growing need to explore the co-evolution of water risks and governance processes to understand and improve water and urban development in intermediate riverine cities of the Global South.

In this thesis, I examine the co-evolution of water risks and their governance within Guwahati, India. Guwahati, situated on the Brahmaputra River, is emblematic of the trends confronting similarly situated riverine cities in the Global South due to its intermediate size (compared to other Indian cities), resource-strapped

governance, and interconnected riverine-urban water risk dynamics. The historical focus I use multiple complementary methods to examine three urban-riverine risks - urban flooding, water supply inadequacies, and river pollution. Through an integrated assessment of these three risks, I understand the difference (and similarities) in modes of governance based on a systems perspective that links social, urban and water systems. The main research objective is to understand how and why centralized models of urban governance develop and persist despite the diversity of actors involved in addressing water risks within resource-strapped intermediate riverine cities. Specifically, I expand the concept of the participation paradox by exploring how decision-making remains vested in national and state-level agencies despite decades of efforts to broaden inclusion and local participation.

This thesis contributes to the intersection of three interconnected bodies of literature— multi-level governance, networked governance, and environmental discourses and narratives. These three parts come together through a systems perspective that draws careful attention to resources, risks, actors, institutions, and external influences in cities like Guwahati, which often lack the resources and capacities available in larger cities. These differences increase the reliance of intermediate cities on decisions taken at national and international centres of power and finance.

The first part of this research (Chapter 4) examines how patterns of multi-level institutional change by focusing on the interplay between water risk characteristics and governance responses (formal and informal). The second part (Chapter 5) contributes to network governance theory by drawing attention to centralization, decentralization patterns, and neglected actors in local governance. Specifically, Chapter 5 research quantitatively draws out the patterns and interaction issues among various actors. Finally, the third part (Chapter 6) analyses how local media coverage framing of water risks influences and promotes specific priorities and

visions for urban development.

Altogether, the research demonstrates that the distribution of authority in water governance (centralization vs decentralization) is not static but an ongoing product of struggles between “making do” via local governments, civil society, and informal actors, on the one hand, and centralized and bureaucratic systems, on the other. These insights are empirically supported by mapping the changes in governance networks. The mapping shows that despite an increasing diversity of actors over time, high-level actors, such as the chief minister, district commissioner, and water-related ministers, maintain their position as focal actors in the water risks’ decision-making and governance. Finally, within these resource-strapped governance structures, I find that media, through dominant narratives, frequency, and repetition, assigns priority to specific risks (water supply) and limit the visibility of solution choices (centralized infrastructure). These framings are increasingly reflected in the decisions made and the funds allocated for investment in infrastructure and policy reforms. However, civil society organizations play a growing role in building accountability and bringing attention to lesser prioritized risks (river pollution) and vulnerabilities (informal settlements).

Theoretically, the research advances the insights and application of multi-level governance theory by experimenting with an approach that includes both formal and informal processes that influence governance within data-scarce regions. Further, this research showcases that despite ongoing urban reforms promoting decentralization, governance in intermediate riverine cities is increasingly reinforcing centralized structures. The findings and methods used in this research are not only relevant to intermediate cities of the Global South but can also be applied to other cities across the global South and North alike. The qualitative approaches here can be used to study multiple risks in tandem, plus quantitative findings are applicable to assess how the broadening of stakeholders impacts decision-making processes.

Enabling inclusive governance of water risk mitigation in intermediate riverine cities requires a different strategy than that followed in large cities due to differences in the mode of governance experienced. Further, for cities at large in the global South, there is a need to review resource allocation strategies to allow the devolution of decision-making to local actors to accommodate the multiple nuances experienced within cities.

A way forward for urban risk mitigation includes proactive, inclusive, and flexible governance processes with insights into vulnerabilities, access to resources, and the capacity of local actors to make needs-based decisions.

List of Publications

This thesis is comprised of work that have submitted to the following peer-reviewed journals:

- **Fanaian, S.**, Fanaian, F. A tug of war between centralization vs decentralization: the co-evolution of urban governance and water risks in Guwahati, India. *Early Career Researchers: Environmental Science in South and Southeast Asia*.
- **Fanaian, S.**, Khosla, R., Kaaronen, R., Garrick, D. 'Too little, too much, too dirty': The evolution of water risk governance networks in the intermediate city of Guwahati, India. *Environmental Science and Policy*.
- **Fanaian, S.** Framing decision priority: The relationship between local newspapers and water risk governance in an intermediate city in India. *Environmental Politics*.

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Acronyms

ADB Asian Development Bank. [109](#), [119](#), [157](#)

AMRUT Atal Mission for Rejuvenation and Urban Transformation. [114](#), [119](#)

ASDMA Assam State Disaster Management Agency. [110](#)

AUWSSB Assam Urban Water Supply and Sewerage Board. [106](#), [193](#), [194](#)

BJP Bhartiya Janata Party. [115](#)

CCA 74th Constitutional Amendment Act. [106](#), [153](#)

CMPO Calcutta Metropolitan Planning Organization. [102](#), [107](#)

CSO Civil Society Organization. [115](#), [147](#), [157](#)

DDMA District Disaster Management Authority. [69](#), [115](#)

GDD Guwahati Development Department. [107](#), [147](#), [190](#)

GMC Guwahati Municipal Corporation. [69](#), [102](#), [103](#), [109](#), [112](#), [147](#), [188](#), [190](#), [194](#)

GMDA Guwahati Metropolitan Development Authority. [106](#), [147](#), [190](#)

GMDWSB Guwahati Metropolitan Drinking Water and Sewerage Board. [196](#)

GoA Government of Assam. [102](#), [103](#)

GoI Government of India. [192](#), [194](#)

HI historical institutionalism. [xiv](#), [31–33](#), [41](#), [76](#), [93](#), [119](#), [213](#)

IAD Institutional Analysis and Development. [31](#)

IIT-G Indian Institute of Technology-Guwahati. [108](#), [112](#)

INC Indian National Congress. [115](#)

IPCC Intergovernmental Panel on Climate Change. [216](#), [218](#), [220](#)

JICA Japanese International Corporation Agency. [109](#), [119](#), [157](#)

JNNURM Jawaharlal Nehru National Urban Renewal Mission. [110](#), [119](#)

MLD million liters per day. [103](#)

MLP multilevel perspective. [xiv](#), [31–33](#), [41](#), [76](#), [93](#), [119](#), [213](#)

NGT National Green Tribunal. [161](#)

PCB Pollution Control Board. [158](#), [186](#), [188](#)

PHED Public Health and Engineering Department. [69](#), [194](#)

SES Socio-Ecological Systems. [31](#)

SNA Social Network Analysis. [63](#), [139](#), [144](#), [223](#)

SOP Standard Operating Procedure. [112](#)

STP Sewage Treatment Plants. [197](#)

ULB Urban Local Bodies. [106](#), [107](#)

CHAPTER 1: Thesis intro

CHAPTER 1

Introduction

1.1 Background - Research Relevance

By 2030, most global urban growth is expected to occur within small and medium, or ‘[intermediate city](#)’ of the Global South (Heinrichs et al., 2013). Compared to large cities, an intermediate city experiences different problems such as unplanned urbanization, underestimated vulnerabilities, and resource-strapped governance (Birkmann et al., 2016). In intermediate cities, more than one in four individuals live in informal settlements in high-risk areas (such as river floodplains), thus exacerbating vulnerability and urban poverty (Colenbrander et al., 2019; Davis, 2016; Dodman et al., 2008). Yet, the ongoing disconnect between urban policies, local governance processes and evolving risks creates a fragmented approach to addressing urban problems (Sharifi, 2021). Water-related [risk](#) form a large share of the urban risks experienced. These water risks can also be summarized as ‘too little, too much, too dirty’ (Dixon, 1990, p. 170). Therefore, improving mitigation of future urban water risks requires a contextual and interconnected systems approach to understand trends in governance and water risks for intermediate cities of the Global South (Bai et al., 2016; Patterson et al., 2019).

The current sustainability discourse is increasingly putting forward cities as solutions to global problems (Angelo et al., 2020). Even though sustainability is becoming part of urbanization

discourses, climate adaptation and sustainable development plans are often at odds with economic agendas, globalization processes, and political priorities (Bai et al., 2016; Chu et al., 2016; Roy, 2009). Further, within urban governance research and practice, silo thinking overlooks interdependencies across the natural, social, and built systems, thus leading to inefficiencies and missed opportunities (Bai et al., 2016). This lack of integration leads to clumsy juxtapositions of roles and creates an ambiguous mix of responsibilities, thus complicating governance processes (Tainter et al., 2014; Westman et al., 2019). Further, applying innovation within many cities is difficult due a lock-in set by the political, social, and infrastructure related path dependencies (Dodman et al., 2022). In this context, intermediate cities' transitory and growing nature makes them well situated to apply innovations toward sustainable trajectories and urban resilience (Véron, 2010; Yasmin et al., 2018). However, within this conversation on the opportunities for innovation, little is known about the participatory governance processes involved in addressing risks in intermediate cities of the Global South (Nagendra et al., 2018).

Water governance literature on water risks often focus on efficiency and management, resulting in a dominance of technical fixes and depoliticization of water governance (Dunn et al., 2017; Frey et al., 2021). In addition, there is an emphasis on how governance should be rather than how governance is actually occurring (Zwarteveen et al., 2017). Collaborative and participatory modes of water governance are then introduced as a panacea. But governance in these cities occurs within asymmetries of power relations, and imposed forms of collaboration can mask a top-down socio-political hierarchy (Frey et al., 2021; García et al., 2019). Further, viewing water risk governance only from a water-centric lens carries the danger of ignoring other urban and social dynamics that shape decision-making (De Loe et al., 2017; Woodhouse et al., 2017). Therefore, there is a growing need for a temporal and integrated systems insight to explore the multiple facets of urban water risk governance.

1.2 Research Context

The term “intermediate city” does not have a specific definition and is problematic to quantify (Rondinelli, 1982; Satterthwaite, 2017a). There are also various terms used in similar context, for example, secondary, second-tier or small-and middle-class cities (B. Roberts, 2019; Rondinelli, 1982; UNDESA, 2019). Each of these terms to allude to a category of cities that are somewhere in the middle within a country’s urban hierarchy (ranging from small towns to large cities). Intermediate cities can have populations anywhere between 20,000–2.5 million (Roberts and Hohmann, 2014; Satterthwaite, 2017b). This wide population range exists because each country has different definitions and urban classification systems, such that, one country’s intermediate city might be akin to another country’s large city (Cohen, 2004). Among these multiple terms available I chose ‘intermediate city’ for my research because it alludes to a transition phase within an ongoing urbanization process.

Many cities have grown on riverbanks to access resources and transportation (Evenden, 2018). However, this proximity also brings water risks and governance challenges. Some urban-riverine water risks include flooding, inadequate water supply issues, and river pollution. These risks are interconnected and often feed into each other. For example, rising river pollution increases costs for water supply, and clogged rivers due to urban waste can exacerbate flooding. Governance challenges include the addition of river basin-related actors within the already complex urban governance network (van den Brandeler et al., 2018). Understanding this evolving and intermingled form of urban water risk governance calls for interdisciplinary insight that includes the ecological, social, and technological (built form) aspects of cities (Bai et al., 2016; De Loe et al., 2017). While factors such as climate change and land use can exacerbate urban water risks, a fragmented and reductionist governance approach can erode the resilience of riverine cities and degrade the urban river ecosystem (Dempsey et al., 2017; Evenden, 2018).

Further, a reductionist view can easily change water risk adaptation to maladaptation practices (Eriksen et al., 2021). Understanding the evolving urban political and social dynamics can

aid in identifying the internal and external factors that impact water risks and unlock how urban governance may unfold in the future (Rademacher, 2015). However, water and urban governance research domains often operate within distinct disciplinary silos, thus limiting the scope of insight (Dunn et al., 2017). Further, there are few temporal studies in urban and water governance, due to non-availability or lack of access to consistent data, within intermediate cities of the Global South (Berardo et al., 2019; Özerol et al., 2018; Patterson et al., 2019; Rademacher, 2015).

Combining insights from urban and water governance through a systems lens provides new possibilities to understand urban water risk and their governance for intermediate cities. To draw on cities as open systems susceptible to multiple influences, I rely on Bai et al. (2016) conceptualization of cities which views interactions between the diverse social, ecological, and technological (i.e., urban built environment and infrastructure) systems. Cities are also influenced by various formal and informal processes across the local, national, and international scales (detailed in Chapter 2.1).

To apply these conceptualizations, I take inspiration from the coupled systems application through case studies of Liu et al. (2007) and (Bai et al., 2016) with operationalization ideas from Yang (2021). Such integrated systems approach allows the inclusion of frameworks and methods drawn from different complementary disciplines pragmatically (details in the Chapter 3). By bringing these theoretical and practical approaches together, I seek to build an theoretically and empirically rich study by tracing the co-evolution of urban water risks and their governance for an intermediate city.

1.3 Research Question

My research addresses the overarching question: How has participation and (de)centralization of urban governance evolved in relation to different water risks in an intermediate riverine city in the Global South? This question is posed in the context of an intermediate riverine

city where many standard assumptions of institutions and infrastructure are often not aligned with broader urban theories (Adelina et al., 2020). Intermediate cities are often far from the notice of urban policy, with underestimated vulnerabilities in the face of climate change and a lack of financial resources to mitigate growing risks (Birkmann et al., 2016; Roberts and Hohmann, 2014; Rondinelli, 1983). Therefore, Guwahati serves as a window to examine the evolving nature of governance trends in such cities particularly with applications extending to other cities and contexts as well (Watson, 2016).

The case study of Guwahati, India, is examined for 50 years for the urban-riverine water risks, i.e., floods, river pollution, and water supply inadequacies. This question is explored through a systems approach in three parts:

- The first part qualitatively assesses the co-evolution of urban growth, water risks, and multilevel governance structures.
- The second part empirically maps the network of actors (stakeholders) involved in addressing these three water risks.
- The third part assesses media influences on how urban water risk mitigation priorities are shaped.

Answering the research question is likened to resolving a research puzzle through a temporal exploration involving three interconnected parts. This first part of this puzzle examines the shifts in multilevel participation of diverse actors concerning water risk change and the processes that lead to new governance regimes, path dependencies and feedback (paper 1- examining institutional change). The second part posits that water risks and their modes of governance can be uncovered by examining the network of interactions among formal and informal actors. Studying these interactions requires reviewing the connections between governance actors and how they change over time (paper 2- governance networks). The third part addresses the reciprocal influence of news media and decision-making by making specific risk

Table 1.1: Comprehensive overview of the sub questions, methods and core body of literature

Sub-research questions	Framework and Method	Body of Literature
1. How have water risk and their governance processes co-evolved in Guwahati? What have been the main drivers and patterns of change?	<i>Framework:</i> Multilevel Perspective theory and Historical Institutionalism. <i>Method:</i> Process tracing	C. Roberts et al., 2019; Thelen, 1999; Trampusch et al., 2016
2. How have the water risk governance networks evolved in Guwahati since 1970? How and why have the types of actors changed?	<i>Framework:</i> Network Governance Theory <i>Method:</i> Social Network Analysis	Berardo et al., 2020; Fawcett et al., 2012; Fliervoet et al., 2016; Yang, 2021
3. What drives the priorities of governance actors in mitigating water risks? How does local media influence these priorities?	<i>Framework:</i> Media Framing Theory <i>Method:</i> Content analysis	Crow, 2011; Tewbskury et al., 2020

perspectives and urban visions more visible. This influence is explored by examining the circumstances and perceptions that influence the co-evolution of media coverage and decision-making (paper 3- media and local governance). Together, these three parts can lead to a viable understanding of the feasibility of future urban water risk adaptation and mitigation plans.

1.4 Connecting the Thesis Story Line

To include the crosscutting water risks and urban governance processes I adopt a pragmatic stand and utilize complementary theories and methods from diverse disciplines. Through such a mix of frameworks, methods and varied data collection methods, my research builds a multifaceted insight into the governance of water risks in an intermediate riverine city of the Global South. The main research questions are examined through three interconnected lines of inquiry briefly outlined below.

RQ1: How have water risks and their governance processes co-evolved in Guwahati? What have been the main drivers and patterns of change?

The first paper sets the scene by uncovering the patterns of co-evolution of water risk and their governance within Guwahati. This paper addresses how water risks and their multilevel institutional structures are formed and reformed over time. The paper combines a multi-scalar and political framework through Multilevel Perspective and Historical Institutionalism (Roberts et al., 2019). The framework is applied through the method of content analysis. In mapping these patterns, I uncovered an increasing trend of centralising governance, infrastructure and urban services. This insight feeds into the theoretical discourse on the decentralization of urban services. Finally, this paper also builds a descriptive narrative used to understand and cross-check actor behaviours examined via social network analysis in the second paper.

RQ2: How have the water risk governance networks evolved in Guwahati since 1970? How and why have the types of actors changed?

The second paper details the patterns of interactions between actors (individuals and organizations¹) to map out what can appear as spaghetti-like interactions within governance processes (Huitema et al., 2017). Due to the gaps in consistent data sets, few researchers have explored temporal changes in network-based governance within intermediate cities of the Global South. Urban and water governance processes build up over time through layers of overlapping responsibilities involving a networked web of actors (Frey et al., 2021). These networks of actor interactions can also mask hierarchies and political agendas (Westman et al., 2019). As these interactions grow complicated over time, they can create ambiguity in institutional rules and implementation responsibilities and engender an environment of distrust. Within such urban environments, what are the dominant patterns of network governance observed, why have these patterns emerged, and what are the impacts of these changes?

This paper, utilizes network governance theory and the method of dynamic social network

¹In this research, 'Local' refers to city-based organizations, 'State' refers to sub-national or provincial level

analysis. The contributions of this research include, first, a practical approach to building a longitudinal data set on network interaction from newspapers. Second, this research provides empirical insight into the evolution of nested and multilevel governance structures and the consequences of these changes. Such a temporal network governance assessment can inform policy and governance of the main actors, along with opportunities to reduce governance bottlenecks.

RQ 3: What drives the priorities of governance actors in mitigating water risks? How does local media influence these priorities?

The third paper looks beyond the institutional structures and policy (Chapter 4) to understand how social discourses (via news media) shape the uptake of ideas and influence decision-making to address water risks. I use media framing theory, i.e., “to frame is *to select some aspects of a perceived reality and make them more salient in a communicating context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation* for the item described.” (italicized in original) (Matthes et al., 2008, p. 264). I use the content analysis method to examine media frames on water risk within a local newspaper over 50 years. The research assesses how decision-making for water risks and related local media content co-evolves in framing the direction of water risk mitigation and adaptation.

This approach has two contributions; first, it allows the inclusion of historical feedback loops generated due to news and connected gossip that are not present in policy documents but propel decision-making. Second, the paper identifies the changes in local perceptions of water risks and solutions to address them. This paper tests how media framing prioritises specific water risks and solution choices while crowding out other water risks and choices (Matthes et al., 2008). The paper also theoretically advances media framing by outlining the relationship between the role of local media as an external mechanism that not only provides feedback but also prompts future decision-making through feedforward processes.

organizations, and ‘National’ refers to the central or national level organizations.

1.5 Structure of Thesis Manuscript

The thesis manuscript follows the format of peer-reviewed papers. However, the papers are slightly adapted in this thesis to weave together a coherent story line (Figure 1.1). While striving for a coherent story line through the thesis, the paper format may contain repetitions in methods and introductory content. The following Chapter is a literature review that cross-examines existing insights in urban and water governance domains and outlines my theoretical and methodological contributions. The third Chapter covers the methods and approaches used, including a detailed insight into the relevance of a temporally rich case study approach.

Chapter 4 (paper 1) qualitatively explores the co-evolution of governance for the water risks of urban floods, water supply inadequacies and river pollution. Chapter 5 (paper 2) provides a visual journey of how the dynamics of water risk governance structures and their actors have changed over time via social network analysis. In Chapter 6 (paper 3), I assess how decision-making priorities are shaped through media framing when addressing urban water risks. Finally, Chapter 7 synthesizes the insights from the three papers to build a cohesive understanding of the applicable policy contributions and future priorities and provides the research conclusion (Supplementary material for Chapters 4, 5 and 6 are included at the end of the thesis.)

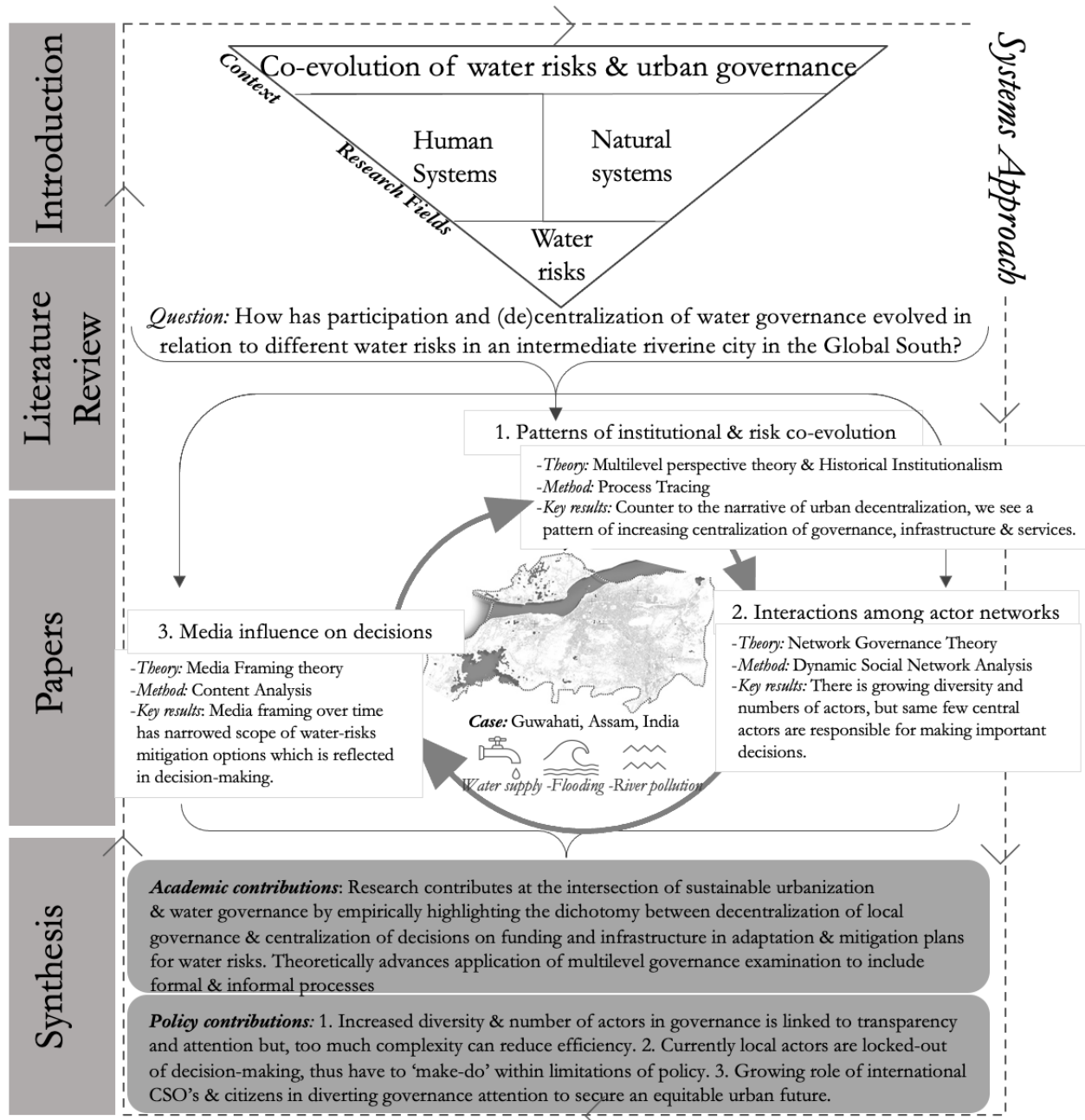


Figure 1.1: Overview of the thesis structure

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CHAPTER 2: Literature Review

CHAPTER 2

Literature Review

Chapter Summary

This chapter outlines the theoretical perspectives and research boundaries that guide the thesis. The first section (2.1) provides a brief conceptual review justifying the application of an integrated systems approach to study urban regions. Based on this integrated approach, I define the relevance, terms, and concepts used to structure and build consistency in studying the co-evolution of water risks and governance for an intermediate riverine city in the Global South. Unpacking the urban water risk and governance puzzle through a systems lens involves three interconnected parts detailed in the second section (2.2). The first part of the puzzle sketches the patterns of institutional change and the interplay between risk characteristics and governance responses via a multilevel perspective theory and historical institutionalism. The second part outlines network governance by drawing attention to neglected actors and evolving patterns of [centralization](#) and [decentralization](#). The third part examines how external influences, such as the media, frame and promote different priorities and visions for urban water development. The final section (2.3) defines the boundaries and assumptions applied to these three interconnected parts to improve replicability and robustness.

2.1 Conceptual Review: Integrated Systems Approach

Since the Industrial Revolution, the influence of humans on natural systems has become more profound. This current era of human dominance is also called the Anthropocene (Lewis et al., 2015; Rademacher, 2015). This dominance is most visible within cities, as a system¹ wholly structured and shaped by humans (built systems). In this way, cities differ from other socio-ecological systems such as grasslands or rural areas (Liu et al., 2007). But until the last two decades, human-natural systems were often studied separately due to traditional disciplinary silos (Liu et al., 2007). As a result, the separate study of natural or ecological systems (e.g., river changes, land use, climate) from human (e.g., multilevel governance structures, social networks, media influences) and physical or built systems (e.g., buildings, infrastructure) overlooks the complex outcomes that emerge from the interconnected linkages such as water risks and ecosystem services (Liu et al., 2007) (Figure 2.1). Fortunately, there has been an increasing number of interdisciplinary research based on an integrated socio-ecological systems approach (Schoon et al., 2015).

Within cities, the dynamics of water risks are influenced by multiple interconnected factors, which can include physical variables (e.g., rainfall, rivers, land-forms), people (e.g., various stakeholders), economic factors (e.g., industry) and the built form (e.g., infrastructure, roads) (Bai et al., 2016). Furthermore, cities are open systems that can also be influenced by factors outside the city, such as national and global influences (e.g., neoliberal trends, free-market economy) (Figure 2.1). Further, formal (e.g., policy mandated) and informal (e.g., friendships) interactions also impact urban water risks (Baldwin et al., 2014; Liu et al., 2007). In addition to the interactions mentioned above, legacy effects and path dependencies also influence how future urban trajectories unfold (Patterson 2020). However, an integrated systems approach involving all the required levels of interaction and timescales can be overwhelming (Bai et al., 2016; Berardo et al., 2020). Therefore, it is necessary to define clear examination boundaries

¹To clarify, a “system” in this research is characterized as an “integrated whole” that involves multiple interacting and moving parts (Schoon et al., 2015)

and to outline assumptions and judgements to clarify who and what matters to a research question (Bai et al., 2016; De Loe et al., 2017).

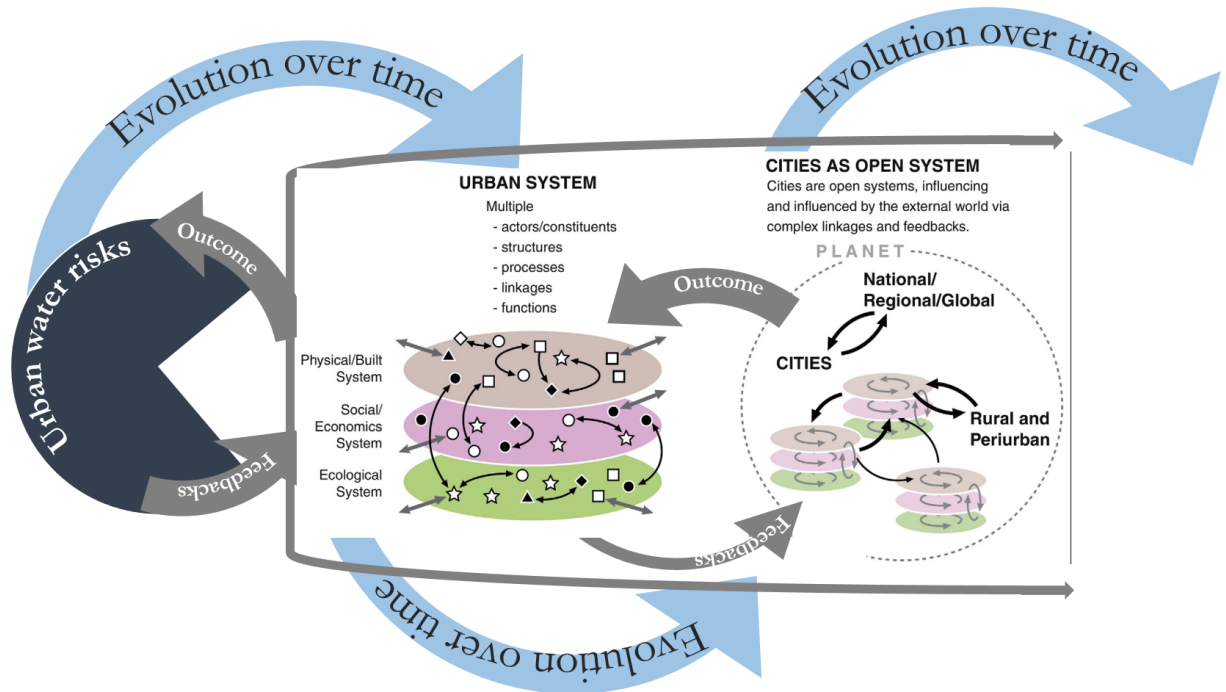


Figure 2.1: Integrated systems approach to understand urban governance of water risks. The conceptual diagram is based on coupled human-nature system approach from Liu et al., 2007 with social-nature-built open system of cities from Bai et al., 2016. Urban systems involve multiple layers of ecological, social, and built systems. These multiple systems are open systems thus influenced by interactions between systems and with different local, regional, global scales, all of which evolve over time in different ways. Urban water risks are an outcome (and feedback) of interactions systems and scales. The city is an open system hence linked to various other cities, and regional/national and global scales. The outcomes of these scales have more influence on intermediate cities and little feedback goes from these cities outside to the scales (shown by different size of arrows). Diagram includes concepts derived from Liu et al., 2007 and part of the figure from Bai et al., 2016, p. 71

Some of the initial path-defining proponents for an integrated systems approach include Ostrom (2009a, 2009b, 2010), Holling (2009), and Folke (2005), among others. In addition, many have built upon these seminal works to advance interdisciplinary and transdisciplinary integration (Schoon et al., 2015). Among the multiple strands of human-nature systems conceptualization, I utilize the comprehensive coupled human-nature systems approach from Liu et al. (2007) with a focused emphasis drawn from the socio-ecological-built systems perspective

of cities by Bai et al. (2016). Although these two conceptualizations of a systems approach are epistemologically similar, Liu et al. (2007) include case study applications across cities, rural areas and forest lands. At the same time, Bai et al. (2016) theoretically focuses on urban systems and the potential for integrated urban governance to achieve sustainable development goals. Further, the systems approach defined by both sets of authors aims to move beyond fragmentation and contribute towards inclusive, sustainable development. Liu et al. (2007) provide an application of a systems approach through case studies by focusing on the outcomes of human-nature interactions (i.e., ecosystem services or water risks). Thus, merging these two complementary conceptualizations provides a frame to build a consistent research boundary for this thesis.

A focus on the outcome of interactions (i.e., in the case of this thesis, urban water risks) provides a rationale to draw system-level and scale-level (Figure 2.1) boundaries to study the subject of interest. Bai et al. (2016) complement and enhances the research of Liu et al. (2007) by moving ahead of the coupled human-nature systems conceptualization to provide a detailed consideration of the socio (human), ecological (nature), and built (infrastructure, technical) systems interlinkages required for cities to contribute toward sustainable development (Figure 2.1). Bai et al. (2016, p. 71) also expand the conceptualization of the cities as open systems with “multifarious manifestations, as geophysical spaces, physical infrastructures, economic relationships, social entities, and cultural practices.” This multi-system integration addresses the challenge of siloed thinking within research on urban governance (Bai et al., 2016; Nagendra et al., 2018; Rademacher, 2015) and water governance (De Loe et al., 2017; Garrick et al., 2014).

Studying cities as open systems with multiple interdependencies and dynamics can be overwhelming. Moreover, such an integrated systems study requires the establishment of clear research boundaries with a pragmatic stand² to consistently select methods from different

²A pragmatic stand includes picking methods from different disciplines to build on the strengths of each. This does not imply a mash up of methods. Rather, together these mixed methods follow a purpose as directed by the broader research questions (Morgan, 2014) (Detailed in Chapter 3).

disciplines (Morgan, 2014). Finally, it is essential to emphasize that such an integrated systems approach, while inclusive, does not seek to offer a silver bullet solution to solve urban water risks. Instead, it aims to build a suite of diagnostic insights based on past and present interconnections to inform and engage urban decision-makers in improved risk mitigation and adaptation (Bai et al., 2016; Schoon et al., 2015).

2.1.1 Risk, Governance, and the Global South

Risk, governance, and the Global South have multiple meanings and interpretations. Therefore, I seek to build consistency by outlining the implications of these terms.

The definitions of risk have varied over time. However, an often used meaning of risk is that of unwanted, random, or adverse outcomes of unknown probabilities due to human and/or natural events that can be experienced by the social and ecological system (Christophers et al., 2020; Field et al., 2014). The degree of risk experienced, however, depends on the hazard or disaster event, exposure levels, and vulnerabilities of those exposed (Birkmann, 2007; Field et al., 2014; Garrick et al., 2014). Among risks experienced, water-related risks dominate the list of most destructive hazards encountered over the past fifty years (1970-2019). Water risks account for more than 74 percent of the disaster-related economic losses experienced globally (WMO, 2021).

The conceptualization of risks has evolved through various iterations, some of which are prominently reflected in the IPCC reports. Risk as of 2019 is referenced as “resulting from the interaction of vulnerability (of the affected system), its exposure over time (to a hazard), as well as the (climate-related) impact and the likelihood of its occurrence” (Hurlbert et al., 2019, p. 679). Through this view, the impact of risks are beyond just variances in biophysical events such as high rainfall patterns but also linked to the capacity to withstand risk, existing governmental and social safety nets, previous hazard events, plus local context of those who experience the risk (Jesse Ribot, 2013; Wisner et al., 2005). This understanding also acknowledges that there various meanings attached to the terms vulnerability and resilience within

literature. This study does not delve into these concepts but retains and reflects on these the multidimensional factors involved in the impacts of risks as the processes of governance are studied.

Further, governance of water risks is not apolitical, and perceptions influencing governance of these risks are not an objective and social interpretation of hazard events, but rather based on technocratically fueled observations (Colette, 2016). Water risk narratives and its governance are also framed by different groups (the media, private, civil society, and government) and this understanding influences how risks are perceived, mitigated, or ignored (Balsiger et al., 2016; Beck, 2015; Borie et al., 2019; Colette, 2016). Water risks however, include all those “potentially catastrophic, manufactured uncertainties that are socially constructed, socio technically contested, and socio-politically criticized across institutional and discursive dynamics” (Fischer, 2019, p. 1434). Finally, whether viewed subjectively or objectively, urban water risks are projected to increase in intensity with the rising global temperatures and changing urban metabolisms (Dodman et al., 2022).

Due to this structured and human-centric nature of cities, urban governance practices play a significant role in either mitigating and adapting and/or exacerbating and maladaptating water risks (since multiple water risks occur in cities, both adaptation and maladaptation can sometimes concurrently happen, i.e., adaption for one risk while maladaptation for another) (Dodman et al., 2022; Eriksen et al., 2021). Further, water risks go beyond “water-centric” aspects and are influenced by other urban dynamics. Therefore, studying governance of urban water risks must also move beyond the “water box” to include and observe all the relevant external factors involved (De Loe et al., 2017).

Here governance is understood as a process that involves more than just government; it includes all persons (private, public, civil society, the media) across various sectors (transport, water, municipal, etc.), arenas (formal and informal), and groups trying to influence decision-making and actions taken toward positive (however perceived) policy and practical outcomes for the city (Chaffin et al., 2016; De Loe et al., 2017; Elmqvist et al., 2013; Ostrom, 2015). Like

risk, governance is also a product of social dynamics that move beyond institutions and regulations (Berardo et al., 2019; Cairney, 2012; Thiel et al., 2019).

Further, most governance theories are designed within the Global North and create mismatches when applied to the political context and variances experienced within cities of the Global South (Frey et al., 2019; Westman et al., 2019). Therefore, a consideration of the political and social differences and inherent biases are included within this thesis as I apply theories and methods, some of which originate from American and European researchers.

The Global South is a metaphor that has recently gained prominence. At a superficial level, this phrase is used to divide “developed” and “underdeveloped” countries, while in another sense, it is applied to all countries in the southern hemisphere (Watson, 2019). Although there are many conceptualizations of the term, there is a growing consensus on what it isn’t (Bhan, 2019; Mohan et al., 2021). The Global South is more than just an indication of “under development”; rather it emphasizes differential geopolitical power relations (Watson, 2019). In this thesis, I follow Dados and Connell’s (2012) definition of the Global South that “references an entire history of colonialism, neo-imperialism, and differential economic and social change through which large inequalities in living standards, life expectancy and access to resources are maintained.” (Dados et al., 2012, p. 13). Viewed through this lens, parts of the “underdeveloped” Global South are visible in the “developed” Global North and vice versa (Watson, 2019). The insights generated from this research can be considered relevant for similar colonial and neo-imperialist urban contexts (Mohan et al., 2021).

2.1.2 Urban Water Risks – ‘too little, too much, too dirty.’

Urban water-related risks such as water supply inadequacies, floods, and river pollution, can be summarized simply as – ‘too little, too much, too dirty’ (Dixon, 1990, p. 170). Urban water risks are complex outcomes of interactions between biological variables (such as climatic events including heavy rainfall and increasing climatic uncertainty), social variables (such as policy implementation, social inequity, political and personal agendas) and built variables (such as

urbanizing land-forms, infrastructure) (Bai et al., 2016; Hoekstra et al., 2018). These ongoing interactions make water risks an ever-changing complex problem. However, the social variables can exacerbate and compound the impact of other variables within cities.

Water supply inadequacies in intermediate cities of the Global South stem from a physical lack of available water (due to water quality and quantity issues) and several systemic challenges. One challenge includes infrastructure mismatches, where the selection of water supply infrastructure is made *ex-ante* based on approximation of financial incentives received, external factors, and learning from large cities, rather than considering local needs and limitations (Millington et al., 2020). Social inequities are another challenge, as more affluent people living in formal neighbourhoods often get all day water supply access. In contrast, informal settlements lack public water supply and rely on private water vendors, paying costs ranging from 52-300 times higher than public utilities (Mitlin et al., 2019). Further, corruption, ranging from petty instances at the service provision level to large-scale scandals, induces delays, contributes to inefficient and inadequate infrastructure, and leads to a low trust environment (Davis, 2004; Gopakumar, 2014).

Urban floods are compounded by changes in the coupled urban systems, i.e., changes in urban land-form, degradation of local water systems such as rivers, lakes and wetlands, and governance gaps (Zope et al., 2016). When adopted from other regions without adequate local insight, governance measures can quickly become maladaptation practices—for example, installing floodwalls along certain parts of the river shifts inundation due to flood waters downstream to those living in the informal settlements, who can least afford these impacts (Marks et al., 2020; Rafiq et al., 2016). Another governance oversight or gap is delays or neglect in the daily operation and maintenance (O&M) that reduces the impact of floods: maintaining green cover and infrastructure, regular cleaning of drains, etc. But this routine O&M is not equally carried out across the city, as the local street-level officers are spread thin and constantly firefighting problems based on perceived priorities (valuable properties receive more attention) (Dodman et al., 2022). Further, as floods impact a whole spectrum of urban sectors,

from transport to water supply, there is a need for institutional coordination across various silos of government bureaucracy, which often falters (Brown et al., 2012).

Rapid urbanization along rivers contributes to the rise of urban river pollution within the Global South (Montero et al., 2006; Xu et al., 2019). Multiple policies have been implemented to reduce the waste burden on urban rivers, but their implementation is often lacking (Dempsey et al., 2017). This gap in implementation is usually due to unaccounted sources of pollution and a lack of infrastructure to treat urban wastewater. In intermediate cities, due to shortfalls in addressing basic infrastructures such as water supply and housing, urban wastewater runoff into rivers, while noted as a point of concern, is often neglected or overlooked (Satterthwaite et al., 2003; Xu et al., 2019). There is also a lack of perceived importance to this issue compared to more pressing concerns such as floods or delivering water supply.

These water-related risks are often studied individually. On the other hand, a human-natural system integrated approach allows the exploration of the various influences on multiple water risks and their governance across normative and strategic levels (Saravanan, 2008). Furthermore, since complex systems exploration can move to infinite details, the inquiry needs to be tied to the reality of the context within defined goals and resource boundaries (detailed in Section 2.3) (Urquiza et al., 2021).

2.1.3 Urban Risk Governance: Challenges of Practice and Research

The dominance of human influence within cities surpasses others, such as those of rural and forest systems. The human variables such as multilevel governance structures, the media, and citizens, can overshadow and restructure the natural and built systems within cities (Urquiza et al., 2021). Therefore, it is vital to focus on the human system and study it nested within and in relation to other interdependencies.

Addressing urban water risks falls under the purview of public service and requires inter-organizational collaborations, but it is also dealt with by individual urban citizens (Bianchi

et al., 2021; Jones et al., 2016). Although the collaborations and individual actions to address water risks play out in multiple ways, three interrelated conceptual avenues are explored in this research. These are multilevel institutional structure and physical risk change, a network of actors, and decision-making influenced by the media (Figure 2.2) (further detailed in Section 2.3). The three parts of research help understand the different elements as required within an integrated system approach. The first part, i.e., **co-evolution** of multilevel institution structure and physical risks, helps map connections across the city's social, ecological, and built systems and the related external levels. However, social systems are structured based on interaction across networks of actors. These actor interactions play a crucial role in shaping changes in the ecological and built systems of the city. Finally, many informal linkages and influences, such as the media, that impact interaction and decisions taken within the social systems. These three research puzzles fit together to understand feedback from risks and the decisions' outcomes (Figure 2.2).

Firstly governance of water risks flows through nested interactions between institutions at different scales (national to local), levels (within local), and various formal and informal processes (Garrick et al., 2014; Larson et al., 2013; Pahl-Wostl, 2017). Secondly, actors (organizations) dealing with risks are constantly interpreting information, coping with interdependencies, and being influenced by values and relationships (political and personal) (Khosla et al., 2019; Marks, 2019). Over time, these relations and interactions can lead to self-organization in the way mandates are formed and systems governed (Dunn et al., 2017; Fratini et al., 2012; van Meerkerk et al., 2013). Finally, these actor interactions and decision-making processes are also influenced by evolving social and cultural norms based on the frequency and visibility of the problem within media outlets (Sun et al., 2018). Unravelling these three aspects requires an interdisciplinary and broader systems approach (Saravanan, 2008).

A challenge faced by existing urban risk water governance is the pervasive Newtonian (reductionist) mode of analysis, which assumes that the whole problem can be understood and governed by breaking it down into its constituent parts and assessing them separately (Fratini

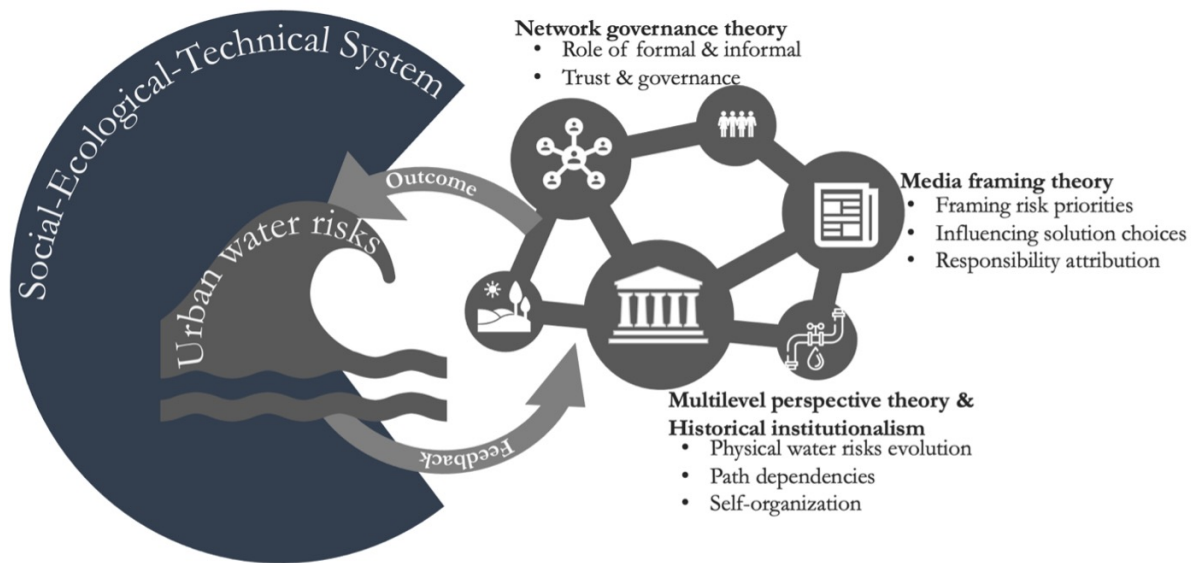


Figure 2.2: Conceptual diagram representing the connection between the three research papers. Within the wider theoretical framework of social-ecological-built systems, I examine three core aspect of social system i.e., multilevel institutional changes; networks of governance and influence of the media on decision-making. These three research parts are nested within a web of interactions with informal and formal entities; plus ecological and built systems. The arrows of outcome and feedback indicate ongoing evolution. Multilevel institutional changes are examined via multilevel perspective theory & historical institutionalism, networks of governance – via network governance theory, and influence of the media – via media framing theory.

et al., 2012; Karakiewicz, 2016). Such a fragmented and linear focus on governance continues to influence decision-making and reinforce path dependencies (Bai et al., 2016; Garrick, 2015; Gupta et al., 2013). Through this mindset, plans and visions for urban systems are built from a state of equilibrium or urban stasis without considering the inherent nature of unpredictable transitions. Therefore, by the time the urban planning process is complete, the city is no longer the same, the problems have evolved, and the plan is now redundant (Bai et al., 2016; Bhan, 2019; Dunn et al., 2017). Further, limited research includes the evolving and coupled impacts of human and natural systems on governance processes. When it is considered, it is mainly within megacities (W. Yang et al., 2016).

A coupled approach with a pragmatic stand (explained in Chapter 3) recommends using an

interdisciplinary array of theories to explore urban water risks and their governance across normative and strategic levels (Bai et al., 2016; Saravanan, 2008).

2.1.4 Intermediate Riverine Cities

In this thesis, I have used the case of Guwahati, India, to explore this systems approach to examine interdependence. Guwahati serves as an emblem of challenges faced within intermediate riverine cities of the Global South (a detailed description of why Guwahati is in Chapter 3). Guwahati is among the smaller or second-tier cities in India, with a population of one million and aspirations to reach ideals of a global or “world-class” smart city (Hemani et al., 2017) while simultaneously struggling with gaps in urban planning, financial, and human resource (Pawe et al., 2018). These challenges of Guwahati are not unique, and they are experienced among many similarly situated and intermediate cities of the Global South (Cook, 2018; Dempsey et al., 2017). Below, I define the relevance of examining multiple water risks in the context of intermediate riverine cities of the Global South.

Firstly, identifying what constitutes an intermediate city is challenging because urban categorizations of each country is different (Cohen, 2004; Marais, 2016). The terms intermediate, secondary, second-tier, small and medium-sized cities allude to a city system that falls somewhere in the middle category, based on each country’s urban definition of what constitutes a large city (Satterthwaite, 2017; Satterthwaite et al., 2003; Véron, 2010). A city in this category can host anywhere from 20,000–2.5 million people (Birkmann et al., 2016; B. Roberts, 2019).

Secondly, riverine cities and urban rivers further connect human and natural systems, complicating governance due to additional considerations required (Evenden, 2018; van den Brandeler et al., 2018). Riverine cities occur on riverbanks, and urban rivers include all “rivers that have been folded into the processes of urbanization, whether flowing through urban centres or not” (Evenden, 2018, p. 11). Rivers contribute to the health and well-being of their riparian residents through multiple services, such as water provision and livelihoods. This connection brings water risks closer to the metaphorical urban doorsteps and adds more actors to the ur-

ban governance mix. There are also social equity issues involved. Many informal settlements are on floodplains. These informal communities use rivers as a water supply source; thus, they are directly impacted by increasing river pollution and vulnerable to floods (Dempsey et al., 2017). Urban rivers are also considered an asset via riverfront and real estate developments. Yet the detrimental impacts of urban development on these water bodies and their dependents receive only cursory attention (Coelho, 2018). Separating these interlinked relationships between the city's socio-political and physical (risks) interactions and its river is short-sighted in the Global South (Dempsey et al., 2017).

In Global South's intermediate riverine cities, water risk governance is carried out within the constraints of limited resources, conflicting information, and an abundance of actors involved in varying degrees and influenced by multiple interest groups (Birkmann et al., 2016; Dempsey et al., 2017). These cities often lack conventional urban data, such as estimates of vulnerabilities, that are often taken for granted within cities of the Global North (Nagendra et al., 2018). Further, while information is considered valuable, river and consequent water risk data are dispersed, and its utilization in decision-making is limited due to overbearing economic, political, and time constraints (Rayner et al., 2005). As a result, when urban decision-makers face conflicting priorities, little is known about what prompts action for some water risks over others (da Cruz et al., 2019). Further, research and governance attention is often focused on infrastructural measures to address water risks in intermediate riverine cities. Therefore, there is a need to reflect on the underlying social-political interactions among actors involved, trends in institutional change, and circumstances that shape decision-making and modes of risk governance (Dempsey et al., 2017; B. Roberts, 2019; Satterthwaite et al., 2003).

Due to the interdisciplinary inclusions, there is a need to clarify the concepts used and their implication for understanding the three parts of this research (i.e., changes in the institution, the network of actors, and the social discourses). Therefore, the following section explores the three parts of the research puzzle, the concepts used, and their implications.

2.2 Three Research Parts

The intermingled governance puzzle in this research is addressed through three moving parts linked to the main research questions: How has participation and (de)centralization of urban governance evolved in relation to different water risks in an intermediate riverine city in the Global South? The three parts include: first, assessing patterns of institutional and physical risk co-evolution. Second, empirically maps the network of actors (stakeholders) involved, and third, assessing media influences on how urban water risk mitigation priorities are shaped.

2.2.1 Patterns of Institutional Change

Governing water risks involves multiple collaborations and nested levels of coordination; hence, building an understanding of the social, environmental, and institutional changes also requires a multi-layered approach. Many systems-related theories have assessed these multi-layered socio-ecological systems and their temporal changes. Early and famous frameworks include [Institutional Analysis and Development \(IAD\)](#) and the [Socio-Ecological Systems framework \(SES\)](#), developed by Eleanor Ostrom and others (Ostrom, 2009a, 2010; Pahl-Wostl et al., 2020). Since [IAD](#) and [SES](#), many derived frameworks have been developed (Berardo et al., 2019; Cox, 2014; Pahl-Wostl, 2017) and equally critiqued (Biddle et al., 2019; Binder et al., 2013; Clark et al., 2020; Pahl-Wostl et al., 2020). Other disciplines also built frameworks and theories to uncover multi-layered analysis. They include socio-technical studies through a structured [multilevel perspective \(MLP\)](#) (Geels, 2002) and, within the field of public policy, through discursive approaches, such as [historical institutionalism \(HI\)](#) (Thelen, 1999). These frameworks, while valuable, are also critiqued for their apolitical application (Frey et al., 2019; Voß et al., 2011), limited insight into agency and hierarchy among actors (Berardo et al., 2019; Westman et al., 2019), being solely focused on actors within institutions (Bell et al., 2021), and ambiguous in defining research boundaries (Stojanovic et al., 2016). Therefore, an inclusive and descriptive understanding of the multi-layered processes is needed to consider these gaps. To address them, I combine the framework of [MLP](#) (Geels, 2005), with [HI](#) (Fioretos et al., 2016; Thelen,

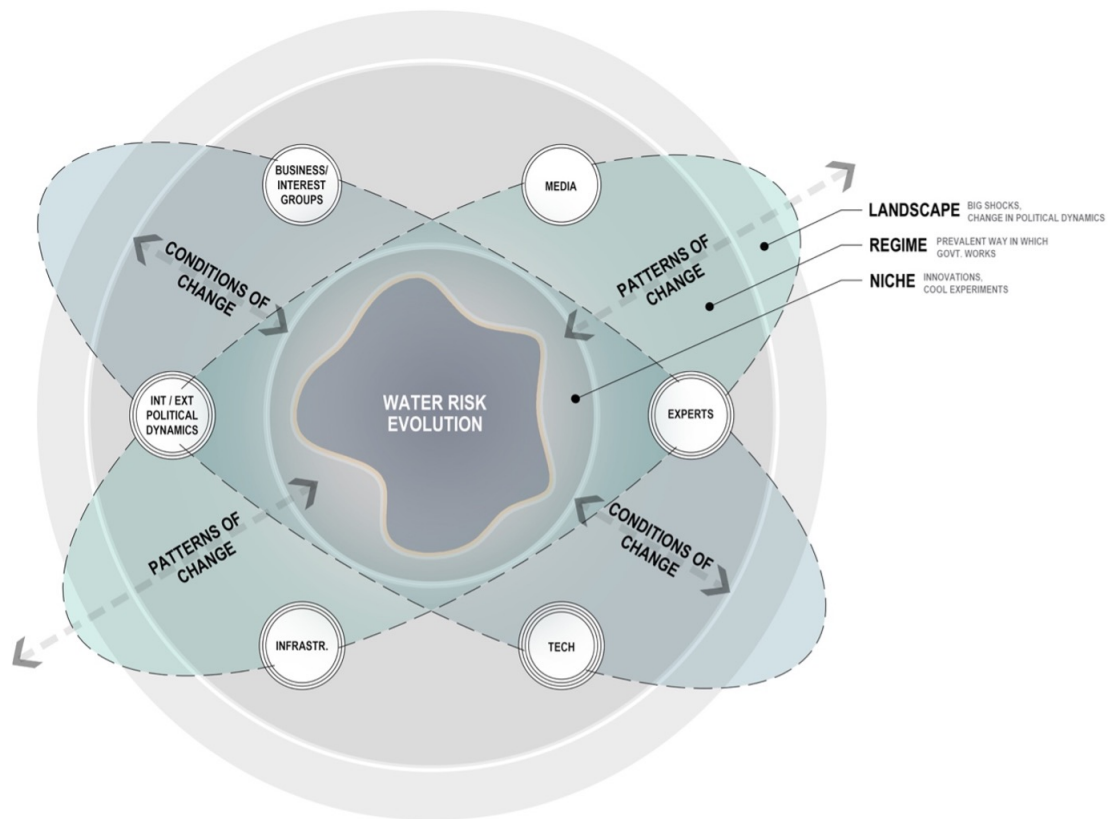


Figure 2.3: Conceptual diagram depicting a combined HI and MLP framework for understanding the evolution of water risks and their governance. The grey concentric circles represent ‘landscape’, ‘regime’, and ‘niche’ (details in chapter 4). Among the two ellipsoids, one depicts the ‘conditions of change’ that constitute either sudden or gradual change of the regime, and the ‘patterns of change’ highlights crisis or/and coalition driven changes occurring across landscape, regime, and niche. The various category of actors (white circles) are like atoms that are constantly moving and impacting water risk governance (inspired by C. Roberts et al., 2019). Diagram from Chapter 4.

1999). This framework allows me to study co-evolution at various levels while accounting for the external and internal influences, along with social and political changes while identifying conditions and patterns of change (Figure 2.3) (C. Roberts et al., 2019).

MLP theory captures various governance interactions across different levels, thus providing a ‘big picture’ of how water risks and their impacts evolve. Though it is often used to structure socio-technical transitions, its extended applications also cover socio-political shifts (Geels,

2005; Nastar, 2014; Yasmin et al., 2018). However, **MLP**, on its own, has been critiqued for being apolitical (Voß et al., 2011) and overlooking the horizontal interactions (i.e., interactions within a particular institution) and temporal impact on social change (Bai et al., 2009). This theory also requires an added contextual and deeper dimensional exploration (C. Roberts et al., 2019).

HI is a research tradition that examines how temporal processes, and cultural and social events influence the transformation of institutions that govern political and economic relations (Fioretos et al., 2016). **HI** provides granular attention to the conditions and patterns of interactions occurring along a horizontal and temporal dimension as institutions evolve (Fioretos et al., 2016; C. Roberts et al., 2019; Thelen, 1999). However, **HI** works with the assumption that institutional change is reliant on formal actors within the institutions. This assumption overlooks external influences on institutional change, such as political, physical, environmental impacts, and more, that also contribute to shaping institutions (Bell et al., 2021; Hameiri, 2020). Therefore, to move beyond apolitical and insular explorations, the combination of **MLP** and **HI**, as seen in figure 2.3, demonstrates how various actors and the institutional changes can be jointly assessed to map the co-evolution of water risks and their governance.

2.2.2 Interactions Between the Network of Actors

Actors within governance have the agency to change the direction of policies and reshape risk interventions. Human entities within governance are often referred to as actors, stakeholders, or agents. Sometimes these terms are also used interchangeably (Saravanan, 2008). However, each of these terms has specific meanings. “Stakeholders” include those among involved individuals who are affected by and/or affect policy action and changes. The term “actors”, on the other hand, consists of those “active participants who process information and strategize in their dealings with various local actors, as well as with outside institutions and personnel” (Long, 2001, p. 13)” (as cited in Saravanan, 2008, p. 203). Finally, “agents” are those human and non-human entities with transformative capacity (Latour, 2008).

In this research, I use the term “actor” to indicate those “organizations and groups (...) who are stakeholders with a legitimate interest.” (Saravanan, 2008, p. 203). Furthermore, as individuals in specific positions constantly change, I use organizations as a proxy for “actor” (Saravanan, 2008). Finally, focusing on organizations also provides insight into organizational dynamics because individual actions are shaped and bound by social norms and organizational rules.

Governance involves multiple actors, yet there is a lack of empirical insight into how different categories of actors influence governance and risk mitigation over time. This insight is essential; Bhardwaj and Khosla (2020) show how specific bureaucrats within a city in India have the power to innovate and superimpose ideas for adaptation to climate change onto regular schemes, such as ones that address housing, water supply, and waste. On the other hand, depending on who is involved, civil society involvement in cities can lead to more attention being paid to social issues neglected by bureaucrats (Chu et al., 2016). Many cities of the Global South are often resource-strapped and must “make do” to appease the different actors involved while navigating the existing socio-political arrangements (Bigger et al., 2020; McDuire-Ra, 2016). However, superficial or ad-hoc make-do behaviours can change institutional dynamics and often cause the bulk of risk and vulnerability to shift towards those who can least afford them (Christophers et al., 2020).

I selected network governance theory to examine the role and involvement of various actors over time. This theory allows for the exploration of the relational ties among actors (organizations) over time (Eberhard et al., 2017; Fawcett et al., 2012). Further, the theory goes beyond statistical network metrics to understand how actors are affected by the broader processes (political, market, environment) within which they are embedded and how they impact it (Eberhard et al., 2017; Fawcett et al., 2012).

2.2.3 Media Influences on Decision Making

In addition to institutions and actor interactions, decision-making processes are influenced by several other factors (Figure 2.4). The way a water risk is conceptualized and understood

by most urban citizens nudges a specific preference among policy responses (Fischer, 2019; Scheufele, 1999). Further, in the face of multiple risks and conflicting priorities, little is known about what prompts decision-making action for some water risks over others (da Cruz et al., 2019). Terms and phrasings repeated in local media can explain some aspects of a water risk behaviour, such as a preference for large infrastructure or neglect of the invisible daily operation and maintenance processes (Adekola et al., 2018; Aerts et al., 2018; Bohensky et al., 2014).

Local news media play a vital role in shaping heuristics by balancing information and perception to construct a relatable story. Therefore, news articles build an association based on repetition frequency and can frame the conception of what is considered a priority (Feezell et al., 2019; Tewbskury et al., 2020).

On the other hand, news content is also influenced by governance decisions. This way, news framing and decision-making co-evolve through positive or negative feedback loops (Lahsen et al., 2021). One limitation of using news is that it includes biases and sometimes self-reinforcing content, but this can be mitigated by recourse to supplementary information and data. Finally, social discourse and framing in news media can help understand the priorities assigned to decision-making for water risks. Local newspapers are a communicative space for local occurrences and shape the understanding of risk by balancing information and perceptions to construct a relatable story (Feezell et al., 2019; Tewbskury et al., 2020). Through daily and repeated coverage, local newspapers build familiarity with repeated terms and phrasings, thus influencing beliefs about risks and policy preferences (Crow et al., 2017).

In intermediate cities of the Global South, few research projects assess the connection between media coverage of water risks and governance trends. When done, the focus is nearly always on urban floods (Adekola et al., 2018; Bohensky et al., 2014; Rinne et al., 2016).

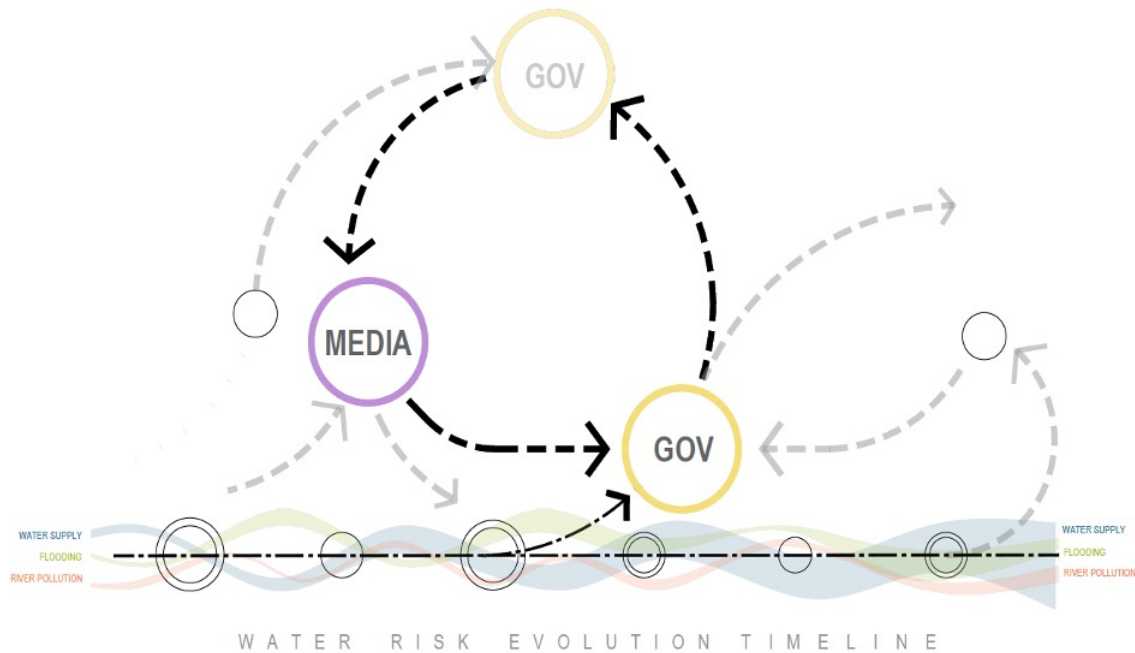


Figure 2.4: Conceptual diagram of the evolving nature of the media influence and governance. The diagram displays the feedback and feedforward influence on governance based on increased visibility of specific risks by media, such as water supply issues. Water risk governance is also influenced by other aspects, as indicated by the smaller empty circles. Although the water risk coverage increases for water supply (the bottom blue line), there is intermittent but increasing focus on flood issues. Moreover, recently there has been growing attention to the mostly neglected issue of river pollution, which indicates a rise in pollution concerns. (Diagram made by authors)

2.3 Boundary Conditions for an Integrated Systems

Approach

The interdisciplinary systems approach often runs the danger of cherry-picking theories to fit expectations (Morçöl, 2013)(Geyer and Cairney, 2015; Morçöl, 2013). Studying co-evolution through an integrated systems approach is challenging, as the actors, institutions, and physical risks change due to various social, built, and environmental dynamics. Therefore, to draw research boundaries, Yaneer Bar-Yam (2008) states that the amount of information required to understand the complexity of a system is based on the scale and context within which observations occur. Mitleton-Kelly (2003), in turn, mentions that, when exploring complex

systems, one cannot pick and choose desirable characteristics or theories (e.g., emergence or self-organization) and study them in isolation from others (e.g., feedback and interdependence). Therefore, water risks in my case study serve as an anchor to delineate a boundary around what is being studied (Mitleton-Kelly, 2003). However, it is important to note that, despite robust efforts, such complex socio-ecological systems can only be partially known, partly studied, partly generalized, and somewhat predicted (Morçöl, 2013).

I define the empirical and theoretical boundaries of the study to streamline the research and enable comparative and reproducible results while avoiding cherry-picking frameworks and methods.

2.3.1 Establishing Empirical Boundary Conditions

Studying all the required aspects based on an interdisciplinary systems approach is daunting. Therefore, I put two empirical boundary conditions within which the research develops (Allen et al., 2017; Dunn et al., 2017). The first boundary is spatial and social, i.e., covering the study site and the extent of governance interactions. This boundary goes beyond the conventional spatial scale, as it is not a static examination of a city within its political or watershed borders. Instead, I undertake a fluid examination with the city as the center point from where water risk interactions moving outwards and inwards are assessed (Allen et al., 2017; Dunn et al., 2017; Gopakumar, 2011). Interactions are examined in relation to the three water risks of inadequate water supply, urban floods, and river pollution and move up to three scales of interaction. The three scales are the following: primary – within the city, secondary – state and national, and tertiary – international (Cash et al., 2006; Cilliers, 1998). These interactions usually exhibit a descending order of intensity as the scale goes up (Bogason et al., 2007; Dunn et al., 2017). This approach also allows the inclusion of the additional diverse actors involved in the governance of the urban river.

The second boundary condition is temporal. But how far behind should one go in a temporal examination of a complex system? Hollway (2021) summarizes four criteria relevant to

establishing time frames, as there is a hierarchy in temporal dependence (i.e., instances that occurred in the extreme past may not be as relevant to current events as those occurring in the recent past). Firstly, one can examine a process as far back in time as one wants. Still, if there is no dependence or relevance of the past events or states to the current subject of examination, then those past instances are “random walks” or “noise” and not relevant to the study (Hollway, 2021). The second consideration includes connectivity between the different periods, i.e., current conditions may be sequentially dependent on observations from the past, thus forming a trend, e.g., an increasing, decreasing, or curve bell trend. Thirdly, some temporal interaction patterns follow seasonality, i.e., repeated at regular intervals, such as election cycles every five years or urban planning cycles that occur every 20 years. Finally, the fourth criteria include junctures in time that can alter or create a lock-in for future trajectories, such as a new institution or designating a city as the capital city of a region. The beginning of a time frame for study can be outlined by identifying the critical junctures. Studying events and states both before and after the juncture is a good practice. However, if one studies future trajectories, only the post-juncture period can be examined (Hollway, 2021).

Applying these criteria comprises identifying a juncture that had the most significant impact. My goal includes identifying this impact on future trajectories. Therefore, I study the period after the major juncture. Further, within this period, there can be many events that occur. However, to reduce the noise, I only examine events relevant to the three water risks. However, seasonal trends are challenging to establish at the outset, especially within systems still growing and not yet mature (Allen et al., 2017; Hollway, 2021). Therefore, the temporal boundary for this research begins at the major juncture (here, it is the selection of Guwahati as the capital of Assam) relevant to current urban water risk governance. I overlook those events that do not affect the decisions or actions linked to the three water risks. Identifying the trends and seasonality patterns becomes an outcome of the research rather than forming a boundary condition.

2.3.2 Establishing Theoretical Boundary Conditions

The theoretical boundaries are rooted in the three lines of examination and defined within the empirical boundary conditions outlined in section 2.3.1. These three lines of examination are drawn from Mitleton-Kelly (2003), Yang (2021), and Hollway (2021). Yang (2021) tries to apply systems approach to account for complexity by outlining time-sequenced steps for examining complex systems. This application assumes that actors and systems follow one another in their evolution pattern rather than evolving together, i.e., a system evolves (step 1), and this influences actors whose behaviours either then conform or change (step 2), the system then transforms into a new evolved system (step 3) on which actors again act to yield future outcomes. However, it is difficult to identify whether the systems and actor evolution are sequential, simultaneous, or both depending on the observation time (Ansell et al., 2022).

My first step or line of examination is to assess the social, political, and environmental circumstances and structures that contribute to governance regime changes, new path dependencies, and feedback (institutional change). The second step involves positing that risks and their governance can be reproduced or changed through outcomes of social interactions. Uncovering these social interactions would require reviewing the relational ties between actors and how they change over time (paper 2) (actor change). The third step addresses the reciprocal influence of actor decisions and discourses on external stimuli such as news media. This step is explored by examining the circumstances and perceptions influencing media coverage and decision-making (paper 3). Each line of enquiry, while holding a central focus, engages with the other two lines of enquiry through periphery interactions (figure 2.2). These three lines of exploration undertaken within the empirical boundaries employ complexity-informed theories to understand the multiple facets of governance. Finally, each line of inquiry outlines the appropriate theory selection processes. The methods used to explore these three lines of inquiry are further examined in Chapter 3-Methodology.

2.3.3 Are Historical Insights Valid in an Unpredictable Anthropocene?

The status quo within the current age of the Anthropocene has been one of unprecedented climatic shifts and public health emergencies. Anthropocene signifies the era in the global timescale where human activity is the dominant cause of changes seen on earth and its climate (Lewis et al., 2015). In this age of unpredictable climatic occurrences, would historical insights be reliable for gauging future risk trajectories? (Islam et al., 2018). However, within the Anthropocene, stasis is rarely the case, uncertainty is prevalent, and thresholds are constantly tipped, with every decision leading to manifold repercussions (Islam et al., 2018; Karakiewicz, 2016; Young, 2017).

Further, organic systems are constantly changing (Young, 2017). Nonetheless, the path of problem-solving or managerial approaches has been deterministic, linear, and operating from the point of stasis (Bhan, 2019; Mohan et al., 2021). This linear approach leads to sub-optimal or even redundant outcomes because the problems constantly change, and historical data is no longer enough (Dunn et al., 2017). Because of this evolving and changing nature, complex systems cannot be solved fully (Morçöl, 2013; Young, 2017). Instead of seeking a silver bullet solution, research direction is better served by identifying patterns and trends to understand our risky urban future.

The solar system can be a simple parallel to understanding patterns and trends in relation to the daily changing reality. While the lived experience of every day on earth is different from the day before, the pattern of the planet's revolution and the seasonality is regular, and the sun always rises. Despite social reality being more challenging, the patterns of reform and change are periodic, even though the intensity or scale at which they occur might differ (Angelo et al., 2018; Holland, 2012). Therefore, instead of searching for a solution, there exists a need to understand historical patterns and trends to gauge the direction of future shifts. This understanding can engender flexible social and physical structures that can better adapt to and mitigate future urban water risks (Geyer et al., 2015; Mitleton-Kelly, 2003).

2.4 Chapter Conclusion

Within the theoretical and empirical boundaries listed, I provide two theoretical contributions and one empirical contribution, and test a proposition. The first theoretical contribution is the novel application of [MLP](#) combined with [HI](#) to assess transitions within urban water risk governance. The second theoretical contribution is based on applying temporal insights into the mode of network diversification of water risk governance within network governance theory. The empirical contribution includes explicitly outlining a unique method to build a dynamic network to examine the specific interactions and their evolution in relation to water risks. Finally, I examine the proposition that local media influence decision-making priorities through frequency and repetition within conditions where there are few resources.

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CHAPTER 3: Methodology

CHAPTER 3

Methodology

Chapter Summary

This chapter begins by outlining the research design and methodology used to develop a longitudinal case study. Section 3.1.3 lists methods used to analyse the three research parts. The first part includes uncovering the patterns of institutional change through the process-tracing method. The second part is to map the networks of actor interactions across decades using dynamic social network analysis. The third part the trends and changes in media discourse and decision-making priorities through content analysis of media frames. Section 3.2.1 describes case study context and an overview of governance trends within India and Guwahati. Following the overview the data collection process detailed. Section 3.3 mentions why particular concepts from a systems approach were excluded, the methodological limitations, and efforts to overcome these limitations. Since the research involved fieldwork, Section 3.4.3.5 lists the ethical considerations and the funding sources. Finally, I conclude this chapter by detailing the impact of COVID-19 on the research outcomes.

3.1 Research Design

The nature of urban water risk and their governance is complex; therefore, our understanding of their co-evolution can, at best, be an initial foray. Such nonlinear co-evolution processes re-

quire an in-depth examination across multiple variables and timescales (Morçöl, 2013; Mundoli et al., 2019). Therefore, the design elements include outlining the data and methodological choices applied to conduct a diagnostic exploration of urban water risk governance. I begin this section with my positionality in this research, followed by a detailed description of why a case study approach is relevant. I close this section by specifying the mixed methods used to address the three research objectives, i.e., uncover multilevel and nested institutional changes, map actor interactions, and the influence of social discourses on decision-making. The three chosen methods include process tracing, social network analysis and content analysis.

3.1.1 Ontology, Epistemology, and Ethics in Positionality

In describing ontological and epistemological positions in political science, Marsh and Gerry (2010) state an individual's research position is not a sweater that one can easily change but rather skin. Further, in addition to ontological and epistemological positionality, the ethical considerations of a researcher are also crucial (Holmes, 2021). Therefore, how researchers engage in knowledge generation and dissemination processes are framed by their positionality and ethical considerations. Further, the difference between various epistemological positions (positivist, interpretivism, realist), at a point, can become arbitrary. However, what is of consequence is that a researcher adopts a position that makes sense to their research and applies it consistently while acknowledging that it too is a contested opinion (Marsh et al., 2010). Therefore, I outline my position in the research in this section along with the research ethics and procedures applied to collect information in section 3.4.

In this research, my positionality as an Indian woman and having worked with government officials gave me an 'insider' frame of reference to view the ongoing complexities within urban governance. My position in this research was also an 'outsider' from a foreign university, albeit from the University of Oxford, complemented by an Indian-based scholarship. This duality enabled me to get information as an 'insider' via interviews (as I was seen as one of them, plus a woman who 'made it' to Oxford). Yet, this duality also made it difficult to obtain specific data,

such as river flow information that was deemed as classified information for researchers from universities outside of India. The 'outsider' position also provided the privilege of getting high-level meetings and appointments that would have otherwise been difficult to obtain. However, there was always the challenge that information shared would be something that sought to showcase only positive aspects.

Another inherent notion I carried into the research was the conception of which water risk is receiving more governance attention. Having worked on issues of river and flooding before my DPhil, I had assumed that floods were the most crucial issue in Guwahati. I also thought that the national river rejuvenation schemes would provide some level of priority to river pollution issues. Finally, as water supply issues are ongoing, I did not assume it would be at the forefront of attention. These perceptions were flipped after my first fieldwork.

To address my bias, I constantly reflected on the direction of the data and adopted a diagnostic and critical realist view toward the research outcomes. I also widened the scale and level of those interviewed (from politicians and street-level bureaucrats to urban citizens and private water vendors). I included various secondary research documents (from archival and legislature documents to local newspapers and academic reports).

In reality, governance of urban water risks unfolds in various observable and unobservable ways. A critical realist position helped me contend with this reality or ontology. I reconciled that reality is complicated with many unobservable elements, however, certain aspects of this reality can be observed and understood. This position helped me to draw boundaries around what I wanted to study and recognize that governance and social structures constrain or enable actor agency. However, these structures are also transformed by the said agency (Archer, 2016; Marsh et al., 2010). Further, this diagnostic position also provided me an ethical stand by transparently outlining how and which aspects of knowledge are engaged and shared. Finally, by adopting this view I was more concerned with what is out there and how it has been shaped. This outlook extended to methodological choices that were qualitative and quantitative (Edwards et al., 2014).

To accommodate both qualitative and quantitative methods along with a critical realism position, I applied an integrated socio-ecological-built systems perspective (Bai et al., 2016; Liu et al., 2007) to include information on changes in physical water risks, governance actors (both local and regional scales), institutional reforms (both local and regional scales), and external influences (via media and political manifestos). A system's perspective allowed the inclusion of the diverse physical risks, with an integration between social, ecological and built systems of the city. This framework allowed me to include insights from all the diverse levels of actions (from high-level bureaucrats to street level engineers who are implementing works) and wide spectrum of actors (academicians to media and private entrepreneurs).

This integrated systems approach conforms with a critical realist view and a pragmatic stand thus providing me with theoretical and empirical boundaries that include rules of engagement and interpretation (Holland, 2012; Marsh and Gerry, 2010; David L Morgan, 2014; Yang, 2021). Such an approach allowed me to move away from a colonially rooted epistemology of how "good governance" should be (Meijerink et al., 2010). Many normative ideas around "good governance" prescribed to address water risks in intermediate cities of the Global South have contributed to maladaptation and mismatched solutions (Eriksen et al., 2021; Meijerink et al., 2010). However, such an interdisciplinary and pragmatic approach is not new and have gained traction as researchers foray deeper into understanding social reality (Berardo et al., 2019; Morgan, 2014).

An integrated social-ecological-built systems approach has potential to contribute towards sustainable urban development and thus prompted this research. Therefore, I began the research with an open-ended question i.e. how do water risks and their governance co-evolve in an intermediate riverine city of the Global South? As the study unfolded and the different parts of the research puzzle came together, a trend kept emerging. This trend included an ongoing tug of war between decentralization and centralization, with centralization almost coming out on the winning end. The three research papers (Chapter 4, 5, and 6) helped to both theoretically and empirically expand on why this trend of centralization kept becoming

stronger despite ongoing incentives (Sivaramakrishnan, 2013) and research lauding decentralization as a better mode of governance for growing cities (Pahl-Wostl, 2017). This research does not question the validity of decentralized vs centralized governance but seeks to understand why particular governance trends persist and their impact on urban water risks. These insights are uncovered in parts through the different research papers (Chapter 4, 5, and 6), and put together to contribute to broader insights in the final Chapter 7.

3.1.2 Case Study Rationale

There are already many case studies that examine the socio-ecological processes of urban risk governance. So why is one more case study needed? Further, how can insight from a single case study provide context for what is happening within intermediate riverine cities of the Global South? The answer to these two questions flows in three parts. First, I begin by outlining the strengths of a case study method in contributing to theory development (in urban, water and other fields). Second, I define how the weakness associated with a case study method can be addressed. Finally, I explain the relevance of a single case study in building diagnostic insights and empirically contributing to an operationally effective methodology.

Case studies are an avenue to build an in-depth understanding of a particular subject but are widely critiqued when drawing generalizations (Flyvbjerg, 2006; Steinberg, 2015). While Steinberg (2015), Ruddin (2006), and Flyvbjerg (2006), among others, are bold in their support of case studies, there is an ongoing distrust or weakness associated with a single case study in comparison to large size sample studies and surveys (Ulriksen et al., 2016). To address this distrust, Flyvbjerg (2006) systematically outlined and justified the five biggest misconceptions around the use of case studies. Yet, the biggest weakness associated with the case study is a discomfort with the idea of drawing generalizations from a single case (Hyett et al., 2014).

A case study method allows exploration of the length and breadth of multiple variables and data for a particular region to provide an in-depth and diagnostic view of “reality” that often cannot be gleaned from extensive surveys (Flyvbjerg, 2006; Steinberg, 2015). Therefore, while

generalizations made from a case study may seem untenable, Steinberg (2015) argues that generalization from detailed case study (for similar situations) are on par with inferences drawn from large sample size research when systematically outlined.

Creating systematization for drawing governance-based inference involves building boundaries to which generalization is applicable, i.e., applicability can extend to a system that shares common characteristics, occurs within similar arenas or exhibits resonance in actor behaviours and modes of functioning (Steinberg, 2015). Further, a temporal case study of environmental governance, even just a single case, comprises a multitude of rigorous observations and data points (i.e. multiple actors, path dependencies, and situations), leading to a significantly large sample size (Flyvbjerg, 2006; Steinberg, 2015). Such depth of detail is often lost or simplified within extensive surveys (Ruddin, 2006).

There is a gap in temporal understanding of governance within intermediate riverine cities in the Global South (Dempsey et al., 2017; Evenden, 2018; Lele, Madhyastha, et al., 2018; van den Brandeler et al., 2018). Therefore, even a single in-depth case study can provide significant inroads to expand theory and build empirical insights. Consequently, I argue that a detailed case study such as Guwahati can aid in understanding patterns of urban water risk governance in other intermediate riverine cities of the Global South. Moreover, these inferences are particularly relevant when applied to three specific research objectives (Table 1.1, i.e. uncovering patterns of multilevel institutional change, evolving network of actor-interactions and examining links between the local media discourse and decision-making (Insights into Guwahati provided in section 3.2.2).

3.1.3 Methods Selection to Explore Three Research Objectives

To build an in-depth case study of changes in governance and urban water risks, I take a pragmatic stand by applying mixed methods (Figure 3.1). In applying mixed methods I also acknowledge that the divide between qualitative and quantitative methods becomes slightly blurred as one tries to quantify trends of human interactions which are inherently subjective

(Creswell et al., 2017; Morgan, 2014; Ostrom, 2009; Poteete et al., 2010). Therefore in my research, qualitative methods provide an understanding of how and why governance evolves in a particular manner, and quantitative methods aid in mapping the recurring patterns and trends (Creswell et al., 2017; Morçöl, 2013). Such a pragmatic combination of mixed methods can contribute new insights to theory development. However, there are certain aspects that need to be considered when taking such a pragmatic stand on methods. They include attention to the assumptions involved, analytical strategy employed, ensuring validity and replicability, type of contribution to theory development and practical considerations such as data, skill, and time availability. These methods are applied within the empirical and theoretical boundaries as outlined in Chapter 2, Section 2.3.

A pragmatic stand to select methods allows me to draw from various disciplines to triangulate insight and understand reality (Morgan, 2014). I bring together insights from the three methods at the end of the research in a convergent manner such that they build a more holistic understanding of governance (Morgan, 2014). Information on data used according to respective variables is detailed later in section 3.2.2.1.

3.1.3.1 Process Tracing to Uncover Patterns of Institutional Change

Process tracing is a systematic qualitative method to unpack temporal and multilevel institutional insights within a case study (Collier, 2011). Through process tracing, a researcher can draw out in-depth and context-specific descriptions, exploration and causal connections in a sequenced manner to understand patterns of change (Creswell et al., 2017; Ulriksen et al., 2016). Further, induction within process tracing is often seated within a specific theory. Therefore, process tracing is used to build on the multilevel perspective and historical institutionalism (Roberts et al., 2019). Trampusch and Palier (2016) outlined ten types of process tracing approaches. In this research, I follow the historical explanation type of process tracing. This type of tracing provides detailed descriptions of internal and external impacts sequenced over time. Further, this approach also contributes to theory building. However, an essential aspect of reducing ambiguity within process tracing is outlining the steps followed to draw

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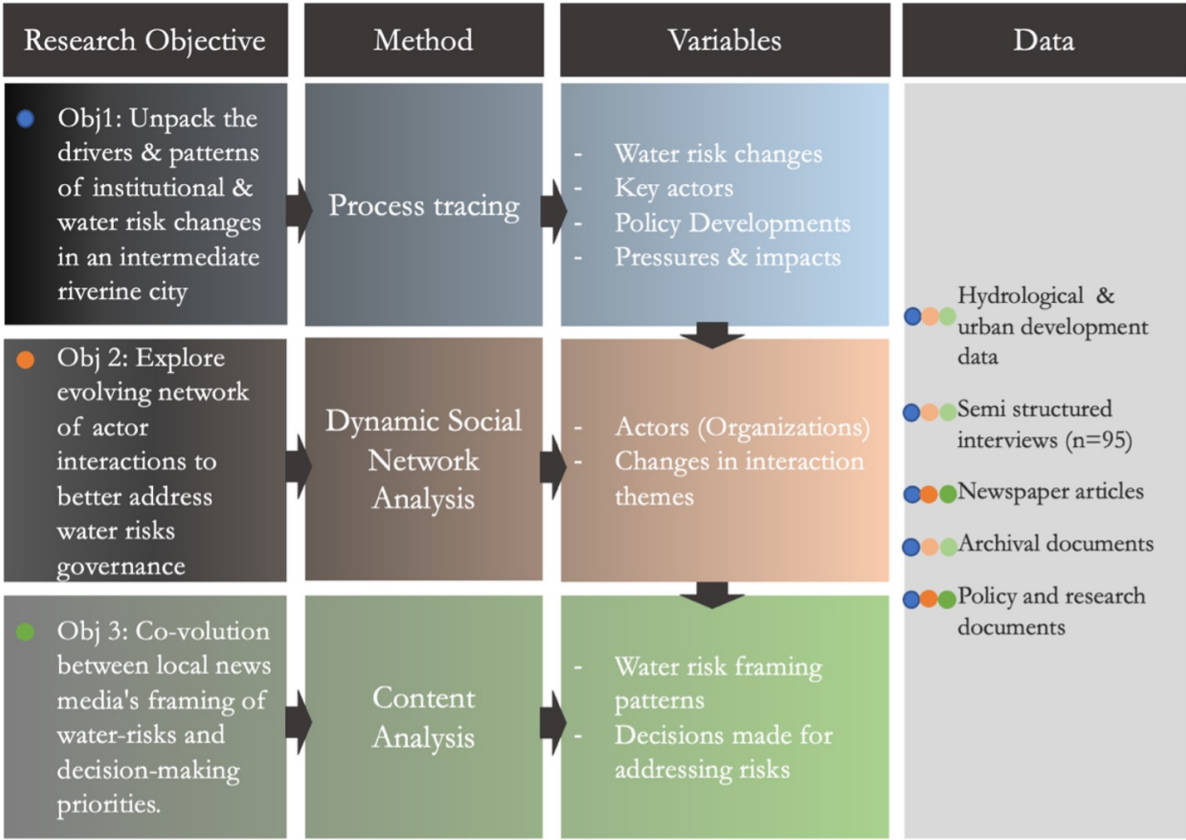


Figure 3.1: Outline of three research objectives, methods and data. The table representing the connection between the three research papers. The diagram outlines the three objectives (Chapter 4, 5, and 6), methods, variables and data used in the thesis. The darker coloured dots in the data section represent the primary data source for the relevant objective. All the data listed is used in one form or the other within the three objectives for triangulation (therefore, lighter shade dots).

inferences (Collier, 2011).

Analysis: My research follows a sequenced historical exploration in two phases. The first phase adopts a chronological listing of different water risk events, related policy interventions and institutional and political party changes (Octavianti et al., 2018; Smith, 2004). This chronology allows differentiation of specific eras based on dominant and repeated themes such as the era of political reforms, economic reform, etc. The second phase creates a descriptive report for each era (Collier, 2011). Descriptions here aid in the diagnostic identification of conditions and patterns that influences governance transitions (Collier, 2011; Siddiki et al., 2019; Smith,

2004). These descriptions allow detailed mapping of the pressures and the influence's points (Roberts et al., 2019; Yasmin et al., 2018).

3.1.3.2 Social Network Analysis to Map Actor Interactions

My research draws on the methodological application of [Social Network Analysis](#) (SNA) (Marshall et al., 2015). [SNA](#) method allows the identification of patterns within complex governance processes. This method is especially applicable to map multilevel governance processes across different issues to uncover scalar mismatches and influences (Stein et al., 2011). However, most social network analyses are conducted for a specific snapshot of time (Berardo et al., 2020). This singular view has advantages in exploring current dynamics but is limited in understanding why the current dynamics are in place and what is influencing change (Angst et al., 2017).

One approach to creating such dynamic [SNA](#) is to build time slices of actor interaction and examine the changes over time (Wolbers et al., 2013). In utilizing such a method, I follow an exploratory approach to understand how the emergence of actor interactions and authority takes shape and why specific patterns of interactions unfold within the case of Guwahati. To visually map the networks, I used the R studio program (R et al., 2009) to process data and the software Gephi (version 0.9.2) to visualize the networks (Bastian et al., 2009).

Analysis: There are many statistical methods to analyse social networks. The choice of statistical analysis is often based on the question and validity of the data to answer those questions. To identify the most important and most connected actors, I use the authority metric (within HIITS in Gephi) (Borgatti et al., 2013; Iacobucci et al., 2019). To evaluate the network-level behaviour of governance dynamics (group dynamics), I use the modularity metric to demarcate clusters based on the intensity of actor interactions. Therefore when actors for a specific risk are spread over multiple clusters, this indicates fragmentation, i.e., low levels of interaction and coordination between the responsible actors (Schwenke et al., 2021). Within Gephi, I use force atlas 2 to visualize the network (Chapter 5, figure 5.9). Force atlas 2 pulls together nodes based on the intensity of interactions, thus visualizing the degree of connectivity (Jacomy et

al., 2014).

3.1.3.3 Content Analysis to Explore Influence of Local Media

In addressing the co-evolution of media framing and decision-making priorities for water risks, I utilize content analysis of news articles. The co-occurrence of similar frames of risk references within decision-making and local news media indicates feedback and evolving influence that I aim to examine.

Content analysis can be quantitative and qualitative and applied to explore how content is framed and changes within its context. The qualitative approach includes “identifying thematic patterns in text” these patterns emerge based on the meaning associated with text and are coded by a researcher (Neuendorf, 2017). However, there is a danger of bias based on what the researcher wants to see rather than what is in the text. Further, there is also a bias in deciding what content is extracted for analysis (Matthes, 2009).

According to Matthes (2009), a few key aspects are required to reduce bias and build reliability within an issue-specific content analysis of media. First, there needs to be a clear definition of what a frame of study captures “particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation” (Matthes et al., 2008, p. 264). Second, there is a need to clearly outline the logic of how issue-specific articles are selected from the whole array of news articles. The third includes testing a hypothesis that can add to building theory.

Analysis: In my research, I build content analysis frames around how water risks are defined within news articles based on problem definition- i.e., how the risks are described., causal interpretation- i.e. risk-related interventions and outcomes are viewed as success or failure, moral evaluation- i.e. is the tone of the article positive, negative or neutral concerning the risk, and treatment recommendation- i.e. the solutions prescribed to mitigate or adapt to the water risks. The insights from these coded frames serve to test the hypothesis that— media framing and decision-making co-evolve, and the direction of co-evolution can be seen in the way risks are referenced and how particular solution options become the dominant frames

within media and decisions made(Matthes et al., 2008; Neuendorf, 2017).

3.2 Case study overview

3.2.1 Situating Water Risk and Governance in Riverine Cities in the Indian Context

Due to its colonial legacy and a federal democratic structure, India serves as a rich setting to examine the governmental and non-governmental interactions that have evolved within riverine cities. Such a multi-layered and nested system of governance required detailed insight. Therefore, before diving into the case of Guwahati, I outline the context of water risk governance within India's riverine cities.

Among the 465 cities in India, more than 100 are riverine cities. They include mega-cities like Delhi, Mumbai, Chennai, Kolkata and many intermediate cities (Census of India, 2011). India's intermediate cities are expected to grow faster than large cities and house more than half of India's urban population, and the risks they face are often underestimated (Birkmann et al., 2016; Haque et al., 2018). Therefore, examining the evolution of risk governance of intermediate riverine cities allows us to ask questions to address the future of urban growth and the impacts on the resilience of the city and its riverine ecosystems (Dempsey et al., 2017; Kondolf et al., 2017; Satterthwaite, 2011).

Within India, urban water risk fall under a public service purview, with most of the adaptation and mitigation efforts shouldered by the government (Lele, Srinivasan, et al., 2018). Such a trend of reliance on the government for risk mitigation and adaptation is seen in the Global South and North (Beinart, 2014; Jones et al., 2016). Addressing water risk within India is also government-led and slightly different from neighboring South Asian countries such as Bangladesh or Nepal, where international and national aid agencies play a vital role in shaping risk governance (Price, 2014; Yasmin et al., 2018). Therefore, I begin by outlining the government's part in shaping water risks, followed by other actors and their roles.

Within the Indian government system, addressing urban water risks is spread across multiple departments with lead implementing authorities scattered at different scales (national, state, and local) and varied for the systems of cities and rivers. Such governance delegates flood mitigation to the water resources department and disaster management department, infrastructure development is a different department and rivers are managed by various departments (Bassi et al., 2012; Price, 2014). Water supply provision is handled by one department, whereas requisite finances and infrastructure are managed by multiple other departments (Gopakumar, 2011). Due to untreated urban sewage, river pollution dangerously impacts both river and urban ecosystems (Araral et al., 2016; Mahanta et al., 2011; Revi, 2008). While river basin authorities refer to river pollution in their policies, the plurality of institutions linked to wastewater and [urban rivers](#) creates challenges in enforcing regulations within riverine cities (van den Brander et al., 2018). Moreover, various political and social forces move across urban and river boundaries, blurring lines of governance responsibility and manipulating the system to create opportunities for rent-seeking and corruption (Hill, 2017). But, there is a growing part played by private entrepreneurs, media, academics and civil society in building insight, accountability and responsibility (Chu et al., 2017).

Addressing water risks was solely a public service until liberalization policies were diffused within the Indian urban economy in the late 1990s and early 2000s (Gopakumar, 2011; Sivaramakrishnan, 2011). These new policies led to a boom of private-public partnerships for water service provisions (Gopakumar, 2011). The inclusion of private entrepreneurs was seen as a measure to increase efficiency and reduce the government's financial burden. However, this neo-liberal approach to improving urban water risks has received mixed responses (Mollinga et al., 2007). Some stated that this approach depoliticizes services to the detriment of those most vulnerable to water risks (Swyngedouw, 2005). Others, such as governments, welcomed this move to devolve responsibility and address gaps in capacity (Price, 2014). Either way, private actors have become a key feature in urban water supply and are also getting involved in various other urban services as the concept of smart cities gains momentum (Angelo et al., 2018; Praharaj et al., 2018).

In addition to private actors, many international, national, and local NGOs, citizen groups, academics, and media have started to get involved in intermediate cities (Véron, 2010). For example, in Indian cities, civil society organizations (CSO) has started playing a prominent role in lobbying for green agendas and in the case of International CSOs, also providing resources to improve urban resilience (Bassi et al., 2012; Chu et al., 2016). But, the level of CSO and citizen involvement is nascent in intermediate cities compared to large cities (Gandy, 2008). Despite the benefits of such participation, there is also the question of who is participating and how far this involvement reduces the vulnerability of those most impacted by risks? Or rather, does this involvement serve the apparent concerns of the elite and middle class (who are capable of participating more), thus shifting the costs of risk to urban poor and marginalized, for example, via ad-hoc evictions of informal settlements from floodplains (Garschagen et al., 2019; Véron, 2010).

3.2.2 Why Guwahati?

Like many intermediate cities in India, Guwahati faces several challenges and often overlooked in investment and support (Haque et al., 2018). The case of Guwahati also highlights the many standard assumptions of institutions and infrastructure that don't match broader urban and water governance theories that are based on large cities. While all the lessons from this case cannot be generalized, insight from Guwahati contribute to a south-to-south policy insight on the underlying mechanism of change within water risk governance for intermediate riverine cities of the Global South (Hollway, 2021). Further, Guwahati also serves as an apt case to explore the overlooked and overextended governance system that characterizes many intermediate riverine cities of the Global South (Dempsey et al., 2017; Kondolf et al., 2017; Marks, 2019; Yasmin et al., 2018).

A little bit about Guwahati: Guwahati is considered a “gateway to Northeast India” and one of the largest cities in the Brahmaputra River basin (Figure 3.2). Being the entry point to the Northeastern region of India, Guwahati (old spelling *Gauhati*) has been a city of strategic and

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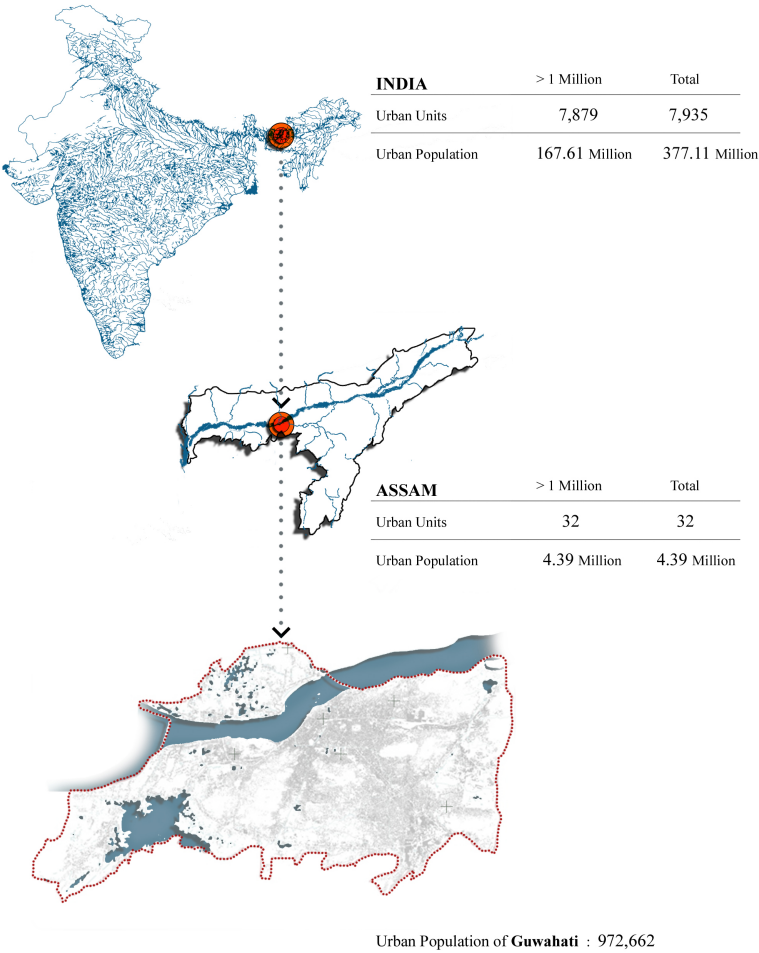


Figure 3.2: Case: study location-Guwahati, Assam, Northeast India. Urban population from census of India 2011 (Diagram made by authors).

geographical importance, dating as far back as the 16th century to the Ahom dynasty. However, Guwahati became the capital of Assam only in 1974, when a bifurcation occurred between the

states of Assam and Meghalaya (Alam et al., 2001; Phukan et al., 2012). The population of Guwahati is currently well over one million (Pawe et al., 2018). As a settlement in a riverine valley, the city comprises many hills, floodplains, wetlands (including a Ramsar wetland) and multiple local rivers (Bahini, Mora Bharalu, Bharalu, Bhasistha, and Lakhmijan).

A brief outline of water risk governance in Guwahati: Water supply in Guwahati is currently handled by three departments they include- The [Guwahati Municipal Corporation](#) (GMC), the Guwahati Metropolitan Drinking Water and Sewerage Board (GMDWSB or Jal Board) and the Public Health and Engineering Department [PHED](#)) (Figure 3.3). Together they supply water to around 40 percent of the city's population (Bhattacharya et al., 2014; Hazarika et al., 2016). While this percentage has grown since the 1970s (10-20 percent access), there are still multiple limitations in providing water supply to the city's wider population (Hemani et al., 2017). As a result, many rely on pumping groundwater or purchasing water from private water vendors at a high cost (Bhattacharya et al., 2014).

Further, the connection between Guwahati and the Brahmaputra River while providing ecosystem services such as navigation, water supply and recreational benefits, also cause urban-riverine water risks such as water supply inadequacies, urban floods, and river pollution. While urban growth and climatic conditions contribute to these water risks, deficiencies in governance can exacerbate risk impacts (Pawe et al., 2018).

Urban flooding is an ongoing and increasing occurrence in Guwahati as it lies in a valley and as urban expansion encroaches into the wetlands, floodplains and mountains (Sarmah et al., 2018). The city's growth has reshaped and infringed on the urban rivers and the surrounding wetlands that used to serve as a sink to store excess floodwaters (Gogoi, 2013). Around 2016, to address these floods propelled by the UN agencies, a consortium of about 16 departments was created to adapt and mitigate the impact of urban floods. The Kamrup District Disaster Management Authority coordinates this consortium [DDMA](#), housed, and headed by Kamrup District Commission (Figure 3.3) (NPb6, GOLa4).

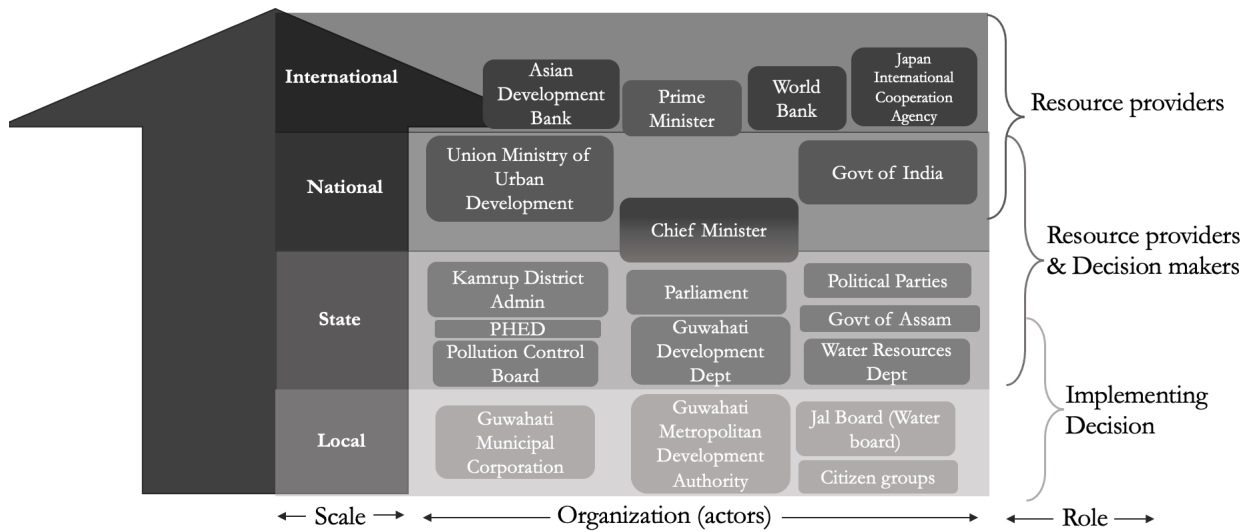


Figure 3.3: Select organizations involved water risk governance in Guwahati and their role.

There are no large scale sewage treatment facilities within Guwahati. Majority of the urban wastewater is directly released into the Brahmaputra river and the surrounding wetlands (Bhattacharyya et al., 2010; Mahanta et al., 2011). As a result, the local rivers of Guwahati are listed among the top ten polluted rivers of India (CPCB, 2013). The Assam Pollution Control Board is the main department responsible for addressing river pollution. However, in addition to pollution, the local water bodies are also under threat of being degraded and filled due to real estate and increasing land prices (Bhattacharyya et al., 2014; Pawe et al., 2018). Guwahati has benefited from multiple government and non-governmental grants to alleviate these water risks. However, the portion of investment received was relatively much smaller and less diverse than cities in other regions (Haque et al., 2018; Sivaramakrishnan, 2011).

Table 3.1 displays other examples of intermediate cities like Guwahati. These cities show similar challenges in data availability, shortfalls in local governance and vulnerability to risk exposure due to urban inequalities (Adelina et al., 2020; Bhardwaj et al., 2020; Marais, 2016; Satterthwaite, 2017; Westman et al., 2019).

Table 3.1: Comparative statistics from other intermediate cities of the Global South. Data sourced from data set (Florczyk et al., 2019)

City	Country	River Basin	Built-up area km ²	Population (2015)	GDP percapita \$	Research Citations
Rajshahi	Bangladesh	Ganges	54.862	793654	2,038.88	(Yasmin et al., 2018)
Guwahati	India	Brahmaputra	73.71	1103543	2,494.33	(Hemani and Das, 2016; Pawe and Saikia, 2018)
Huambo	Angola	Cunene	32.529	574072	4,422.12	(Meissner and Jacobs, 2016)
Bandar Lampung	Indonesia	Way Sekampung	62.617	1091523	4,634.79	(Brown et al., 2012)
Mangaluru	India	Netravathi	92.438	878093	4,732.67	(Cook, 2018)
Aswan	Egypt	Nile	8.275	329229	5,220.49	(Hamdy et al., 2020)
Hat Yai	Thailand	U-Tapao	42.155	297792	7,633.04	(Marks, 2019)
Emalahleni	South Africa	Limpopo	25.496	160230	9,535.53	(Marais, 2016)
Rizhao	China	Yellow	117.581	549263	11,760.16	(Westman et al., 2019)

3.2.2.1 Research Variables Based Data Collection

A case study relies on multiple sources of evidence and data to aid triangulation within long term explorations (Tsang, 2014). In addition, various sources and proxies for data are also required due to the non-availability of consistent data within such cities (Nagendra et al., 2018). This case study also utilizes multiple databases to triangulate findings (Table 3.2).

The time frame of exploration for this case study is between 1970 to 2019, as urbanization and governance grew exponentially from the juncture when Guwahati was designated as the capital of Assam in 1974 (decision and shifting processes started in 1970) (Alam et al., 2001). Two field visits were conducted between August–December 2018 and September–October 2019 to collect data and understand the context. Building insight for this case study also did not begin from scratch, as I have previously worked in Guwahati for many years and am familiar with the region and context. Details of data collected are listed in Table 3.2 (List of document titles and interviewee codes in Appendix 8.2). The data was collected to build a consistent database across time as per the required research variables (outlined in Figure 3.1)

Policy and legal developments: I reviewed multiple policy and legal documents to address institutional and policy regimes changes and map decision-making shifts (list of documents in appendix 8.2). Old document on policy and decision-making were obtained from the Assam State Archive (1960–1984) and the Assam State Legislative Assembly library (2001–2017). In addition, recent policy documents were obtained from the government department websites and offices.

External pressure and impacts: Two types of pressures and impacts linked to the water risks were examined, hydrological and sociological. Hydrological data for floods was rainfall, river level (at DC court station), and flood events extracted from news data. For water supply, use statistics were drawn from the Census of India. River pollution data was collected from the Pollution Control Board. Sociological pressures include political campaigns, protests, and international aid influences extracted from multiple sources, including newspapers, policy documents, campaign manifestos, and semi-structured interviews (N=95) (Questionnaire in appendix 8.3). Some interviews were short and provided basic insights and access to data sets. Some were longer and provided a depth of historical narratives. A prominent and oldest local newspaper was used as a backdrop to reconstruct the timeline of events and extract nuances.

Actors and interaction themes: There are nine different categories of actors (organization) examined in this research. They include government-local, state, and national, private in-

Table 3.2: Details of data collected from two field visits, web scraping and content mining

Data type	Collected via	Source	Dimension
Interviews	Semi-Structured interviews (n=95)	Across different sectors include GON* (n=7), GOS (n=25), GOL (n=24), PL (n=3), M (n=6), NP (n=7), A (n=14), EP (n=11).	Interviews involved semi-structured questions to allow narration of the recent history of water risk governance processes and problems faced (Detailed list of interviewees in Annex1).
Newspaper	Daily newspaper microfilms from 1970 to 2015 Web scraped articles with keywords from 2016-2019.	Assam Tribune archives library in Guwahati and Online source from 2016-2019	Microfilms (~175,000 images) were converted into text files. Due to newspaper format, the converted text files are not uniformly consistent, and hence the study was limited to simple keyword search. Web scraped based on keywords: Master plan, Inundation, Flood, water supply.
Hydrological & urban development data	Datasets	Local government offices (Water Resources Department & Pollution Control Department) Local academic researchers (Guwahati University)	-Rainfall per day (1970-2019) -River level at DC court for the monsoon season (May-October) (1979-2018) -River pollution (2003-2018) -Built-up area (Pawe & Sakia 2018) -Water supply statistics (census of India database)
Archive documents	Photograph of archive documents	Assam State Archive department at Guwahati (records available from 1940–1984) Assam State Legislative Assembly Library (2001–2016)	Keyword search included - Bharalu River - Guwahati Development Department - Sewage/Wastewater - Guwahati Municipal Corporation (GMC) - Water supply scheme - Guwahati Metropolitan Development Authority (GMDA) - <i>Gauhati (old spelling Guwahati)</i> - Flood - <i>Pandu</i> (river gauging station) - Water Supply - <i>Master Plan</i> - Master Plan - <i>Deepor Beel/Dipor Bil</i> (wetland) - Brahmaputra - Urban planning - Grant demand - Inundation - Jal Board - Pollution Master Plan for Water Supply, Sewerage, and Drainage 1971. The Guwahati Municipal Corporation Act 1969. Urban Maps: 1970 & 1980
Policy & Research documents	Physical/digital documents & library search	Government websites and offices, Gauhati University archives and Shod Ganga website (Indian online PhD thesis repository)	Policy: Water (Prevention and Control of Pollution) Act, 1974; Guwahati Metropolitan Development Authority Act 1985, Disaster Management Act 2005, etc. Plans: Guwahati Master Plans 1987-2001 & 2006–2025, City development Plan 2015. Government reports: Detail Project Reports of infrastructure proposals. Thesis: Local Master and PhD thesis (Detailed list in Annex 2).

*GON: Government Officials-National, GOS: Government Officials-State, GOL: Government Officials-Local, PL: Politicians, M: Media, NP: NGO personnel, A: Academicians, EP: Entrepreneur/Private Enterprise.

dustry, politicians, international Civil Society Organizations (CSO), local CSO, judiciary and academia. The actor information and interaction were extracted through two avenues, first, from water risk-related articles from the oldest and most prominent local daily newspaper (Assam Tribune) over 50 years to obtain a robust data set (details of extraction processes in Chapter 5, Figure 5.9). Second, the current governance themes and actors included were also cross-examined against semi-structured interviews (Questionnaire in appendix 8.3). Themes of actor interaction are coded based on recurrences, such as infrastructure, funding grants and challenges, complaints from citizens (Details in table 5.4 in Chapter 5).

Water risk and urban changes: Mapping water risk changes was done using multiple data sets triangulation. Changes in floods via daily rainfall, river level (at DC court station), and flood events extracted from news data. For water supply changes, statistics on urban water are used from the census. River pollution changes were obtained from the pollution control board. Maps of urban and river changes (Chapter 4 Figure 4.4) were built with multiple layers of data, used with permission from Pawe et al., 2018 and old maps from archives, google maps and open street view.

3.3 Research Limitations

3.3.1 Fieldwork challenges

Every fieldwork contains challenges. Despite the privilege of researching a context that I was familiar with, there were still several challenges in getting access to information and interviews. The first among them began when I saw a series of dusty untouched shelves filled with policy briefs, reports, and urban plans that I was not allowed to access. Data meant to be digitally available faced similar neglect, lost in hidden folders, or erased when people in positions changed. Further, in some instances, there was also an expectation of compensation for delivering information that resulted in the delay or lack of access when not provided.

Further, obtaining a historical data set was a significant challenge. Digitization of government

records in the Northeast has been at a relatively slower pace than in other regions in India. For example, the governmental operations in Guwahati were digitized around 2009. Even then, paperwork still forms a large part of the bureaucracy, thus limiting what can be accessed by a researcher. In addition, the state archives store data only from 1950s–1980s.

In addition to people and data, many physical factors narrowed down the available working days and increased uncertainty even before COVID-19. Assam is known for a generally relaxed attitude towards work, which translates into a high number of official and unofficial holidays. Further, the officials required for interviews were often absent from their posts due to other duties such as election monitoring or participation (local/rural/state/national). The city comes to a standstill during the monsoon months (June–September). The region has regular political strikes (*bandhs*) that shut down transportation and public offices. There was a significant political agitation (Citizen Amendment Act) with violent outbreaks where the whole state was officially shut down (November 2019–January 2020). To get approximately 15 working days, I spent more than two and half months in the city.

3.3.2 Methodological Limitations

Because urban water risks are complex and have multiple facets, therefore, any exploration, at best, remains a partial foray (Geyer et al., 2015). The methods outlined involve the triangulation of multiple types of data and inferences. This approach, while robust, has a few limitations.

The first limitation is that these multiple data sources only capture the well-known governance trends and perceived responsible actors, thus missing out on insights from those most vulnerable to water risks. Building a representation from those most impacted, such as communities living in informal settlements in low lying areas and flood plains, will require further in-depth exploration. Such an in-depth exploration of the concurrent evolving impacts of governance trends on those most vulnerable to water risks will benefit from ethnographic stories and recollections of adaptation strategies to cope with water risk. Such an exploration can contribute

a nuanced and context-specific understanding of the existing coping mechanisms and insight into areas where coping mechanisms are not enough, and external interventions or support are required. These locally sourced insights can add detail to governance plans and policy (Eriksen et al., 2021).

The second limitation is that the historical descriptions involved many minor events, thus leading to a tediously long narrative. Many of these incidents had to be removed when summarizing research insights. Risk and decision-making are complex processes involving many inputs, even these tiny events have impacts (Ziervogel et al., 2016). Creating a compelling story line within research required sacrificing many little bits of insight and data noise (Hollway, 2021). While removed from the manuscript, these little details have been shifted to the Appendix [8.2](#), [8.3](#).

The third limitation includes researcher bias. I conducted the coding of the literature in discussion with my supervisor. Despite maintaining objectivity through predefined rules for coding and drawing inference, there are many chances for individual bias to enter into the research (Marsh et al., 2010). Therefore, I have drawn research boundaries and rules by which the data was coded to address and mitigate this bias. Further, I also outlined all the steps taken to make visible inherent bias (if any) in each action taken rather than a black-box approach to delivering results. This detailed outlining may have resulted in lengthy descriptions of the methods and research boundaries but will serve to maintain reproducibility and rigour.

3.3.3 Concepts Excluded

Integrated systems theory include many concepts, not all were used in this research. Each concept (e.g., path dependence, critical juncture, trust) used in this research is based on the question and context being explored. Some concepts of [MLP](#) and [HI](#) that were not explicitly involved in this research some include emergence, far-from-equilibrium, technical or infrastructure transitions and tipping points (North, 1990; Octavianti et al., 2018; Roberts et al., 2019).

Within network governance (paper 2), the research boundary consisted of a first step toward outlining the actor interactions over time. Therefore, I did not go deeper into multi-scalar networks, risk hypothesis, knowledge flows, bridging and bonding structures, regression models, alter and ego effects (Berardo et al., 2016; Ö. Bodin et al., 2020; Bodin et al., 2019; Siciliano et al., 2021). Nevertheless, these concepts are applicable as the next steps in the research questions to be explored in the future.

3.4 Research Ethics and Funding

Research ethics and approvals were followed for the fieldwork. The CUREC approval number is AC-2019-CW-283. All those interviewed (> 90 individuals reference list in Appendix 8.2) for this research were professionals and above 18 years of age. The interviews did not include vulnerable or “at risk” individuals. The interviewees belonged to the following categories: government officials, academics, media personnel, private entrepreneurs, and NGOs in Guwahati and Delhi.

Formal procedures and consent for information collection and use were followed within the research. The interviewees were informed of the purpose of the study and how the data will be used. Further, each interviewee was given a printed research information sheet which included the details of the research. Each interviewee was also given a consent form with information on recourse actions in case they were unwilling for the data to be used after the interview. They were given the choice between providing an oral or written consent. The choice for oral consent was included because some government officials, due to their official status, are not allowed to sign external documents. Further, some street-level officials did not want to give signed consent due to fear of reprimand when information is shared. The choice of oral consent, with information about how anonymity will occur, was provided to both high and street-level professionals.

There were some personally identifiable data collected such as audio recordings, written notes,

and transcribed documents from the interviews. After transcription was complete, everyone's identity was anonymous. Anonymous codes for individuals were used as follows: government officials from respective departments at local/state/national scale (GO Dept Scale x); NGO personnel (NPx); Media (Mx); Entrepreneurs/Private vendors (EPx); Academics (Ax); Others (Ox).

Further, official permission from the head of the respective offices was also sought when collecting data from institutions such as Assam Legislative Assembly, Assam Archives, Gauhati University Library, etc. Some institutions such as the Assam Legislative Assembly and Assam Archives requested for a copy of the thesis to be deposited within their library in exchange for access to their archive contents. This request will be complied with once the thesis is complete.

The data gathered will be stored for three years after the research is complete on an encrypted hard drive. The pre-anonymized and anonymized data will be stored on an encrypted hard disk. It will be retained for future reference based on prior consent. Anonymized codes for individuals will be used within all research analysis. While the research is ongoing the data will be stored on password protected laptop and backed up on an encrypted hard drive. The data will also be stored on the online backup service provided by University of Oxford until my DPhil is completed.

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3.5 Covid-19 Impact

COVID-19 impacted my final fieldwork and the time available to effectively carry out research. The third and final fieldwork (planned for August–September 2020) was cancelled due to COVID-19. This last fieldwork was part of an ongoing process to involve local stakeholders in Guwahati to co-produce knowledge on possible strategies to mitigate water risks based. I had planned to build a Bayesian Network Model to create future water risk and governance projections followed by consultation on what future trajectories were feasible and which ones would result in sub-optimal outcomes. Initially I planned to convert this workshop to a virtual session. However, the second COVID-19 wave in India had caused several casualties and I did not deem it appropriate to ask the stakeholders to participate in a virtual program during such difficult times. Therefore, I shifted my research focus for the last paper.

The research plan for the last part evolved into a media analysis of water risks and the influence on decision making processes. The chapter six (Paper 3) was adjusted to accommodate these changes as I shifted my research focus to the existing data I had collected and assessed media influence on decision making. This research provided valuable insight into the inner workings on how specific ideas get selected as risk mitigation strategies.

Other COVID-19 impacts included getting sick myself which morphed into chronic allergies eventually. Further, there was also a constant worry and stress as my parents and close friends went through traumatic periods of dealing with the Delta variant and other aspects of COVID in India. During this ongoing worry, I also had an accident while riding my bicycle. I was hit by a car door which resulted in a fractured arm and consequently delays in submission processes. A close friend of mine gave birth to her second child during the first wave of COVID lockdown. Since her family could travel to help, I supported the child care during these difficult times.

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CHAPTER 4: Paper 1

CHAPTER 4

Paper 1

A tug of war between centralization vs decentralization: The co-evolution of urban governance and water risks in Guwahati, India

An edited version of this chapter has been submitted to Environmental Research Communications, special issues – Early Career Researchers: Environmental Science in South and Southeast Asia.

Fanaian, S., Fanaian, F., 'A tug of war between centralization vs decentralization: The co-evolution of urban governance and water risks in Guwahati, India'.

Abstract

Intermediate cities (small and medium-sized cities) in Asia and Africa house more than 60 percent of the world's urban population. However, most research attention is given to larger cities, leaving knowledge gaps about the changing water risks and socio-political trends in intermediate cities. Therefore, this study aims to examine the socio-political responses to the water risks in intermediate cities and how they have co-evolved. The case of Guwahati is studied as an example of such a growing riverine city situated on the banks of the Brahmaputra River in the Northeast of India. The risks studied are based on the connection between the city and the river, i.e., inadequate water supply, urban floods, and river pollution. The shifts in the socio-political structures for these risks are assessed by combining historical institutionalism with multi-level perspective theory. The results show a growing decentralization through diversity of actors involved in addressing water risks. However, there are also clear centres of decision making that are gradually shifting away from the local to the national contributing to a centralized governance structure. However, when differences arise between the local and national, local actors circumnavigate nationally dictated mandates to fit local needs. Counter to the growing recommendations for decentralization for effective governance in cities, our findings show a trend of increasing centralization in decision-making.

4.1 Introduction

Medium and small-sized, 'intermediate' cities in Asia and Africa house more than 60 percent of the world's urban population (UNDESA, 2019), but there is limited insight on how these cities govern and cope with risks (Birkmann et al., 2016; Nagendra et al., 2018). Further, due to the emphasis on large cities, many assumptions about institutions and infrastructure do not necessarily match the governance involved in mitigating and managing urban risks for intermediate cities (Beck, 2015; Birkmann et al., 2016; Véron, 2010). Urban water risks (such as floods, water supply issues, river pollution, and more) in cities are often assessed in isolation within defined institutional, political, sectoral, or social boundaries (Hoekstra et al., 2018; Molle, 2009; Mollinga et al., 2007). These separations lead to a mismatch between research

and the reality of water risk governance (Bakker, 2012; Finewood et al., 2015). To address this challenge, we integrate physical risks and socio-political processes to map the transitions in governance of water-related risks in an intermediate urban context in the Global South through the case of Guwahati, India.

This research seeks to identify trends over time in urban water risk governance and the implications they hold for understanding present-day practices. We do so by assessing drivers of institutional and policy transitions coupled with changes in water risk. The context explored is Guwahati city (formerly Gauhati) in the Northeast of India, and the Brahmaputra River. While Guwahati is the largest city in Northeast India and on the Brahmaputra River Basin, it is classed as an intermediate (second tier) city in India, due to its relative population size (Hemani et al., 2016). Guwahati is one among the many intermediate cities of the Global South whose positioning is viewed as smaller (or inferior) variation to the norm of “proper” large city the global North. This perception of variation from the norm is significant as it impacts various governance processes all the way from funding to governance capacities (Cook, 2018). These trends are prevalent in Guwahati in the governance of urban-riverine physical risk i.e., river pollution, inadequate water supply, and urban floods. Water-related risks selected because they are responsible majority of damages, for example, the local river Bharalu in Guwahati is among the top ten polluted rivers in India (CPCB, 2013).

We unpack the changes in physical risks and drivers of institutional and policy change through the following question: How has governance in Guwahati co-evolved alongside its water risks? This question is assessed via two lines of enquiry:

- How do institutional structures and policy regimes associated with governing the water risks change overtime in Guwahati?
- What are the drivers of institutional and policy change? What are the implications of these drivers of changes in managing future water risks?

This paper addresses these questions through a socio-politically situated framework that combines multi-level perspective theory and historical institutionalism. We apply this mixed methods approach via process tracing by connecting multiple data sources detailed in section 4.3, and an analysis of the water risks and governance processes is outlined through a timeline in section 4.3. The key outcomes from this analysis are discussed within section 4.5 and concluded via section 4.6.

4.2 Conceptual Framework

We define governance to include all persons and groups trying to influence decision-making and actions taken towards policy outcomes (Berardo et al., 2019; Chaffin et al., 2016; Garrick et al., 2016; Ostrom, 2015). Although often conceptualized in research as a snapshot of a specific period, governance is not static (Lele et al., 2018). Important insights can be gained on urban risk governance by exploring the connection between social and physical interaction across time (Evenden, 2018; Geyer et al., 2015). Further, we conceptualize risk as those “potentially catastrophic, manufactured uncertainties that are socially constructed, socio technically contested, and socio politically criticized across institutional and discursive dynamics” (Fischer, 2019, p. 1434).

Governance of risks often involves diverse stakeholders, such that, even within the most hierarchical regions, a [polycentric](#) system of interaction is seen (Jones et al., 2016). Polycentric governance refers to those regions where multiple governing authorities work together across different levels and scales, rather than a single dictating authority (Ostrom, 2010b). Such diverse interactions, however, become complex due to multiple interdependencies thus requires a framework that is able to capture all the different levels of physical risks and social interactions over time (Cairney, 2012; Edelenbos et al., 2015). Therefore the framework selected for this research is Multi-Level Perspective and Historical Institutionalism which collectively include insights from socio-technical studies and public policy. The theory and its application are outlined in the following sections.

4.2.1 Combining Multi-Level Perspective and Historical Institutionalism

Transitions in governance occur over time and at different levels involving a combination of social, political, and technical aspects. The multi-level perspective (MLP) theory captures various interactions across different levels and provides a 'big picture' of water risks and their impacts. Though often used to structure socio-technical insights, there are extended applications of this theory within socio-political contexts (Geels, 2005; Nastar, 2014; Yasmin et al., 2018). However, MLP on its own has been critiqued as apolitical (Voß et al., 2011) and overlooking the horizontal and temporal dimensions that impact social change (Bai et al., 2009; Westman et al., 2019). Therefore, there is a call for the inclusion of agency and political insight (Roberts et al., 2019; Voß et al., 2011).

Historical Institutionalism (HI) is research tradition that uses a socio-political lens to gain insights into the origin and progressive transformation of institutions (Fioretos et al., 2016). HI allows granular analysis of the ongoing interactions occurring within a particular period and across periods as governance evolves (Fioretos et al., 2016; Roberts et al., 2019; Thelen, 1999). However, HI is often narrowed down to a dualism to describe change, but change is more fluid. This dualism is seen in how governance shifts are defined either as states of stability and instability, where change based on institutional structure and agents, between endogenous and exogenous actors. Further, change is dependant on critical junctures, path dependencies and rule bound dynamics of agents (Bell et al., 2021). While HI seeks to capture all the discursive aspects involved in change, the interpretation falls within a binary explanation (Pilon, 2021). This approach constrains other ongoing influences on institutional change that are constantly shifting over time (Bell et al., 2021).

HI due to its discursive and diagnostic approach has an epistemology that is complementary to MLP (Roberts et al., 2019). Therefore, combining MLP with HI provides a comprehensive framework to study evolution at various levels, including external and internal influences, along with a range of social, environmental an political changes to identify conditions and

patterns of change (Roberts et al., 2019) (Figure 4.1). The combination of MLP and HI allows integrated insights into the transition patterns as water risks and their governance co-evolve for an intermediate riverine city in the Global South. Such a framework can also be applied to other explorations of governance processes.

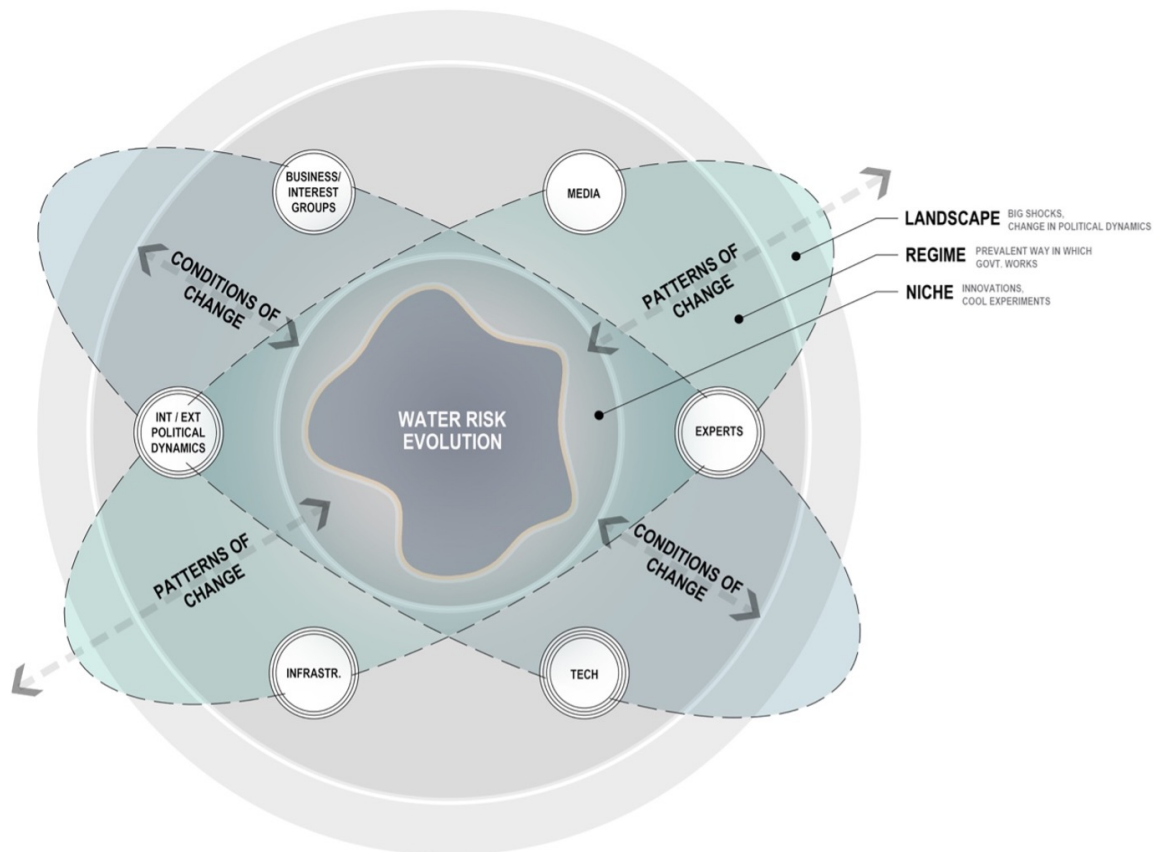


Figure 4.1: The conceptual diagram depicts a combined HI and MLP for evolution of water risks and their governance. The grey concentric circles represent landscape, regime, and niche. The ellipsoids depict ‘conditions of change’ constituting either sudden or gradual change of the regime, and ‘patterns of change’ that are either crisis or coalition driven occurring across landscape, regime, and niche that push change. The various category of actors (smaller white circles) are like atoms, constantly moving and can impact water risk governance all throughout (Diagram made by authors, inspired by Roberts et al., 2019, Fowler 2013).

4.2.1.1 How does a combined MLP and HI framework work?

MLP provides this research with a systematic exploration of governance processes arranged into layers of ‘landscapes’, ‘regimes’, and ‘niches’ (Geels, 2002, 2005) (Figure 4.1). ‘Landscape’ includes broader events or trends with the potential to exert pressure and change policy regimes. Landscape, for example, can include political trends (e.g., political coalitions, elections, corruption scandals), major climatic events (e.g., floods, earthquakes, droughts), societal and economic trends (e.g., stock market crash, civil unrest) to name a few. ‘Regimes’, or policy regimes represent the accepted governance norms or rules of engagement. Regimes usually tend to stay stable but not stationary, meaning they can change gradually (although sudden changes can occur in rare instances). ‘Niches’ are innovations, ideas or experiments, either local or external, that have the potential to create new norms and change the regime (Geels, 2002; Voß et al., 2011; Yasmin et al., 2018). This categorization provides attention and inclusion of all the various nuances that can impact changes in governance.

One example of such change is the water supply system of The Netherlands in the 1870s. A combination of landscape events, such as media pressure, a health crisis, industrialization and rise in spending power, propelled the previous niche innovation of piped water supply and sanitation to become a norm. This new norm changed the regime from dispersed water source and open sewers to a piped water supply and closed sanitation system (Geels, 2005).

From HI we utilize conceptual arrangement of path dependency, actor agency, and policy feedback to understand transitions between and within the multiple levels (i.e., local, regional, national, and international). Path dependence refers to future decisions depending on path decisions due to lock-in created by existing infrastructures, including physical, social, or behavioral (Fioretos et al., 2016; Pierson, 2000; Thelen, 1999). Path dependency also contributes to feedback loops, which can be positive and strengthen a policy regime, or negative and weaken or change a policy regime (Fioretos et al., 2016; Weaver, 2010).

Combining HI and MLP allows us to map the patterns and conditions of change (Figure 4.1).

Identifying patterns of change allow us to uncover trends that recurring repeatedly, and condition of change allow us to know when these patterns are perpetuated. While physical changes in water risks can be modeled and estimated, it is challenging to capture or predict changes in socio-political systems (Cairney, 2012; Rayner et al., 2005). What can be defined, however, are patterns of change that emerge out of the interaction of actors, institutions, and physical risks (Berardo et al., 2019; Cairney, 2012). The patterns of change are identified within the policy regimes when there is sufficient support for a particular change. The factors and actors involved in influencing policy change are diverse. These influences range from politicians, private enterprises, academicians, media, technological advancements, infrastructure and more (Berardo et al., 2019; Roberts et al., 2019).

Governance transitions are often slow and occur through gradual changes involving interest groups or coalitions overtime. This is because deviation from the norm in policy-making carries threats of undefined implications and new path dependencies (Rayner et al., 2005). When the stakes are high, most policymakers are risk-averse and have resistance towards transitions (Pahl-Wostl, 2017; Roberts et al., 2019). Sudden shocks to the system such as political change or disasters can cause quick transitions, but this is rare (Berardo et al., 2016; Nohrstedt et al., 2021; Weaver, 2010). While the MLP and HI framework originates from roots outside of urban and water governance literature, it serves to provide insight and structure for this research (Lockwood et al., 2017; Roberts et al., 2019). This combination keeps the research from being apolitical, includes the relevant risks, and allows a context-driven mixed-method study suitable to assess cities in the Global South.

4.3 Methods

Building an integrated understanding as required by the MLP and HI framework is an information-intensive process. Here below we outline the data collection process and methods used in this research.

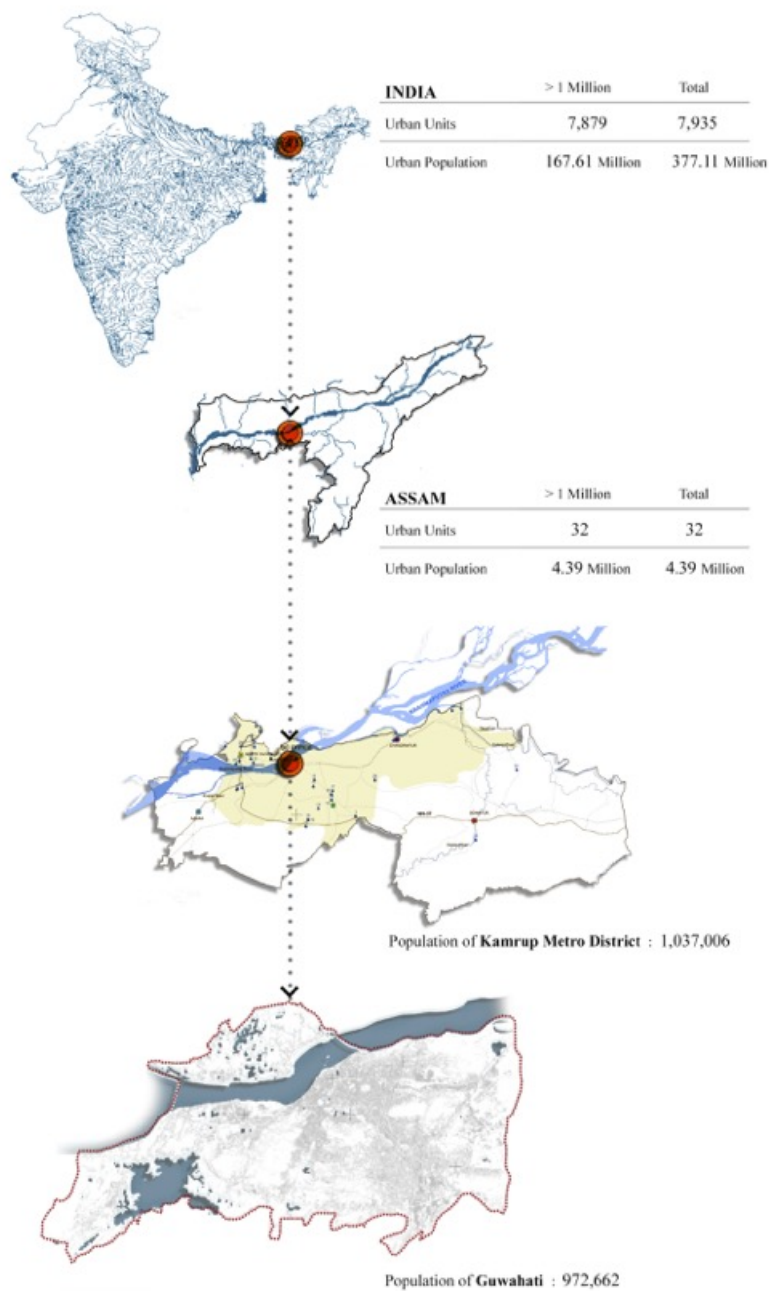


Figure 4.2: Location of Guwahati and Brahmaputra River (population statistics: Census of India 2011)

4.3.1 Guwahati and its Rivers, Assam, India.

Guwahati is the capital of the North-eastern state of Assam and the largest city on the Brahmaputra River. Among Indian cities, Guwahati is one of the many fast-growing, intermediate-

sized riverine cities (Hemani et al., 2016).

Focusing on Guwahati allows a specific assessment of the governance impacts of a city on the river and vice versa within a growing urban context. Further, the city has experienced multiple crises ranging from disruptive floods to violent curfews and lock downs. These cycles of crises allow examination of co-evolution of risks and institutional responses. Due to this interplay between the river and the city, additional river-related actors are also involved in governing the emergent urban water risks.

The history of Guwahati dates back roughly to the 16th–17th centuries (Alam et al., 2001; Phukan et al., 2012). The city is situated within the Brahmaputra Valley, interspersed with local rivers (Bahini, Mora Bharalu, Bharalu, Bhasistha, and Lakhmijan) and wetlands of importance such as Dipor Beel among others (Alam et al., 2001; Chakraborty et al., 2016).

The intersection of rivers, wetlands, and a growing urban population give rise to water risks such as urban floods, river pollution and water supply inadequacies. Our study, therefore, assesses water risks and the drivers impacting governance beginning from 1970. 1970 is selected as the starting date because Guwahati was selected as the capital of Assam between 1970–1974. The capital status of Guwahati gave rise to a spate of investments for water-related infrastructure and institutional change (Alam et al., 2001).

4.3.2 Data Sources

It is difficult to get access to longitudinal governance related data sets in intermediate cities of the Global South (Nagendra et al., 2018). To offset this challenge a patchwork of various data was collected to supplement and triangulate information. Historical and contemporary data from 1970–2019 was collected from a range of sources, including archived documents, interviews, newspaper data sets (Assam Tribune 1970–2019), academic research, and journal articles (details in Appendix 8.2).

More than 95 individuals were interviewed via the snowball sampling method (Appendix 8.2).

Table 4.1: Details of data collected from two field visits, web scraping and content mining

Data type	Collected via	Source	Dimension
Interviews	Semi-Structured interviews (n=95)	Across different sectors include GON* (n=7), GOS (n=25), GOL (n=24), PL (n=3), M (n=6), NP (n=7), A (n=14), EP (n=11).	Interviews involved semi-structured questions to allow narration of the recent history of water risk governance processes and problems faced (Detailed list of interviewees in Annex1).
Newspaper	Daily newspaper microfilms from 1970 to 2015 Web scraped articles with keywords from 2016-2019.	Assam Tribune archives library in Guwahati and Online source from 2016-2019	Microfilms (~175,000 images) were converted into text files. Due to newspaper format, the converted text files are not uniformly consistent, and hence the study was limited to simple keyword search. Web scraped based on keywords: Master plan, Inundation, Flood, water supply.
Hydrological & urban development data	Datasets	Local government offices (Water Resources Department & Pollution Control Department) Local academic researchers (Guwahati University)	-Rainfall per day (1970-2019) -River level at DC court for the monsoon season (May-October) (1979-2018) -River pollution (2003-2018) -Built-up area (Pawe & Sakia 2018) -Water supply statistics (census of India database)
Archive documents	Photograph of archive documents	Assam State Archive department at Guwahati (records available from 1940–1984) Assam State Legislative Assembly Library (2001–2016)	Keyword search included <ul style="list-style-type: none"> - Bharalu River - Sewage/Wastewater - Water supply scheme - <i>Gauhati (old spelling Guwahati)</i> - Flood - Water Supply - Master Plan - Brahmaputra - Grant demand - Jal Board - Pollution - Guwahati Development Department - Guwahati Municipal Corporation (GMC) - Guwahati Metropolitan Development Authority (GMDA) - <i>Pandu</i> (river gauging station) - <i>Deepor Beel/Dipor Bil</i> (wetland) - Urban planning - Inundation
Policy & Research documents	Physical/digital documents & library search	Government websites and offices, Gauhati University archives and Shod Ganga website (Indian online PhD thesis repository)	Policy: Water (Prevention and Control of Pollution) Act, 1974; Guwahati Metropolitan Development Authority Act 1985, Disaster Management Act 2005, etc. Plans: Guwahati Master Plans 1987-2001 & 2006–2025, City development Plan 2015. Government reports: Detail Project Reports of infrastructure proposals. Thesis: Local Master and PhD thesis (Detailed list in Annex 2).

*GON: Government Officials-National, GOS: Government Officials-State, GOL: Government Officials-Local, PL: Politicians, M: Media, NP: NGO personnel, A: Academicians, EP: Entrepreneur/Private Enterprise.

To avoid selection bias in snowball sampling, interviewees were selected from a diverse pool of initial participants (Kirchherr et al., 2018) that included national, state, and local governments, academics, NGOs, private agencies, media, and politicians (current and ex-ministers). The interviews included open-ended questions including involvement in water risks and their governance; perceptions on how water risks have changed; concerns; changes in priority over time; mitigation measures employed; the connection between the city and its rivers; challenges in mitigating water risk; institutional performance; and what is required to improve and better address water risks. Out of the 95 interviewed, ten recalled incidents over the past 10–15 years and remaining shared contemporary narratives for the subsequent 5–10 years. The interviews were conducted during fieldwork in September–December 2018 and August–October 2019. Between these two visits, many government officials changed positions, hence these interviews were carried out anew for the same posts.

4.3.3 Method Applied: Process Tracing

We employed a type of processing called historical explanation, which provides detailed descriptions of internal and external impacts sequenced over time in order to expand theory (Trampusch et al., 2016). We follow a two-stage assessment. The first stage adopts a chronological listing (Octavianti et al., 2018; Smith, 2004) of different water risk events, their related policy interventions, and institutional and political party changes. This chronology allows an identification of eras based on dominant and repeated themes. These eras include:

- 1970–1980 Political reforms era
- 1981–2000 Economic and institutional reforms era
- 2001–2014 Guwahati urban reforms and modernization era
- 2015–2018 Smart city era

The second stage creates a descriptive report for each era (Collier, 2011). Descriptions aid in a

diagnostic identification of conditions and patterns that influences transitions (Collier, 2011; Siddiki et al., 2019; Smith, 2004). Newspaper content is used to triangulate information and flesh out missing information (e.g., scandals or complaints) (Barbehön et al., 2016; Leetaru, 2013). Each description follows three parts:

1. Key actors involved
2. Policy developments
3. Pressures and impacts

These detailed risk descriptions allow mapping of the pressures that exert influence and the points at which the influence occurs (Roberts et al., 2019; Yasmin et al., 2018).

4.4 Results: Transitions in Water Risks and their Governance

4.4.1 Era of Political rReforms 1970–1980

This period reflects the challenges in establishing governance structures and processes as a new city emerges. It includes regional agitations and civil unrest that were demonstrated in Guwahati. The norm or regime of this era was instability and delay. The niche included ideas sourced from experiments in other large cities (e.g., Delhi, Mumbai).

4.4.1.1 Key Actors Involved

The main actor in this phase was the Government of Assam (GoA). The national government, international aid agencies, such as the Ford Foundation and the United National Environment Program, also played a role in shaping urban growth. The media played a role in bringing citizens' concerns to the forefront.

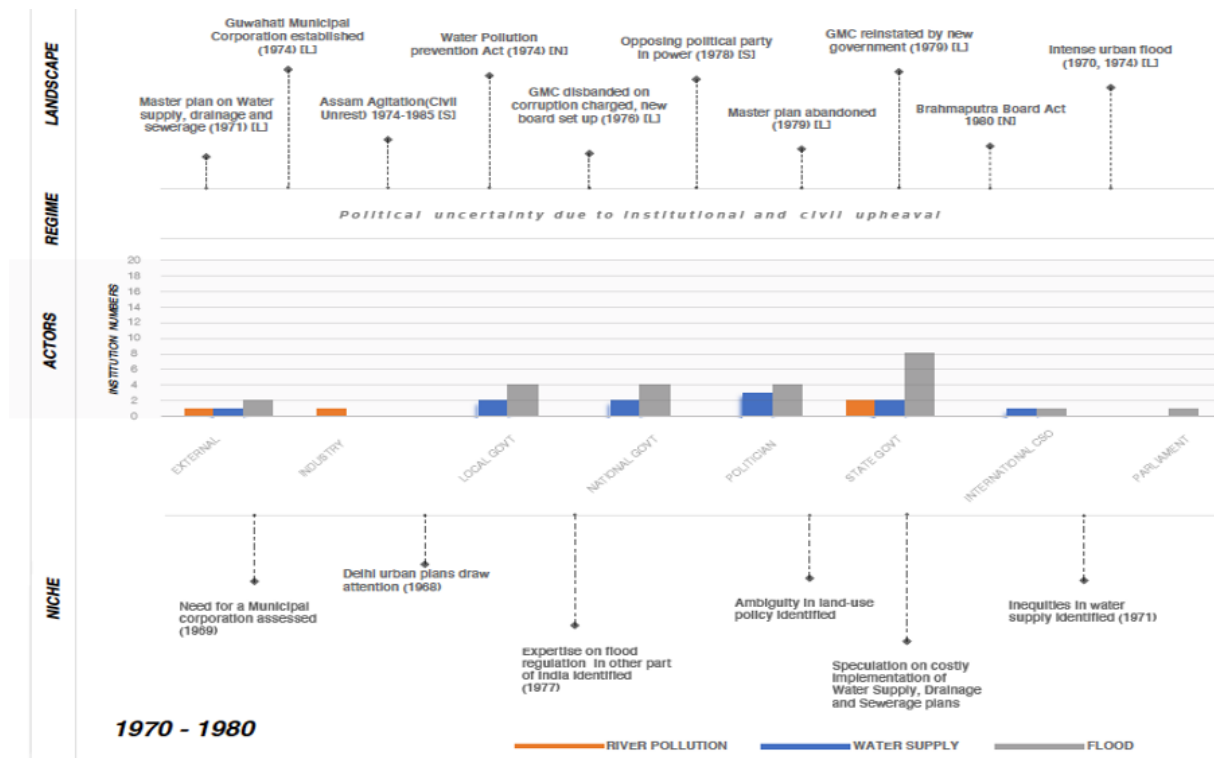


Figure 4.3: Processes and institutional actors involved between 1970–1980. L=local level; S = state or regional level; N= national level and I= International level. Actors are listed by categories (detailed list of actors and programs in 8.3)

4.4.1.2 Policy and Political Developments

After a three-year deliberation Guwahati was made the capital of Assam by the Legislative Assembly of Assam in 1974, thus bringing in political attention and investments. The Guwahati Municipal Corporation Act was drafted in 1969 and established as Gauhati Municipal Corporation (GMC) in 1974 (Alam et al., 2001).

A priority concern of policymakers was developing a drainage (flood control) and sewerage plans for Guwahati (CMPO, 1971; Sarma, 1988). For this plan, Government of Assam (GoA) approached the Ford Foundation, who recommended the Calcutta Metropolitan Planning Organization (CMPO) to create a master plan for sewerage, and drainage. Water supply infrastructure was an afterthought and added towards the end of this plan. The master plan was estimated to cost 290 million INR (36 million USD\$ in 1971) and was considered expensive

for its time (Alam et al., 2001; CMPO, 1971). An Assam State Pollution Control Board (1975) was constituted as an autonomous statutory organization in Water (Prevention and Control of Pollution) Act 1974 introduced by the Ministry of Environment and Forests, Government of India.

4.4.1.3 Pressures and impacts

In efforts to decrease congestion from large cities (e.g., Bombay, Calcutta, Madras), the 4th five-year plan of the national government of India included loans to states for urban development programs (Sivaramakrishnan, 2011). GoA capitalized on these loans for the urban development of Guwahati (Government of Assam, 1966, fol. TCP-228/66). However, the Assam Movement or Assam Agitation to retain an Assamese majority and culture, began in early 1947 and was wide-spread by 1979 (Alam et al., 2001; Weiner, 1983). This movement sparked regular civil unrest/curfews in Guwahati thus diverting institutional attention from service provision to maintaining law and order (Alam et al., 2001).

The ongoing instability and lack of infrastructure plan implementation (i.e. water supply, drainage, and sewage) were attributed to multiple reasons. At the foremost this included suspension of GMC due to corruption charges (Assam Tribune, n.d., August 26, 1975 p.1). There was also a reported lack of coordinated and dedicated body to implement the urban development plan (Alam et al., 2001). The perceived costs for implementation of the Master plan were considered very high (1971–2001). Even though water supply (43 million liters per day (MLD)) was enough to provide the city's needs, due to "inequities in water supply" (CMPO, 1971, p. 62) access was limited to only 10–20 percent of the population. Further, a change in the ruling political party in June 1978, led to rejection of the previous plans and removing GMC's suspension (Assam Tribune, n.d., August 23, 1980 p.4; GoA, 1979, fol. MA 17/79).

Four urban flood episodes of varying intensity occurred between 1970-1980 impacting policy outcomes (Figure 3 and 6). These floods were big enough to draw political attention and budgetary allocations in their aftermath. Further phrases in the news around causes of urban flood

included: encroachment of wetlands and rivers; lack of clear land allocation policies (Alam et al., 2001); high rainfall draining into Guwahati from the surrounding hilly regions; swelling of the Brahmaputra river and local rivers creating a backflow of water into the city; lack of urban planning, changes in drainage patterns of rivers (Figure 4.4); and faulty urban designs (Assam Tribune, n.d., July 22, 1980 p.1).

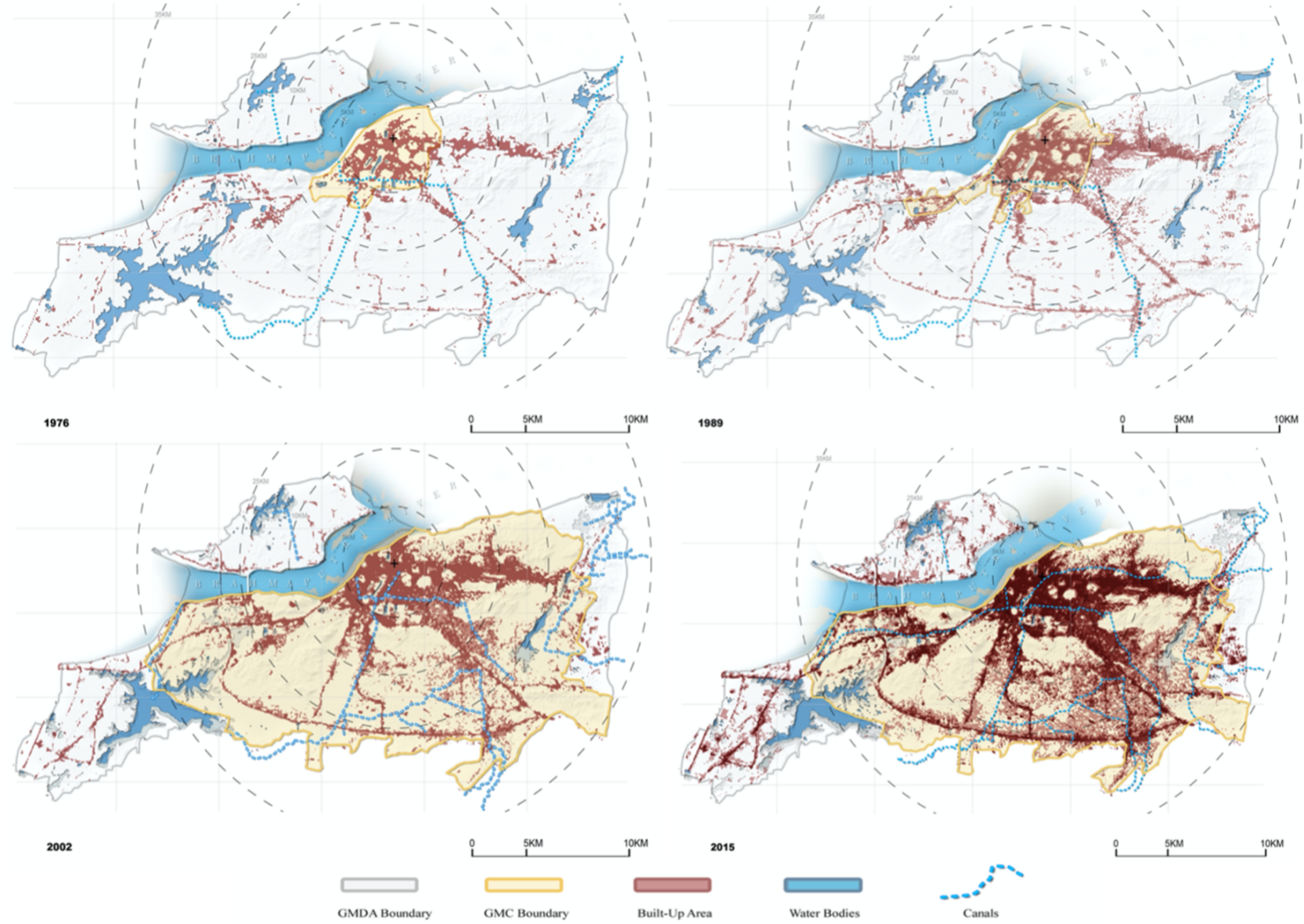


Figure 4.4: Urban growth across 1976, 1989, 2002, 2015. Visualizes changes in boundary of the city, wetlands and local rivers (canals) (Data: Pawe and Saika 2018, Master Plans: 1971–2001, 1987–2001, 2009–2025, Open Street Maps, Google Earth)

4.4.2 Era of Economic Reforms 1981–2000

This era is characterized by the creation of water infrastructure, implementation of new plans, devolvement of responsibilities to Urban Local Bodies (ULB), and an increase in specialized institutions. The norm of this era was strengthening of water supply institution and infrastructure. Involvement of private enterprise was a niche idea that was gaining traction for water supply within the government domain.

The main actors included the national government, state government and media. Despite devolvement of powers to ULB, the state played still played a substantial role in local decision making. The new specialized institutions led to the creation of new coordinating institutions. The Guwahati Municipal Corporation (local), Public Health and Engineering Department (state) and Town and Country Planning department (state) were all involved in implementing the water supply schemes.

4.4.2.1 Policy and Political Developments

The 74th Constitutional Amendment Act (74thCAA) of 1992, provided institutional, fiscal, and financial reforms aimed at strengthening and giving autonomy to ULB. However, most state and national governments still had control over the revenue streams and therefore continued to influence decisions around urban growth (Sivaramakrishnan, 2011). This trend was also observed for Guwahati.

A niche idea drawn from large cities was creation of separate organizations to administer to the needs of the city, such as, urban water boards and urban development authorities. This niche was driven towards actualization by local political coalitions. The Assam Urban Water Supply and Sewerage Board Act 1985 (AUWSSB) and the Guwahati Municipal Development Authority Act 1989 (GMDA) were both introduced as bills in 1985 (Assam Tribune, July 13, 1985 p.1). and established as institution in 1988 and 1992 respectively to execute water supply and urban master plans accordingly. It was the 74th CCA provided a structural leverage to create the new ULBs for Guwahati. However, these ULBs were not autonomous and eventually

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regulated by state created Guwahati Development Department (GDD) that was set up in 1994 via an order of the Governor (Order No. 46/93/22) to enable coordination between all the ULBs for Guwahati (details of institutions and policies in Appendix 8.2).

To address the ambiguity in land-use and ownership, Assam Land Policy (1989) was drafted. However, the policy had a loophole that enabled purchase of land from squatters who have encroached on wetlands and hills for more than 15 years (Alam et al., 2001, p. 41). Rejecting the previous CMPO plan, a new master plan (1985–2001) was created and expected to resolve flooding in Guwahati.

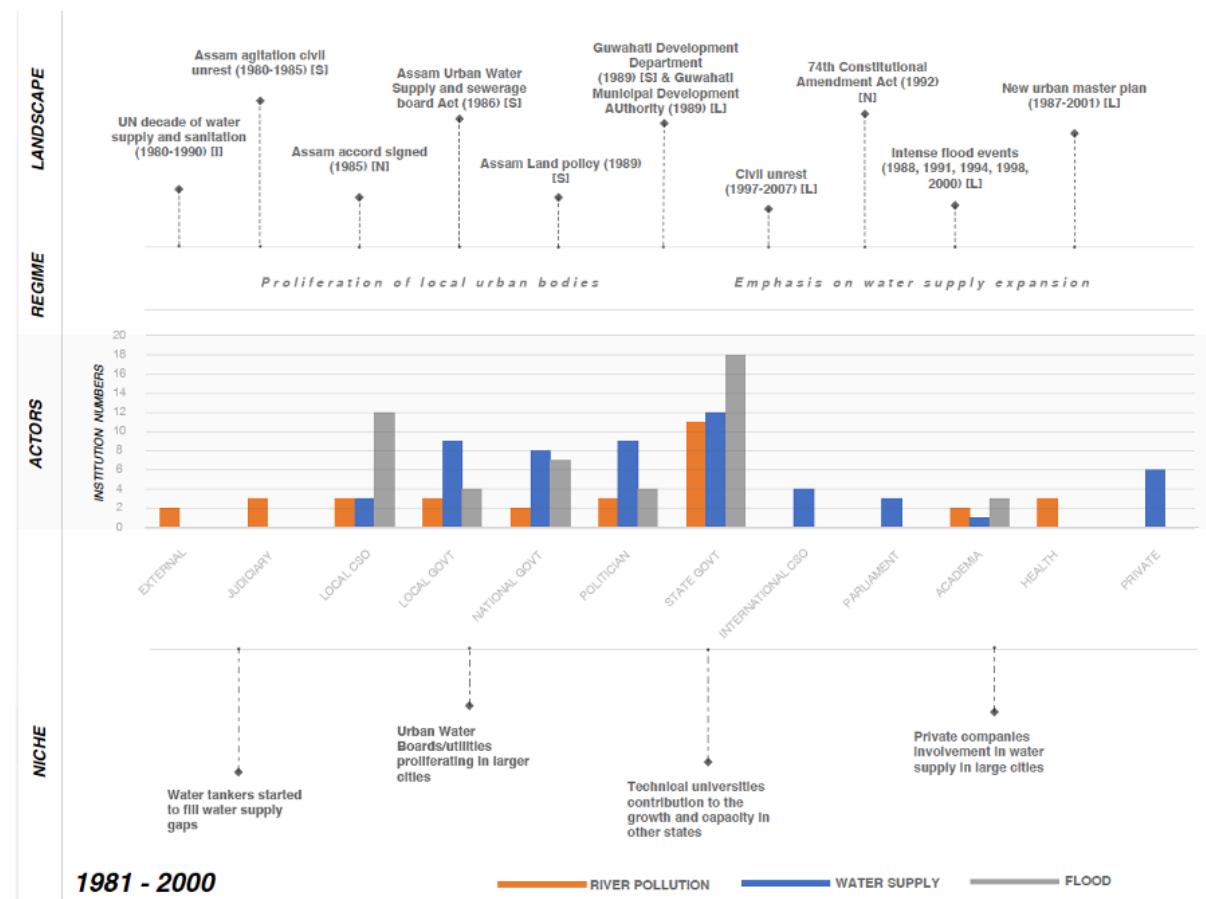


Figure 4.5: Processes and institutional actors involved between 1981-2000. L=local level; S = state or regional level; N= national level and I= International level)

4.4.2.2 Pressures and impacts

India was a signatory to the UN International Drinking Water Supply and Sanitation Decade. As a signatory, investment support for water supply and sanitation in the urban region were more than doubled (Planning Commission of India, 1980). The scheme's national five-year plans had a targeted focus on urban development ranging from provision and services for urban poor to specific allocations for small and medium towns (Planning Commission of India, 1980; Sivaramakrishnan, 2011). These two pressures, along with a change in the structure of grants provided to Northeast Region (90percent national government and 10percent locally raised), resulted in more than INR 200 million (\$1=INR42 in 1998) allocated towards the construction of water supply schemes for Guwahati. This investment sought to address the gap in water demand in Guwahati (from 79MLD to 165MLD) (Alam et al., 2001, p. 65). The new urban development plan (1985–2001) also addressed water supply and flooding concerns.

The increase in usage of groundwater for water supply started during this period with proliferation of water pump and bore-wells(Hazarika, Barman, et al., 2016). Prior to this period, the Brahmaputra river, shallow dug-wells, and ponds were the main drinking water sources (Alam et al., 2001; CMPO, 1971). Sale of domestic water via water tankers and groundwater-based small private supply schemes grew around this period (GOLa32). This diversification in water supply source, while filling the water demand gap, brought out inequalities, as access was limited to those who could afford these infrastructures (Alam et al., 2001)).

Civil unrest peaked again in the early 1980s resulting in instances of curfews, lock-downs and disruption of essential services within Guwahati (Ranjan, 2019). This unrest reduced by 1985 when the Assam Accord was signed by the national and state government. The Accord, among other things, resulted in a government-sponsored technical university, the Indian Institute of Technology-Guwahati (IIT-G) in 1994 (Ranjan, 2019). As a governmental institution, IIT-G became a source of technical verification for local decision-makers for water supply, flooding, and river-related decisions.

Flood-related policy was propelled by more than seven episodes of urban floods (Figure 4.8). But flood mitigation plans were commented to be on an ad-hoc basis, led by three departments—flood control department, Kamrup district administration and the GMC. The plans were infrastructure driven including constructing flood walls and dredging the rivers. On average after each flood 7.8 million INR (1\$=42 INR in 1998) was spent on flood damage repair (Alam et al., 2001, p. 53). There are limited policy or news reports linked to river pollution.

4.4.3 Urban Reforms and Modernization Era 2001–2014

Constitutional provisions and interventions in urban water policy by the national government increased from the year 2000, with focus given to medium and small cities (Sivaramakrishnan, 2011). Guwahati witnessed an influx of water supply schemes. There was ease in political communication and flow of funds as both the national and state government belonged to the same political party (Congress). This era included alignment with an overall neoliberal wave and the rise of private-public partnership (Gopakumar, 2012; Sivaramakrishnan, 2013). Private companies were mandated to bid competitively for large infrastructure projects in Guwahati.

4.4.3.1 Key Actors

Centralized large water supply plans were funded and supported via multilateral and bilateral agreements. Arrangements included a mix of national government grants and international aid agencies such as the Japanese International Corporation Agency (JICA), Asian Development Bank (ADB), and the World Bank (GOLb18, EPb2). With the impetus of the Disaster Management Act 2005, UNICEF played a key role in developing disaster mitigation interventions, resulting in the creation of a quasi-governmental institution Assam State Disaster Management Authority (ASDMA) by 2010 (NPb6, GOSa4). An active Kamrup district administration also saw the creation and implementation of plans for flood mitigation in Guwahati (GOSa4; GOSb29).

4.4.3.2 Policy and Political Developments

National funding emerged in the form of mission and programs as the primary instruments for urban water supply reforms in India. Jawaharlal Nehru National Urban Renewal Mission (JNNURM) launched in 2005, targeted civic amenities by improving urban infrastructure and governance (A. Kundu, 2014; MoUD, 2005; Sivaramakrishnan, 2011). The eighth five-year development plan further devolved power of execution from the state government to ULBs (D. Kundu, 2014; Sivaramakrishnan, 2011).

For Guwahati to be eligible for the external funds (from the national government and external aid agencies), new detailed plans were created for water supply, storm water drainage, and sewage (Tahal Group, 2010, GOLb1). These infrastructures were included as efforts “to improve the quality of life of its citizens” (Tahal Group, 2010). The new urban master plan (2009-2025) integrated these water supply plans therefore ensuring that the execution of these plans was monitored by GMDA (GMDA, 2009). New institutional plans followed infrastructure plans. A push for the creation of a separate water board was propelled by the JNNURM mission guidelines, perceived success of Delhi Jal Board, ongoing water supply institutional challenges, a local political coalition and reports from funding agencies favouring a separate water board (JICA et al., 2008)(Legislative Assembly 2008). The Guwahati Metropolitan Drinking Water and Sewerage Board (Jal Board) was created in 2009 (overtaking the AUWSSB), under the purview of the Guwahati Development Department. The Jal Board was supposed to take over all water supply responsibilities from the different ULBs to reduce coordination inefficiencies. But this move, which is still pending as of [year], was also seen as an inter-departmental and state vs. city power grab due to the substantial increase in water infrastructure budgets (GOLb1, GOLb4).

The Disaster Mitigation Act (2005) coupled with the assistance of the United Nation agencies, led to the creation of the Assam State Disaster Management Agency (ASDMA) in 2009. ASDMA sought to coordinate the various departments involved in disaster relief and mitigation (GOSa5, GOSA4).

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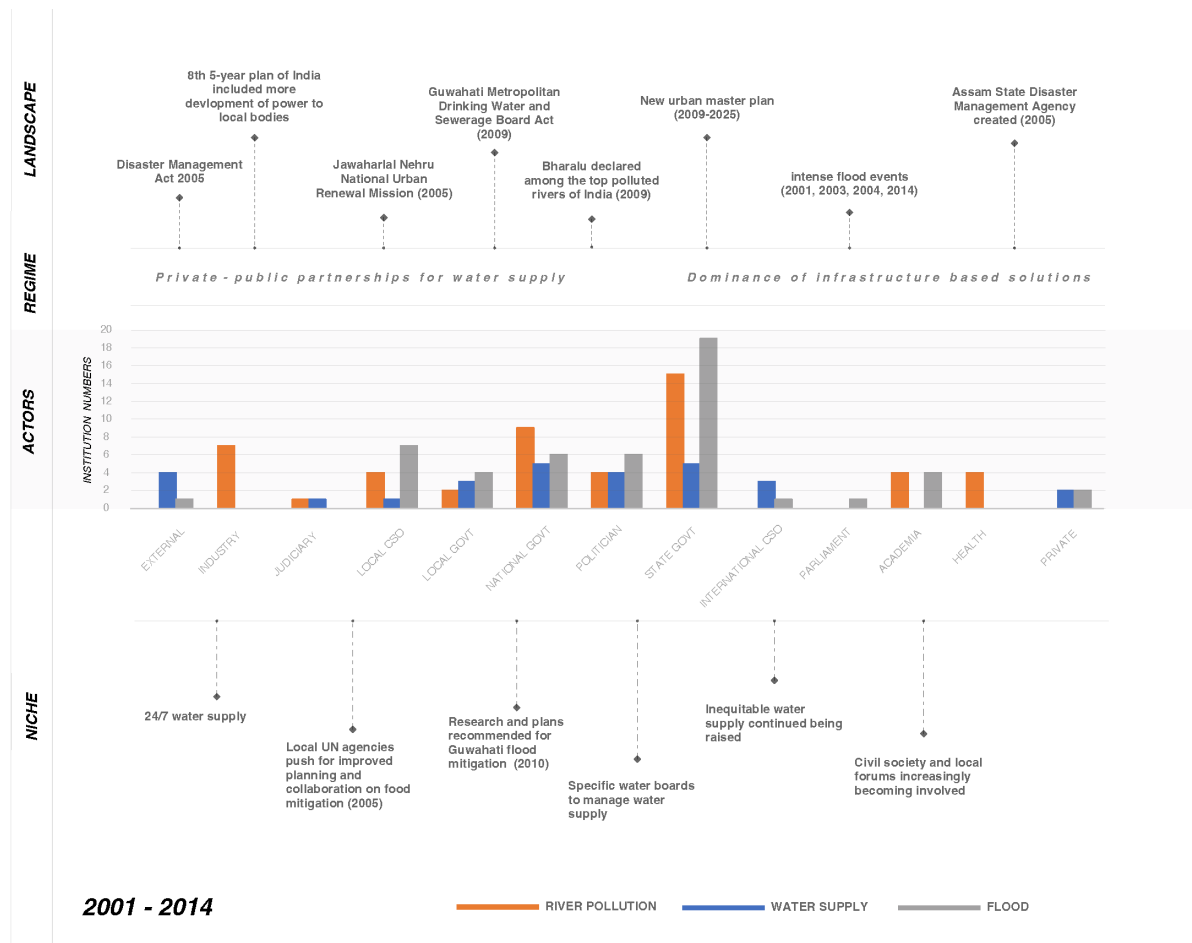


Figure 4.6: Processes and institutional actors involved between 2001-2014. L=local level; S = state or regional level; N= national level and I= International level.

4.4.3.3 Pressures and impacts

Nationally, a change from schemes to mission mode demonstrated how views on water services shifted from socialist state intervention to an economic commodification (Gopakumar, 2011, 2012). This change put emphasis on infrastructure creation, devolving power to local bodies, and building the capacity of local institutions to recover costs (A. Kundu, 2014). This period also saw a continuation of Assam agitations and civil unrest from 1997–2007, which fed into a decline in water supply provision and infrastructure creation (GOLb4).

An estimated 101 MLD of public water supply reached only 40 percent of the city, whereas the demand was estimated at 135 MLD (GMDA, 2009). The supply is centered at the core of the

city, with reduced access near peripheries and limited account of water lost in transmission (estimated between 40–50 percent) (GOLa32) (JICA et al., 2008). The population without supply relied on groundwater, wells, and private water vendors. As in other cities of India, a rise is observed in private water supply through water tankers for domestic water supply and for those who could afford, bottled water for drinking water (Bhattacharya et al., 2014; Gandy, 2008)). Private water vendors, while providing quick delivery, cost 200percent more per liter than public water supply. Private water vendors one-time price range from 490–550 INR/2000 liters tanker vs. public water supply 140 INR/month providing on average 21000lit/month (GOLa32, EPb4, EPb5) (1\$ =45.28 INR in 2006). This difference in price and access exacerbates inequalities and vulnerabilities, specifically during times of crisis when the informal water vendors are not able to deliver. As one news article referred to this challenge.

“...[the] majority of city dwellers are crying hoarse over the failure of the GMC and the public sector agencies to cover them under piped water schemes. Only 37.60 percent of the city households are covered by these agencies with their piped water schemes. Newly emerged water pirates have also added to the woes of the commoners.” (Assam Tribune, May 05, 2006).

After flood events in 2001, 2003, 2004, and 2014 (Figure 4.8), new infrastructure-oriented management plans were introduced, such as flood walls or dredging of rivers (Assam Tribune, May 22, 2010). However, despite these plans, the 2014 flood resulted in more than ten deaths and immense damaged, but also instigated a new mode of action to mitigate floods. “In 2014, 12 people got killed. Anil Nagar, Navin Nagar was underwater for more than 48 hours. That is when we really got into addressing floods” (GOLb4). An innovative niche of Standard Operating Procedure (SOP) was produced by IIT-G and consortium of institutions. The SOP recommendations included infrastructure, land protection, water management, and inter-department coordination arrangements. The SOP brought together 16 departments, academics, and NGOs to work together, leveraging both governance and infrastructure (GOLb4, and GOLa4).

In 2009, Bharalu river in Guwahati was declared as one of the most polluted rivers of India by the Central Pollution Control Board with BOD at 50mg/l (Desired limit is 3mg/l). The subsequent pollution levels at Brahmaputra river near the city were increasing (CPCB, 2013), bringing increased attention to river pollution issues (GOSb22).

4.4.4 Smart City Era 2015–2019

This era marks a change on the type of urban growth desired coupled with targeted investment provisions. The diversity of actors increased more than fourfold since 1970. Water supply witnessed an increase in partnership mode of operations including private-public, public-public and public-CSO partnerships.

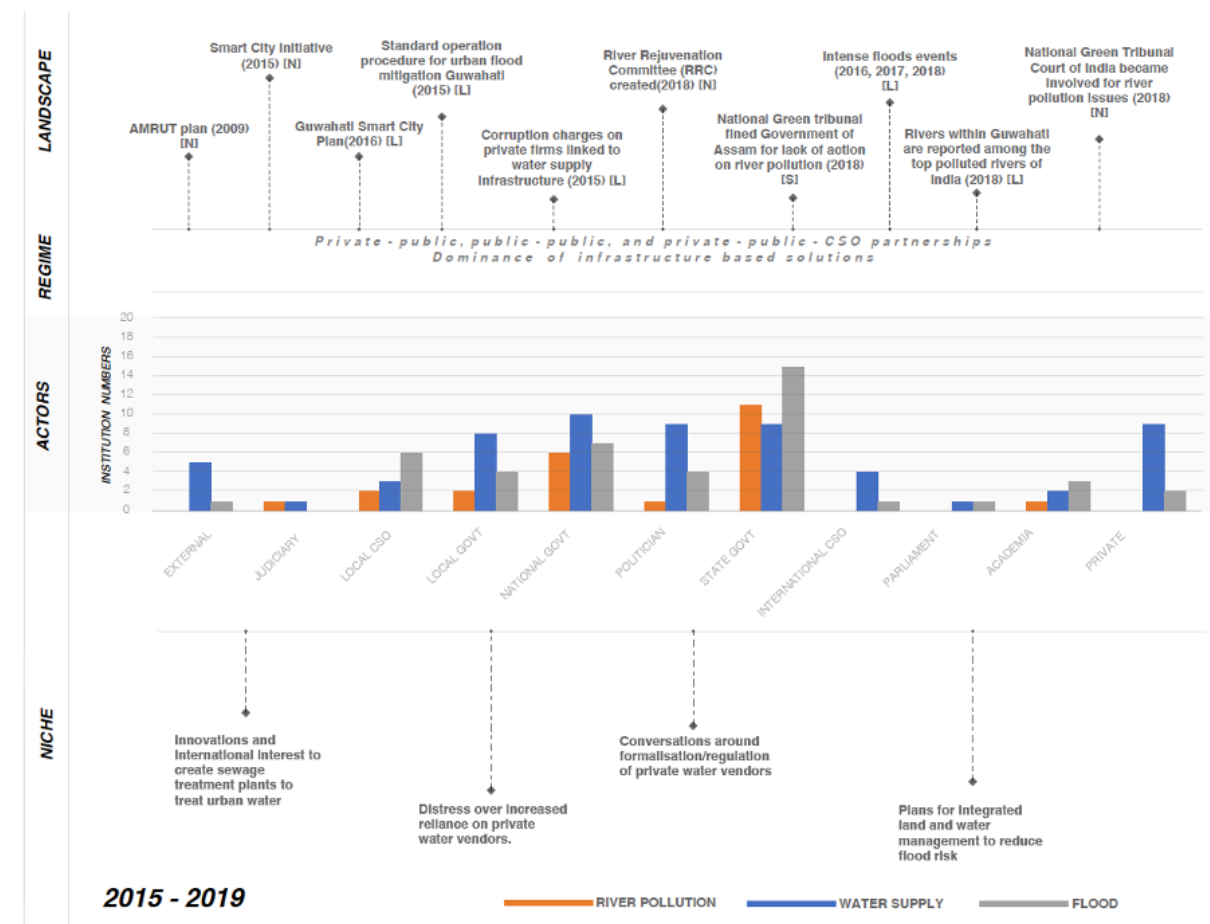


Figure 4.7: Processes and institutional actors involved between 2015-2019. L=local level; S = state or regional level; N= national level and I= International level.

4.4.4.1 Key Policy Actors

Inter-governmental collaboration is seen in the form of more than 16 departments working together to mitigate floods, along with media, academia, and a few local NGOs. The increase of news media outlets, proliferation of social media, and growth in civil society involvement brought more attention to public grievances. Private actors were involved through formal and informal arrangements. Formal includes policy provision for implementation and construction of large infrastructure projects and informal is through water vendors serving to fill the gaps in demand.

4.4.4.2 Policy and Political Developments

In June 2015, the national government launched the Smart Cities Mission to create 100 smart cities by 2019–2020. The mission sought to "...promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment, and application of 'Smart' Solutions." (MoUD, 2015a, p. 5). The mission's focus was broad and could include any (smart) idea that matched the framework of the mission. Strong emphasis was placed on private-public partnerships (Praharaj et al., 2018). The "Atal Mission for Rejuvenation and Urban Transformation" (AMRUT) was also launched in 2015, focusing on water supply and sewerage infrastructure, maintaining open spaces, and transport. AMRUT's ideology, in addition to developing infrastructure, also sought to build capacity and enable urban institutional reform (MoUD, 2015).

Guwahati was selected for both the Smart City and the [AMRUT](#) mission. Guwahati's smart city plans included the revival of urban rivers, wetlands, and development of riverfront infrastructure on the main stem of Brahmaputra (GoA, 2016). However, there were reported gaps in development of plans "ASDMA was not involved in consultation for 2025 city plans, some presentation on the plans were shared with us but we are not involved in consultation" (GOLa5 and GOLa6). The AMRUT mission initially focused on sewerage and septage management, transport, and development of green spaces and parks (**saap**)(Guwahati smart city plan, 2016;

SAAP 2017). Later, sewage and septage plans were said to be shuffled between the executing bodies -Guwahati Smart City Ltd. office and AMRUT mission office (GOLb30; SAAP, 2017).

The 2014 flood crisis, a new policy at the national level (The Disaster Management Act, 2005;) interest of high level government (Secretary of State) and international aid agencies involvement (UN agencies) together enabled the creation of Assam Disaster Management Authority (in 2009). This collective interest pushed for the formalization of a previously niche idea of the Standard Operating Procedure (SOP) to address urban floods in Guwahati (Assam Tribune, June 27, 2014 p.1)(SOP, 2015). This plan included coordination of 16-government departments, media houses, local universities, and civil societies. A specific department-District Disaster management Agency ([DDMA](#)), under the directive of the District Commissioner (Kamrup Metro), was responsible for coordinating this disaster mitigation effort. The SOP is said to have reduced flood inundation time and provided mechanisms for preemptive action (when implement effectively) (GOLb4, GOLa4, GOLb24). River pollution management was still perceived in terms of infrastructure development and dredging.

4.4.4.3 Pressures and Impacts

The onset of the new government regime in India (Bhartiya Janata Party, [BJP](#)) after a decade of the opposition party (Indian National Congress, [INC](#)) led to a spur of new missions. The Indian government focused on urban growth, as it was stipulated that by 2030, cities would house 40 percent of India's population and provide 75percent of its GDP (MoUD, 2015; Sankhe et al., 2010). In this era, steps were taken to build partnerships to address urban water risks and services. The partnerships included private-public, public-public, and private-public-Civil Society Organizations ([CSO](#)) in various formal and informal arrangements.

The water supply projects that started around 2006–2009 and were supposed to be completed by 2015-2016 are still incomplete. Corruption charges and scams (Baruah, 2017; Patowary, 2018), extensive monsoon, late payments, and local disruptions are mentioned reasons for the delay in completion (EPa6). The funding extensions have been conditional based on the

construction of a sewage treatment plant for the city (EPb2). As none of the new projects are completed, the water supply available has not changed (99 MLD). However, the losses in water transmission and the demand for water supply is set to increase. There was also a reported decrease in groundwater due to rising groundwater abstraction and an increase in groundwater pollution due to inadequate waste disposal (Girija et al., 2007; Sarmah et al., 2018). There are no rules against groundwater abstraction on private property in the city. Further, there is reported ongoing decrease in groundwater levels(Hazarika & Nitivattananon, 2016).

Four episodes of high rainfall and high river level resulted in only three flood reports (2016, 2017, 2018 (Figure 4.8 and 4.7). At the same time, there were barely any news reports of flood damages. A correlation can be seen between the SOP implementation and low damage reports. However, over time due to changes in bureaucrats involved, the SOP implementation eventually became diluted. Further, increased media attention to flood events created a social and political incentive towards relief measures rather than preventative measures. As preventative measures are often behind the scenes and require higher time and monetary investment (Mb5, GOLa4). An Professor working on the technical plan for flood mitigation mentioned “The technical solutions are fine, but the flood problem of Guwahati, is not a technical problem. It is a social problem. Similarly, it is an economic problem.” (Aa5, November 2018).

The smart city project has prioritized the execution of the riverfront development project and a few water ATMs (GOLb20). However, none of the plans for wastewater treatment have been initiated. Wastewater and sewerage that goes into rivers are within the mandate and recent plans of the more than six departments and programs, i.e., GMDA, GMC, Smart city limited, AMRUT, Jal Board, Assam Pollution Control Board, and Brahmaputra Board. However, only Assam Pollution Control Board is considered responsible for river pollution (GOLb22; GOLa22).

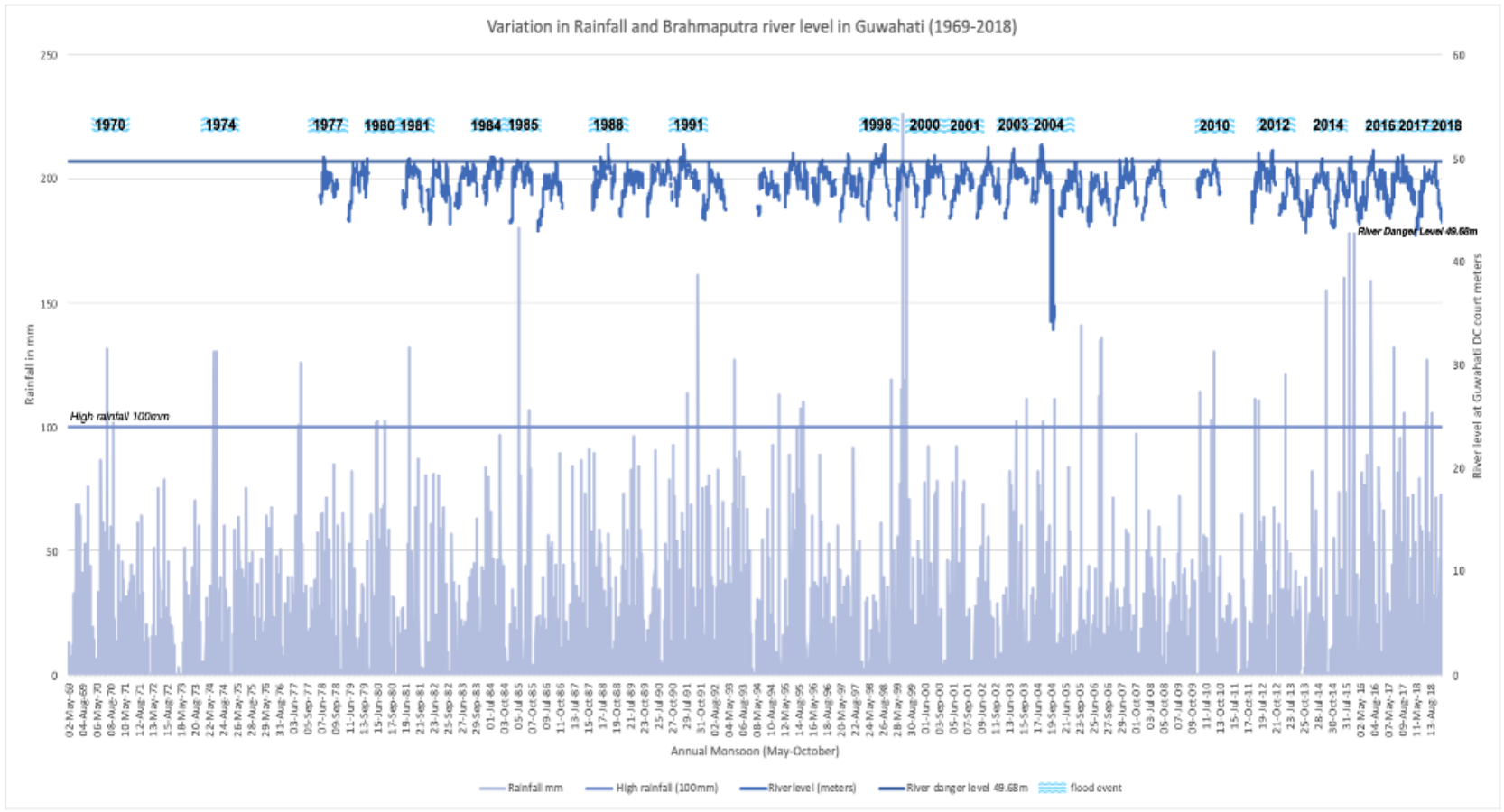


Figure 4.8: Rainfall and flood events in Guwahati 1970–2018 matched with Brahmaputra River level and news reported flood events

4.5 Discussion

Guwahati has seen different regime shifts from political instability to a drive for decentralization, an infrastructure focus and then an emphasis on smart city ideals. These shifts occurred within a rising tide of informal water supply systems, followed by efforts to consolidate, and regulate the new institutions under a banner of improving coordination. This evolving nature of institutions along with a struggle for agency as water risks change is seen among many intermediate cities (Birkmann et al., 2016; Marais, 2016; Roberts et al., 2019; Zwarteven et al., 2017).

4.5.1 An Ongoing Wrestle Between Centralization and Decentralization

New institutions and policy do not neatly replace old institutions, but rather form an opaque layer that is enmeshed in responsibility and personnel with the previous entities. These policy layers and the growing diversity of institutions are adding to the overlap and ambiguity of responsibilities (Zwarteven et al., 2017). We see a constant tug between the state and the national in outlining how Guwahati is governed. When the national government encouraged decentralisation of institutions within the city, the state created new institutions to oversee and improve coordination of these decentralised institutions.

Further, while decentralization is considered a good urban governance practice (Bassi et al., 2012), within Guwahati the unfolding externalities of power dynamics, existing path dependencies, and multiple centres of decision-making, complicates efforts to address urban water risks. What this means for many growing cities such as Guwahati is that the policies are increasingly decided by national decision-makers based on aspirations and learning from larger cities with a strong Global North bias (Bhardwaj et al., 2020; Hemani et al., 2017; Verrest et al., 2019). Many of the current regime's practices, such as urban water boards and riverfront developments, centralized water supply systems are adopted based on the external experiences rather than local learning. Further, in federal systems such as India, national governments have

evolved to play a substantial role in shaping intermediate riverine cities due to the increasing budgetary allocations and targeted urban growth programs (e.g.: Smart cities program). The local actors of the city however are not without agency.

4.5.2 Circumnavigation of External Mandates by Local Actors

Factors that affect a regime change are not limited to a binary interchange between landscape and niche factors (Voß et al., 2011). The interactions among and within institutions, and the interpretation and implementation of policies by local actors, also contribute to change. The inclusion of [historical institutionalism](#) within the [multilevel perspective](#) framework, highlight these internal political changes (Roberts et al., 2019).

Most large cities, due to higher internal revenue, bargaining power, and stronger grassroots movements have capacity to push for local priorities (Gandy, 2008; Mundoli et al., 2019). Intermediate cities often have limited resources and rely on funding from state and national government. This reliance means easier acceptance of changes to the governance structures and the adoption of new mandates dictated by the national government or donors (Bhardwaj et al., 2020). This reliance however does not eliminate local agency to navigate around imposed mandates.

This circumnavigation of the external mandates by the local actors can be witnessed in the different national and donor programs ([JNNURM](#), [AMRUT](#), SMART city, [JICA](#) and [ADB](#) water schemes). When urban national programs are drafted, smaller cities such as Guwahati have little influence on mandates created (D. Kundu, 2014; Sivaramakrishnan, 2011). The circumnavigation therefore occurs in how the city aligns locally perceived priorities and needs within national mandate by rephrasing narratives. This rephrasing is witnessed in the way the city's water supply infrastructure was negotiated under the JNNURM program as a requirement for social equity. A similar narrative was pitched under banner of sustainability and risk reduction Guwahati for AMRUT and smart city program There is also frequent postponing of mandates that are not perceived as a priority such as construction of a sewage treatment plant that was

planned in the JNNURM plans(2005) which was forwarded to AMRUT (2012) program and then to the smart city program (2015) and shuffled again to the next urban master plan (2023).

In Guwahati local governance prioritizes infrastructure-based solutions to resolve water risks. This infrastructure prevalence in plans is linked to a positive feedback loop and path dependency based on three reasons. First includes, the dominance of technical or engineering based positions in government departments (Niranjana, 2021), second finance incentives based on infrastructure creation and finally the existing infrastructure creates lock-in for more infrastructural fixes (Bigger et al., 2020). This approach can be seen in Figure 5. through the gradual increase in structuring of local rivers as canals or drains so as “to send flood water faster into the rivers” (GOLa19). Albeit aspects such as improvement of cross sector coordination and green infrastructural measures are very slowly gaining some relevance among measures to address water risks. These alternative measures are difficult to coordinate or implement due to limited capacity and local willingness.

Within intermediate cities such as Guwahati, the local government increasingly 'make do' by seizing opportunities, implementing efforts, and renegotiating new risks (feedback risks from interventions) when they occur. However this make-do attitude also encourages maintenance of institutional ambiguity thus making it easy to pass off responsibilities and mistakes (Heinrichs et al., 2013; McDuire-Ra, 2016).

4.5.3 Implications of Increasing Diversity of Governance-Related Actors

The actors involved in local governance regimes have increased in number and diversity. Usually shifts in regimes average between 5–10 years, depending on structure (within the government and private domain) available to accommodate change, perceived priority, and importantly a coalition willing to push change (Nastar, 2014; van Buuren et al., 2016). The drivers of change in Guwahati have grown from the national governments and state government being the sole decision-makers, to now including a range of academics, international aid agencies,

media, private companies, local societies, and political parties. While the number and diversity of institutions have increased to address the complexity, the resulting need for greater convergence and coordination has not been actualized. As mentioned by a local government official, "...even if you have convergence at the top, percolating it down to the ground level is not easy unless there is a very strong driver at the top" (GOLa15, November 2018). The network of actors involved in governing water risks for intermediate cities function within ad-hoc arrangements due to lack of sufficient workforce and clear directives.

The increasing diversity of actors also creates downward accountability challenges (Biddle et al., 2019). For example when funds allocated to address risks are repurposed or adjusted towards other (not risk related) activities, the responsibility for such decision are ambiguous. The highest diversity and number of actors are seen for water supply issues followed by flood and while interest remains low on river pollution. Currently, expenditure preference aligns with this trend, as highest preference is towards water supply infrastructure, followed by flood mitigation and low interest on sewage treatment options or improving urban river quality. This trend of expenditure has not changed since 1970. While funds and plans were available for sewage treatment plants and improving urban river quality since 1970, the plans were not executed due to various reasons including political priority, reallocation of fund and more. Such trend and priorities towards risk-related infrastructure investments is not unique to Guwahati. This trend is seen are seen in other cities of the Global South ranging from large cities like Cape Town to small ones like Surat, India (Acharya, 2012; Bigger et al., 2020).

4.6 Conclusion

Our research shows that water risk governance involves a complex interplay of local internal processes, which frequently circumnavigate nationally set mandates. Local priorities associated with water risks rarely include attention to rivers beyond the capacity of storm water drains. The governance processes have co-evolved based on path dependencies (related to infrastructure and policy)political priorities and overlapping institutional arrangements, which

further displays growth of mixed messages by overlapping governmental mandates.

Within intermediate riverine cities, understanding the patterns of change and modes of operation involved in addressing water risks can help identify strategic opportunities and areas where intervention is likely to succeed or fail. The most significant changes for Guwahati have been the increase in diversity of organizations involved in governance. This diversity, however, can lead to challenges in coordination and overlapping actions where responsibility and blame (for institutional inefficiencies) are dispersed. Further, the authorities responsible for the river basin are rarely involved with urban water risk governance, apart from permissions to access the rivers and data provision. This low level of involvement coincides with the perception among city and river basin authorities, that the urban impact on rivers are negligible.

Intermediate riverine cities are usually on the receiving end, rather than informing end, of urban policies. The changes in urban water risk governance processes are influenced by external factors and driven by local coalitions with little conscious inclusion of learning within the changes taking place. Such external drivers of changes are also observed in other intermediate cities in India due to the growing influence of national policies and external actors in the last ten years. Further, there is a consistent gap among decision-makers both city officials and river basins authorities in acknowledging the impact of the city on the river.

Changing the impacts of the climate and human-induced urban water risks begin at local-level governance (Ostrom, 2010a). Within this landscape, the push towards smart cities, urban growth, and urban river management is locally translated through infrastructure-based solution. Further, these solutions are based on politically perceived priorities rather than the actual water risk. There, unpacking the changes in local governance processes over time is essential to map overlooked vulnerabilities and opportunities available to address future urban water risks and conserve rivers.

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CHAPTER 5: Paper 2

CHAPTER 5

Paper 2

‘Too little, too much, too dirty’: The evolution of water risk governance networks in the intermediate city of Guwahati, India

An edited version of this chapter has been submitted to Environmental Science and Policy

Fanaian, S, Khosla, R., Kaaronen, R., Garrick, D. ‘Too little, too much, too dirty’: The evolution of water risk governance networks in the intermediate city of Guwahati, India.

Abstract

The Global South's small and medium cities are set to grow more than twice as fast as its large cities. The water risks emerging from this rapid urban growth, and considering increasing climatic uncertainty, are challenging – especially as the human resources networks needed to respond to such risks are often spread thin and weakly coordinated. Understanding the evolving nature of how growing water risks are governed is crucial to inform urban plans that are inclusive of the physical risks, vulnerabilities, and local governance challenges. Guwahati, India, is a medium-sized city in the Global South which serves as a window to understand evolving trends in urban water risk governance. To explore how and why governance structures change for water risks within Guwahati, we draw on network governance theory and map evolving governance networks via social network analysis. The data is based on actor interactions extracted from a prominent local newspaper over 50 years, supplemented with interviews and policy documents. We assess three, interrelated urban water risks: inadequate water supplies; urban floods; and river pollution. We find that despite a growing diversity of actors and attention given to each of the three risks, the actors who make the most important decisions (such as, resource allocation and infrastructure) have not changed much since 1970. However, since 2000, there is an increase in the role played by local and international civil society in bringing accountability and attention to the lived experiences of water risks. These empirically mapped dynamics demonstrate the ongoing challenges and shifts between centralized and decentralized modes of urban water risk governance.

5.1 Introduction

Intermediate – or medium and small – cities of the Global South are increasingly becoming vulnerable to water-related risks, given their rapid urban expansion, limited resources and climatic uncertainties (Birkmann et al., 2016). Inclusive and context-specific [governance](#) of urban water risks is vital for minimizing the impacts of hazards experienced (Chu et al., 2016). However, decisions to address water risks are complex, involving path dependencies, resource scarcities, political motivations and often corruption (Aartsen et al., 2018; Eberhard

et al., 2017; Millington et al., 2020). In such environments, uncertainty and distrust become ingrained among the stakeholders (actors) and can colour future interactions (Dempsey et al., 2017; Siciliano et al., 2021). Over time, these actor interactions can influence changes in the urban governance system and be affected by the system (Yang, 2021). Therefore, taking a “long view” to map the changes in actor interactions is essential to help urban stakeholders navigate future water risks ((Patterson, 2020; Reed et al., 2010).

As experience in addressing urban water risks evolves, accompanying governance structures also adapt and restructure to accommodate change. This restructuring, rather than replacing, juxtaposes old and new governance structures in complicated configurations creating a “spaghetti bowl” of ambiguous responsibilities (Huitema et al., 2017; Mohan et al., 2021). The vulnerabilities of intermediate cities’ (especially riverine or coastal) and their governance requirements are often underestimated due to a limited understanding of their changing urban and water systems, actor dynamics, and path dependencies (Birkmann et al., 2016). Moreover, existing urban discourses often flatten insights from the varied cultural and social practices present in the Global South that impact local path dependencies (Rademacher, 2015). Overlooking local practices in urban discourses impacts urban inequality and inefficiencies in governance in the Global South (Bigger et al., 2020; Dodman et al., 2022).

Therefore, we utilize the diagnostics processes in network governance theory (Bevir et al., 2007; Fawcett et al., 2012; Klijn et al., 2004) to study [network](#) changes in water risk governance over 50 years within Guwahati. Guwahati is one among India’s rapidly growing intermediate-sized riverine cities. Methodologically, we apply social network analysis to map data extracted from local newspaper articles, supplemented with interviews from diverse local stakeholders. The water risks based on urban-riverine interactions of Guwahati are assessed, they include urban floods, inadequate water supply, and river pollution.

Within this context of urban-riverine water risks, we ask two questions: How have the water risk governance networks evolved in Guwahati since 1970? How and why have the types of actors involved changed? Based on the insights generated, we consider the implications

of changes in governance for future water risk mitigation strategies for Guwahati and other intermediate cities of the Global South.

We begin by discussing the existing literature on network governance theory and its relevance for this research. Then, in the methodology section, we outline why Guwahati is a relevant case to study, the mixed methods adopted, their challenges, and validity. We also briefly touch upon how the method can inform broader processes of south-to-south learning. Next, the results section portrays how the governance networks have evolved and an interpretation of their dominant actors and trends. Finally, the discussion and conclusion sections address the implication and contributions for other intermediate cities in the Global South.

Our results show a growing trend of top-heavy governance. High-level actors (such as ministers) are often involved in critical decision-making and resource allocation. While there is an increasing diversity of actors and focused attention given to the risks (i.e., multiple actors working specifically on one risk vs one actor working on multiple risks), those actors who make the most critical decisions (such as financial and infrastructure) have stayed the same since the beginning of this study (1970). At the same time, there is an increase in the role played by local and international civil society in bringing accountability and attention to the lived experiences of water risks.

5.2 Literature Review

5.2.1 Urban Governance Trends in the Global South

A global urban governance survey conducted among 127 cities in 53 countries by da Cruz et al. (2019) suggests that currently, there is little in common between scholarly research on urban governance versus real-world problems of city administrators. For example, some of the main concerns raised among city managers in the Global South included overlapping responsibilities, lack of horizontal coordination in the policy sector, insufficient public budgets, inflexible bureaucracies, rapid urban growth and maladapted or outdated policy silos. In contrast to this

listed need, academic attention is often focused on citizen participation in governance, institutional shortcomings, capacity issues and civil society engagement (da Cruz et al., 2019; Tanner et al., 2009).

Urban water risks, easily summarized as ‘too little, too much, too dirty’ (Dixon, 1990, p. 170), are a product of physical hazards, socio-political constructs and vulnerabilities that shape the risk experience (Garrick et al., 2014; Hoekstra et al., 2018). Risk mitigation and adaptation, however, do not occur in an objective vacuum but rather in an arena inundated with contradictory belief systems, affiliations, power plays and uneven resource distribution. As seen in the São Paulo Macrometropolis, decisions linked to water are informally finalized in arenas that are not democratically legitimate or collaborative (Frey et al., 2021). An assessment in Rizhao, China, shows how formal network-oriented governance masks an underlying top-down hierarchy in power structures (Westman et al., 2019). These risk governance trends are also visible in different cities of the Global South (Bhardwaj et al., 2020; Marais et al., 2017; Mohan et al., 2021; Neves Alves, 2021). Further, the priorities and adjustments to implementing urban plans are actor dependent, and actors change over time, but a stasis in the governance of urban systems is often assumed when plans are made (Allen, 2008; Bhan, 2019).

However, when plans evolve with histories of conflict and corruption, and with hidden hierarchies and obfuscation, a legacy of distrust¹ is sustained (Ansell et al., 2020; S. Nooteboom et al., 2010; Siciliano et al., 2021). In such conditions, lack of trusted leadership can result in low accountability, fragmented coordination and increasing the transaction costs (Bianchi et al., 2021; B. Nooteboom et al., 1997; Wegner et al., 2019). To overcome distrust, a higher level of government become an intermediary (contributing to centralization) to aid in arbitration or finance and capacity provision (Bassi et al., 2012; Véron, 2010). On the other hand, decentralized autonomy is also prized as a mechanism to deliver environmental services without being

¹Trust in this context “...implies one’s belief that a partner will not behave opportunistically, thus lowering the risks associated with coordination” (Siciliano et al., 2021, p. 69). Further, maintaining an environment of trust in governance requires perceived dedication and fairness, along with absence of opportunism and corruption (Ansell et al., 2022; B. Nooteboom et al., 1997)

caught up in bureaucracy (Gopakumar, 2011; OECD, 2016; Véron, 2010). Oversight by trusted intermediaries and procedural process to ensure accountability increases institutional transaction costs and can lead to delays (Ansell et al., 2022; B. Nooteboom et al., 1997). Therefore, this delicate sought-after balance between centralization and decentralization is often tipped due to political dynamics, and autonomy is co-opted by a few key actors responsible for directing plans and finances (da Cruz et al., 2019; A. Kundu, 2014).

Finally, governance involves multiple actors beyond government, yet there is a lack of empirical insight on how such actors influence governance and risk mitigation over time. Civil society involvement in cities, depending on who is involved, can also lead to more attention to social and environmental issues that are overlooked by government (Chu et al., 2016). Many cities of the Global South are often resource-strapped and are beginning to rely on various private-civil society-public-political combinations to navigate the existing risks and socio-political challenges (Bigger et al., 2020; McDuie-Ra, 2016). But this combination increases transaction costs of coordination and can also lead to a danger of superficial or ad-hoc actions to demonstrate competence (Jones et al., 2016; Nohrstedt et al., 2021). Such ad-hoc measures often cause the bulk of risk and vulnerability to shift towards those who can least afford them (Christophers et al., 2020).

Given the complexity of processes at play in water risk governance, a long view of the various urban actor interactions is vital to improve the functionality of any future urban plans for intermediate cities of the Global South. This paper uncovers these processes for Guwahati, India.

5.3 Methods

5.3.1 Mapping the Evolution of Governance Networks

Governance involves multiple actors at different levels, both governmental and non-governmental, formal and informal, and working through different configurations toward a

common goal (Frey et al., 2021; Ostrom et al., 2007; Thiel et al., 2019). “Actor” in this research is indicative of all those “organizations and groups of individuals, who are stakeholders with legitimate interest.” (Saravanan, 2008, p. 203). To explore these relational ties over time, we apply network governance theory (Bevir et al., 2007; Eberhard et al., 2017; Fawcett et al., 2012). The theory assesses networks beyond their statistical metrics to understand how governance actors are affected by the broader processes (political, market, environment) within which they are embedded, and how they impact it (Eberhard et al., 2017; Fawcett et al., 2012). The theory acknowledges the role of non-governmental and governmental actors in shaping the terrain that they collectively navigate within governance processes (Fawcett et al., 2012). Further, network governance theory allows the examination of factors such as politics, path dependencies, and trust in the evolution of governance networks (Albrecht, 2019; Olivier et al., 2021; Wegner et al., 2019).

We utilize the methodological applications of Social Network Analysis (SNA) to visually map the actor interactions (Marshall et al., 2015). The software Gephi (version 0.9.2) is utilized to visualize the networks (Bastian et al., 2009). In utilizing this theory and methodology, the research follows an exploratory approach to understand how the emergence of actor interactions and authority takes shape and why specific patterns of interactions unfold within the case study of Guwahati.

5.3.2 Why Guwahati as a case study?

Guwahati is an intermediate riverine city that exemplifies conditions prevalent across the Global South, where infrastructure, governance and finance are concentrated in large and megacities (Hemani et al., 2016; Pawe et al., 2018).

We use Guwahati to examine the nature of governance patterns and trends unfolding within such intermediate cities (Watson, 2016). Guwahati is the capital of the North-eastern state of Assam, on the Brahmaputra River (Figure 5.1). As a federal country, India’s urban governance falls within the state government’s jurisdiction. However, as the Brahmaputra is a

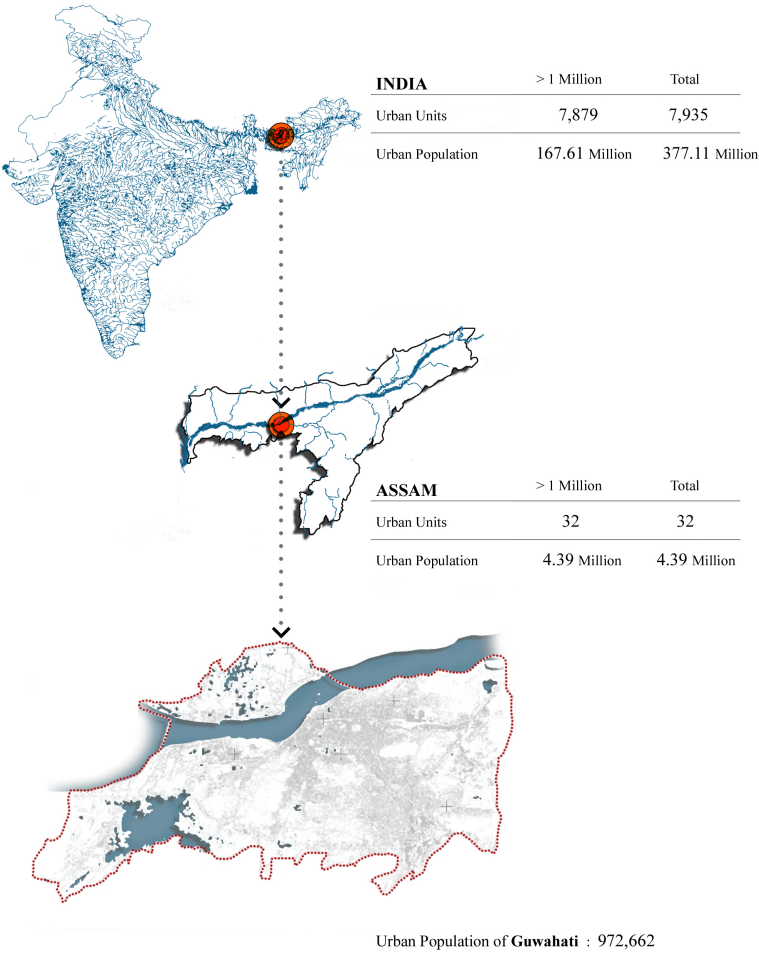


Figure 5.1: Location of Guwahati and Brahmaputra River (statistics from Census of India 2011)

transboundary river, apart from national river basin authorities, few other national actors are also involved in Guwahati’s governance processes. Figure 5.2 gives a brief indication actors involved, the [scale](#) and their roles.

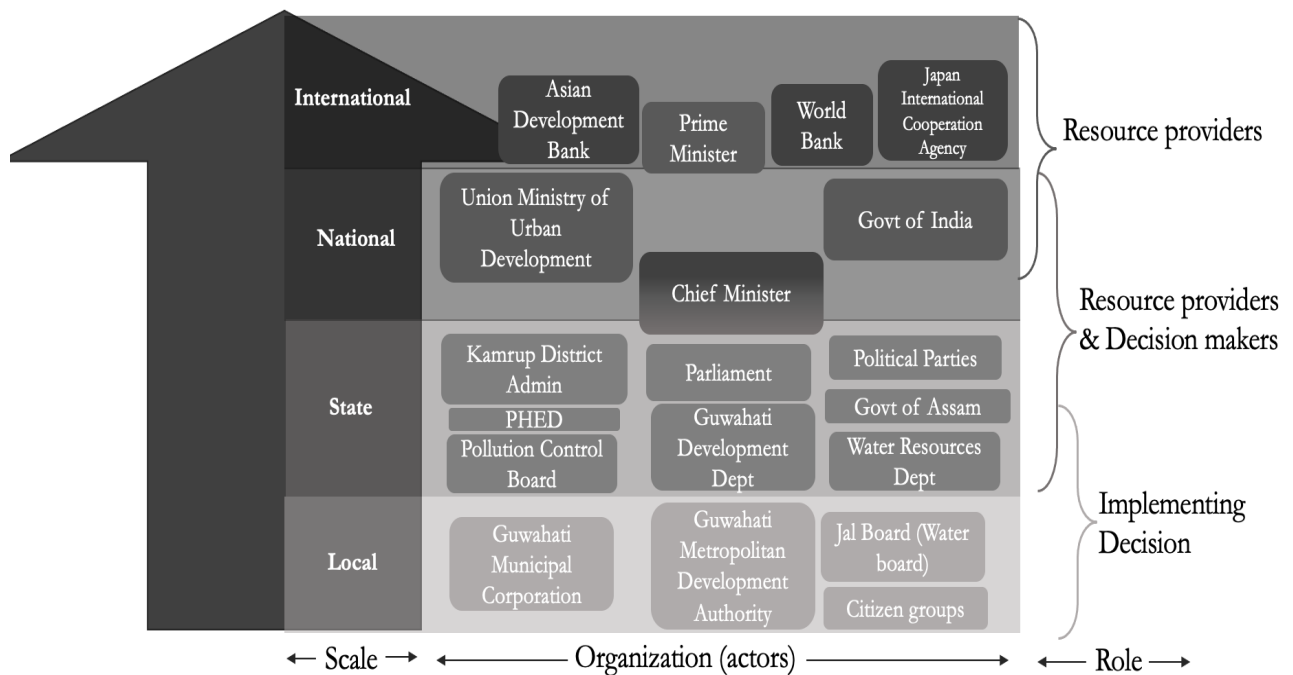


Figure 5.2: Governance hierarchy and key actors and their roles in Guwahati

The connection between the city and its local rivers lead to water risks such as urban floods, water supply inadequacies, and river pollution. About 40 percent of Guwahati currently has access to public water supply (Bhattacharya et al., 2014). While this percentage has grown since the 1970s (when access was in the range of 10–20 percent), there are still multiple limitations to access water (Hemani et al., 2017). Guwahati’s rivers are listed among the top polluted rivers of India (CPCB, 2013). Urban flooding is an ongoing and increasing occurrence in Guwahati as it lies in a valley, and the urban expansion is encroaching into wetlands, floodplains and mountains (Sarmah et al., 2018).

While this study focuses on Guwahati, it is worth noting that despite their diverse lived experiences, intermediate cities of the Global South show similar challenges in data availability, local governance and vulnerability to risks due to urban inequalities (Adelina et al., 2020; Bhardwaj et al., 2020; Satterthwaite, 2017a; Westman et al., 2019).

5.3.3 Local Newspapers as a Data Source

Newspapers have been rarely used for SNA due to tedious cataloguing of articles and extracting information. However, due to advances in data mining, compiling relational data is becoming more convenient (Scott, 2017). Yi and Scholz (2016) and Angst (2019) demonstrated the use and robustness of newspapers as a proxy data source for information on governance networks. In addition, local newspapers are a consistent source of information that directly reflects local relevance (Henrique et al., 2019). Therefore, to connect with locally relevant issues, we focus on one of the oldest and most prominent local daily newspapers, Assam Tribune (AT), from 1970 to 2019.

As newspapers also include specific political or ideological orientations (Angst, 2019), we supplement the network statistics with insights from interview-based narratives and other literature to mitigate bias. We conducted 20 interviews with stakeholders from different arenas (carried out between 2018 and 2019) and examined literature such as, policy documents, peer-reviewed papers, and grey literature (Appendix for details 8.3).

The relationships between actors from relevant news articles are parsed over 50 years to obtain a robust data set, which was created based on the following analytical steps:

- i Batch digitization of newspaper images obtained from the Assam Tribune using OCR software (1970–2015) No. of files was 170,395 (each file is one page of a newspaper).
- ii Assessment of the front page (exclusively) which has the most important and visible news (Boydstun et al., 2013). This brings the relevant files to 18,250.
- iii Water risk specific files were extracted through keyword searches in the program R, e.g., inundation, river pollution, sewage, water supply. The remaining news articles were web scraped from 2015-2019 based on similar keywords (N=88). Total files are 1126.
- iv Manually cross-checked the 1126 files for relevance using the criteria: risk information was about Guwahati; if the article continued to inside pages, information from inside pages was

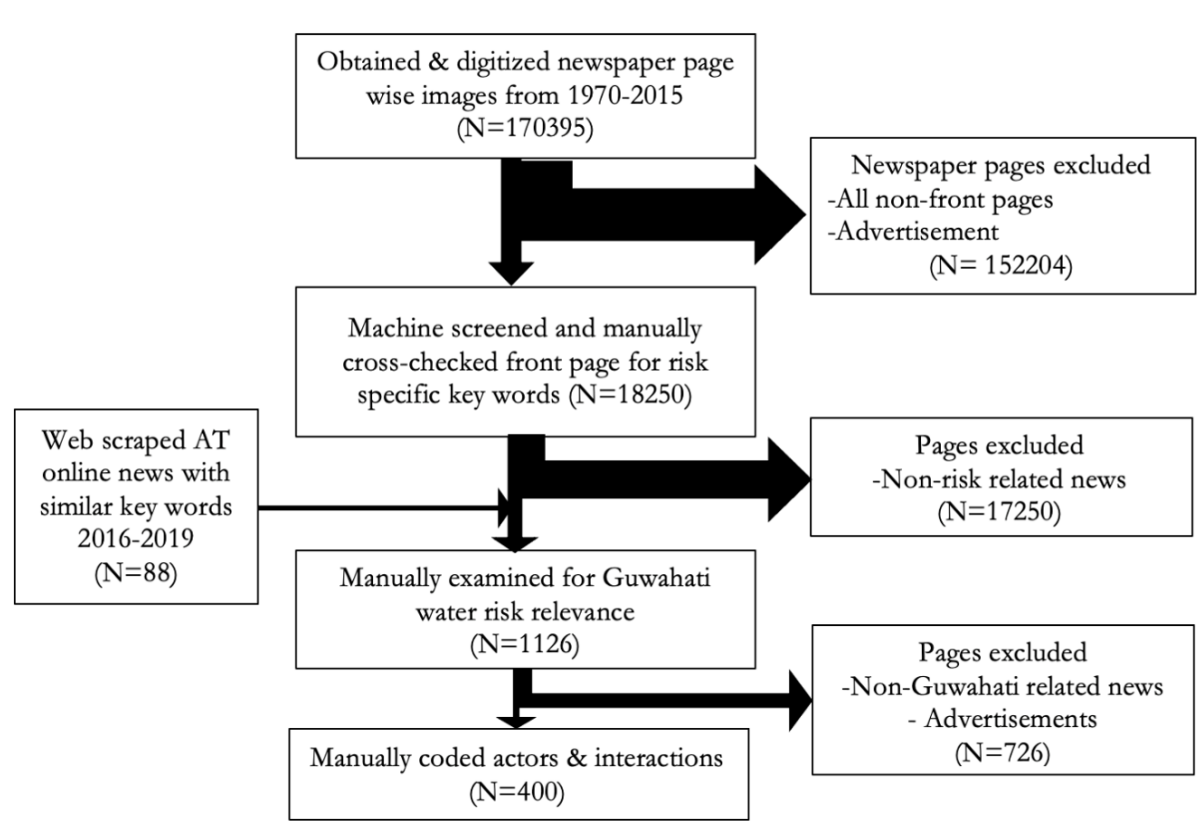


Figure 5.3: Flow diagram for narrowing the selection process

also included; advertisements were not included. Results narrowed to 320 articles.

- v Manually coded 320 articles (400 files) for responsible actors and governance themes, of which 222 articles had actors and interactions mentioned. The themes on which actors collaborated were sorted based on repetition within the news articles. The themes identified include planning, infrastructure, funding, institutional challenges, operation and maintenance, encroachment (of water bodies), protests (civil), pollution, corruption, flood events and judicial actions (Detailed in Table 5.4). These nine themes are bundled under three headings—management, politics, and risk-specific themes.

The governance themes coded do not have a valence, i.e., whether the theme has positive or negative connotation is not explicitly indicated to reduce researcher bias in the thematic assortment. For example, the infrastructure theme can allude to either construction of new

infrastructure (positive) or faulty and broken infrastructure (negative). Further, the network is undirected, i.e., the direction of interaction is absent. As the newspaper information does not explicitly indicate the direction of interaction, we create an undirected network and infer authority based on interviews and secondary literature (McAllister et al., 2015).

5.3.4 Social Network Analysis Metrics

Most social network analyses for governance is conducted for a specific snapshot of time (Berardo et al., 2020). To build a dynamic SNA, we created five decadal time slices between 1970–2019 (Wolbers et al., 2013). Each time slice has two types of nodes: actor and theme. The connection between the two nodes is risk specific and represented through a coloured edge line (edge= connecting line between two nodes).

‘Actor’ refers to a specific organization such as the local municipal corporation, water resources department, specific political party (e.g., Congress, BJP) and more. The ‘category of actors’ refers to the type of organization, e.g., national government, local government, civil society, private and so on. The actors are divided into nine categories—government (local, state, and national), private sector, politicians, international Civil Society Organizations (CSO), local² CSO, judiciary and academia (Detailed list in 8.3).

To examine actor interactions and governance dynamics we use node-specific and network-specific metric. We visualize the dynamic nature through time slices using Gephi software (version 0.9.2) (Bastian et al., 2009). Within Gephi, we use force atlas 2, to visualize the network. Force atlas 2 pulls together nodes based on the intensity of interactions thus visualizing the degree of connectivity (Figure 5.9) (Jacomy et al., 2014). The importance of an actor (node) is measured via Authority metric (within HIITS in Gephi). This metric allows characterization of those actors who are most connected (Borgatti et al., 2013; Iacobucci et al., 2019). To evaluate the network-level behaviour (group dynamics), we use modularity metric. Modularity

²Within this paper, ‘local’ refers to city-level organizations, ‘state’ refers to the provincial or regional organizations, and ‘national’ refers to country-level organizations.

Figure 5.4: Governance category-based themes coded from the following types of newspaper statements.

Risk Themes		Floods	Inadequate Water Supply	River Pollution
Management	Plan	Need for plans; plans being made; plan recommendations; plans to solve the problems; lack of plan implementation	Sharing plans of the city water supply schemes	Plan for control of pollution
	Infrastructure	Infrastructure approval/sanctioned, infrastructure construction delays, faulty/old infrastructure, need for improved infrastructure	Delay in construction, creating water supply schemes, any water supply schemes approved, under construction, new schemes	Sewage treatment plant, lack of infrastructure
	Funding	The lack of funds for schemes and maintenance, the funding required for flood control measures	Funding for amenities, funding for water supply repairs, financing of projects, lack of funding	Funding for infrastructure, funding for cleaning
	Institutional	Authorities' negligence, lack of action/coordination by institutions, bad management, failure to implement	demand new institution, blame institution, faulty institution, Institutional failure, demand change	Need for policy to reduce pollution in rivers and wetlands. Regulations
	Operation and Maintenance (O and M)	Action-oriented complaints, e.g., need for cleaning of water drains to prevent waterlogging, maintenance	Irregular/inadequate water supply, shortage of water supply, bad water quality, lack of/deficits in water supply	-
Politics	Encroachment	Removal of encroachment, encroachment occurring	-	Pollution due to encroachment in rivers and wetlands.
	Election	Election manifesto promises	Election manifesto promises	Topic included in manifesto
	Protest	-	Strike, or protests for water supply	Environmental Activists, Judiciary action
	Corruption	-	company paid bribe; Water scam	Allegation of corruption
Risk specific themes	Flood events: Reports of the city flooded, worst floods ever, flooding because of rains, river overflowing	Lack of water supply	Pollution: Health hazard, Industrial pollution, Wetlands polluted	

statistically demarcates groups or clusters based on the intensity of actor interactions, i.e., if actors for a specific risk are spread over multiple clusters, this indicates fragmented functioning with low interaction and coordination (Schwenke et al., 2021) (detailed network statistics in 8.3).

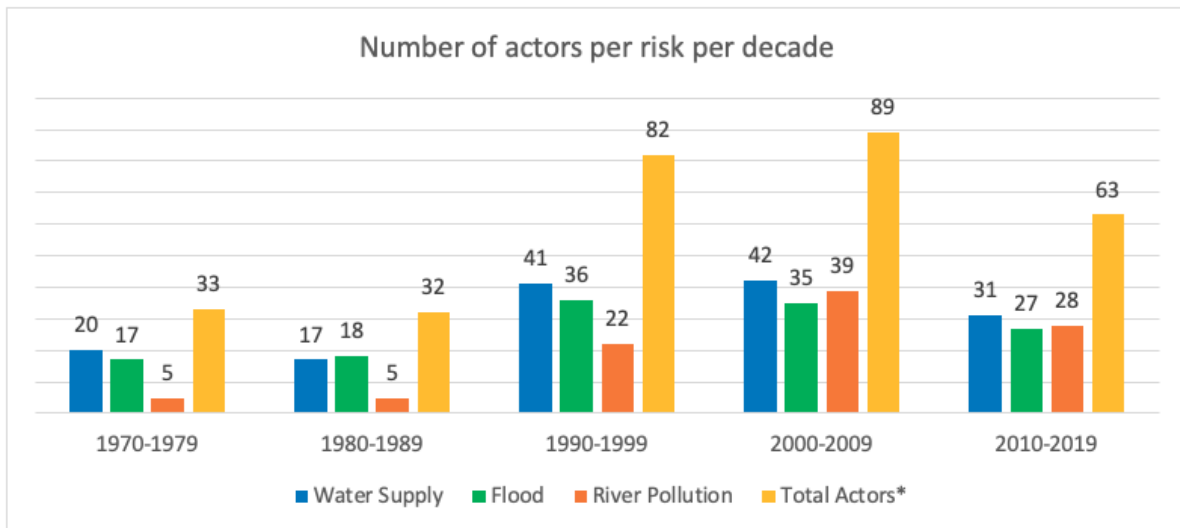


Figure 5.5: Number of actors per risk per decade. *Total actors' number is not cumulative as few actors overlap across risks.

5.4 Results

This section examines changes at the network level and actor level interactions for each water risk. We begin with an overview of the combined cross-risk assessment, followed by discussing specific changes involved in each risk i.e., urban floods, water supply, and river pollution respectively. The implications of trends introduced in the results section is unpacked in the discussion section.

5.4.1 Water Supply

Overall, the governance of water supply has received the most attention with an increasingly diverse number of actors involved compared to river pollution and flooding.

In the first three decades (1970–1990), important decisions such as plans around infrastructure and funding were held by state government actors (mostly Government of Assam, and Town and Country Planning Department) and physical day-to-day implementation such as operation and maintenance (O&M) by the local government, i.e., Guwahati Municipal Corporation (GMC). Post-1990s, it is seen that actors from the national government were increasingly linked to funding and planning themes (figure 5.6). There was also an increase in CSOs, academia, and private enterprises, for example the involvement of international CSOs such as Asian Development Bank and Japan International Cooperation Agency in guiding institutional setup, infrastructure, and fund support (Figure 5.6A). Further, the post-2000 authority metric changed drastically from GMC to new government institutions, i.e., the Guwahati Metropolitan Development Authority (GMDA) and Guwahati Development Department (GDD). The GMDA was created to execute water supply and urban development plans (GoA, 1992) and GDD to oversee coordination, these new institutions can be considered as a response to complaints about institutional failures. Finally, political actors (various ministers) have consistently been involved in themes such as funding and infrastructure (Figure 5.6).

The theme of funding (i.e., need for and lack of funding) is most connected to water supply issues (in comparison to flood and river pollution). The gaps in service delivery and maintenance are also brought up regularly. One of the private actors involved in construction of water supply infrastructure mentioned this gap is because, *“People are not ready to afford the cost. Government goes for subsidies (on water supply) to get votes. And finally (the government) says no money (for the required infrastructure).”* (EPa2). Further, corruption (with one exception) and protests appear only in conjunction with water supply. While corruption was mainly linked to political and government departments before the 1990s, post-2000, it is also linked to many actors in the private category. Corruption has also diversified over time. Further, local CSO and citizen-led movements post-1990 were mostly associated with themes such as institutional failures and maintenance challenges. This rise in corruption is also indicative of eroding trust among actors. On issue of this trust and ambiguity of responsibilities, the president of a citizen forum stated, *“The entire system is faceless now, no face, no accountability.*

Had there been a department associated with these (infrastructures), the department would have been accountable. Who is accountable?”(NPb4). Through modularity clustering (Figure 5.8), we



Figure 5.6: Between 1970–2019, A. Actor Category: displays shifts in actor category and B. Governance Themes: displays shifts in governance themes. RP=River Pollution; WS=Water Supply issues; FL= Flood. (Table in Appendix 8.3)

can see that the actors working on water supply issues were almost always part of the same cluster (except for the first decade). This single clustering indicates that most actors working on water supply have a high level of connectivity. Further by 2010–2019 (Figure 5.9), a separation is seen of water supply related actors from flood and river pollution related actors (such as, specific private actors working only on water supply infrastructure) .This separation indi-

cates an increasingly specialized focus on water supply. This special focus has created a niche where many actors are only involved on water supply issues. Many of these new specialized actors are in the new private and local CSO categories. The external reasons and implications of changes in trends of actor involvement is explained in discussion section.

5.4.2 Urban Floods

From 1970 till today, the top ten actors (Figure 5.8) with the most authority in dealing with urban floods have been in government. Among the government, specific actors have played a more prominent role. For example, the Kamrup District Commission has increasingly become recognized as the authority for institutional coordination and the Water Resources Department (erstwhile Flood Control Department) is linked to flood infrastructure. National level-river basin institutions such as the Central Water Commission and the Brahmaputra Board also provided information on flood events and infrastructure support (see supplementary material 8.3 for list of organizations). Further, there is an increasing diversity in government actors involved (from various departments) in addressing urban floods along with an increasing number of local CSOs. Interestingly, floods also brought out the highest involvement of local CSOs (greater than 13) post-1990 (Figure 5.6A). This involvement was in conjunction with the period of high flood events from 1990-99. The CSOs engagement was mainly on the themes of gaps in O&M, critiquing infrastructure present to mitigate floods and mitigating institutional failures.

Thematically in the first two decades, the focus was on planning followed by infrastructure gaps (Figure 5.5B). Post-1990s, however, themes around institutional failure to curb urban floods started rising along with infrastructure challenges to address the floods. For example, institutional failures included statements such as “lack of coordination between the concerned departments has aggravated the problem” (Assam Tribune, July 03, 1998). Further, reasons for flooding in the later years were attributed to urban encroachment into the rivers and wetlands. Encroachment issues were framed as “clear rampant encroachment from the natural water exit

channels... are major cause of water logging in the city” (Assam Tribune July 01,2014). The local involvements also grew in retaliation after the 2015 floods that lead to eviction drives to remove informal encroachments from the floodplains (formal big hotels and industries on the same floodplains were not evicted). Apart from the involvement of CSOs and academia, there are relatively few actors involved. It is also of note that while infrastructure was a growing theme of concern, a lack of funding was rarely reported.

Finally, the clustering trends (Figure 5.8) are dispersed except between 2000-09. The flood-related actors had the highest clustering i.e., high cohesion and focus on flood mitigation. This focus can be attributed to two levels of change, first, at the national level the Disaster Management Act was created in 2005. Second, at the local level, the implementation of this Act was encouraged by CSOs such as UNICEF resulting in the formation of the quasi-governmental institution Assam State Disaster Management Authority (ASDMA) in 2010 which focused on disaster reduction. Further, the Kamrup district administration became the coordinating body for the various actors involved in flood mitigation in Guwahati (Fanaian et al., 2022 In Review). But this attention was dispersed in the next decade as the higher spread of actors between different clusters indicates that different groups are formed among actors based on different focuses in flood-related activities. This spread in modularity between clusters indicates a low to medium level of coordination and specialization for flood issues, i.e., actors involved in addressing floods are involved in river pollution and some water supply issues.

5.4.3 River Pollution

For river pollution, as seen in Figure 5.5, between 1970-1990, only five actors were involved, i.e., the state and national government, local citizen groups, and private industry (the polluters). After the 1990s, however, there was a jump to more than 22 actors from various categories. Post-1990s, the diversity in actors also increased to include academia, the health sector (hospitals), judiciary (courts), private actors (local industries), plus local and international CSOs. This post 1990 growth follows a similar trend as other risks and can be linked to the 1992 Act

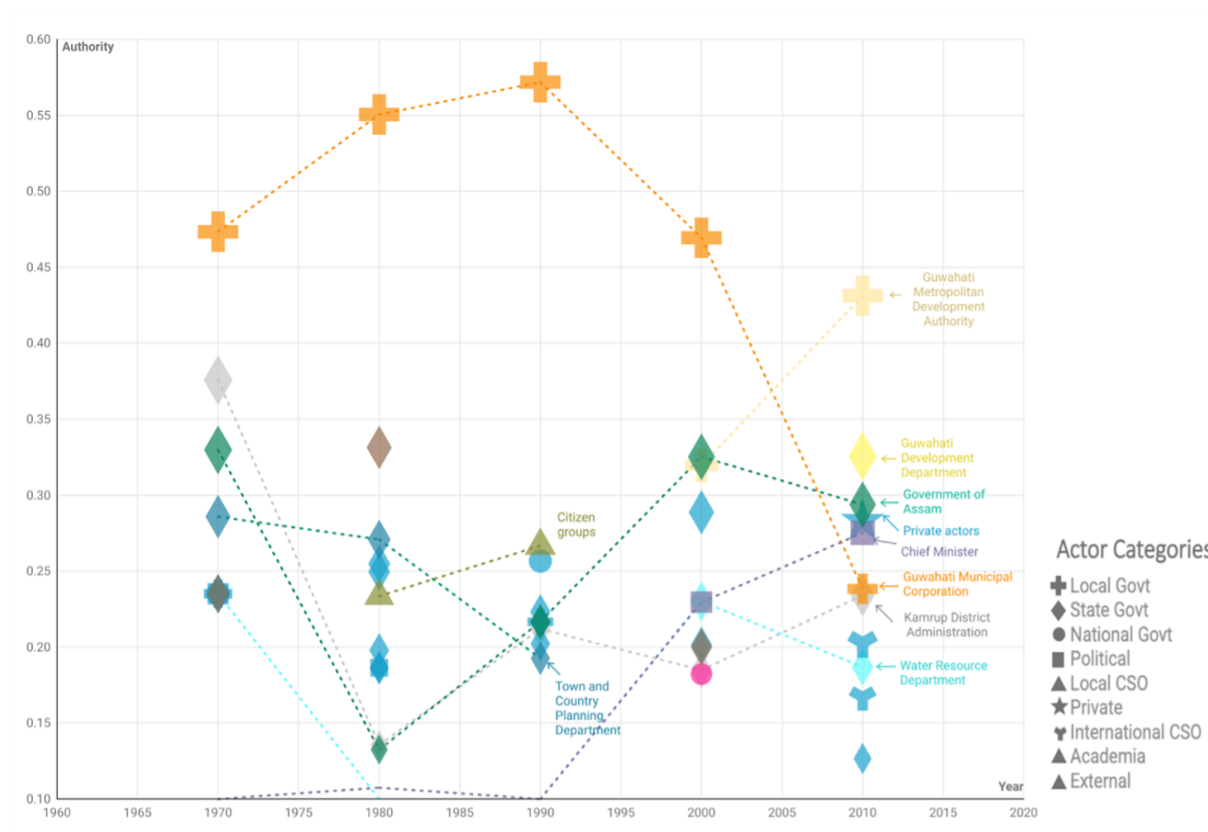


Figure 5.7: Overall shifts in authority when addressing water risks within Guwahati. The top ten central actors are mapped (Values in supplementary material 8.3).

that focuses on increasing decentralization of local urban bodies (Fanaian et al., n.d.).

The theme of industrial pollution in the urban rivers of Guwahati is visible since the 1970s, but engagement on this issue began only after the 1990s when the number of actors grew. Infrastructure gaps in addressing urban waste and river pollution have been an ongoing theme since 1970. River pollution also uniquely displays a rise in judiciary action. An increase is also seen in the themes of rivers' encroachment, recognition of wetlands' pollution, and the linked health hazards. Along with growing diversity in awareness of causes of river pollution, the theme of corruption also rose in 2000 to 2009.

As a result of this increase in actors, the authority while residing within the government sphere (Figure 5.7) has gradually shifted from state-level actors (Government of Assam) to national

level actors (Pollution Control Board), then finally resting on the local government (Guwahati Municipal Corporation). The most consistent actor has been the Environment and Forestry department of Assam. Further, the modularity shows dispersed clustering i.e., a low level of cohesion and interaction among the actors. This lack of concern can be noticed in the perception of river pollution issues among actors, for example, a prominent news editor mentioned “Only one river, the Bharalu is contributing to the river pollution. Out of 52 rivers that joint Brahmaputra, only one river is polluted which is not that much.” (Mb5).

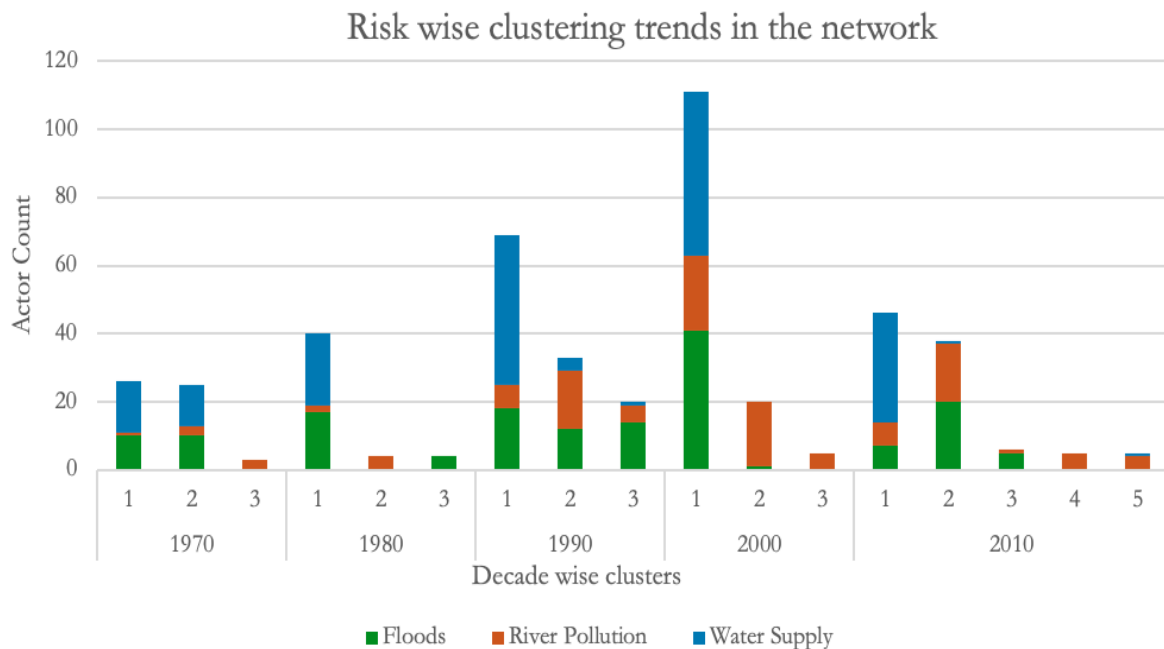


Figure 5.8: Risk and decade wise, actors clustered into groups. Risk specific actors when spread over multiple clusters indicate low cohesion among actors for that risk. E.g.: River pollution actors are dispersed among the different clusters every decade, indicating low levels of cohesion and coordination vs. water supply with actors in fewer clusters thus increasing cohesion

5.4.4 Combined water risk governance

Overall, authority is held in a hierarchical structure with a few actors at the top. From 1970 till 2019, the top ten actors (Figure 5.7) with the most authority for floods and river pollution have always been the government. Whereas for water supply, the most important actors included

private entrepreneurs and international CSOs. Between government and non-governmental categories present, the governmental actors retain the highest positions in number and authority. However, between 1990–1999, authority metric was closer among all actors, thus indicating a slight shift to decentralized nature of functioning. But this shift moves back to centralized post-2000 and goes back to centralized functioning. The most consistent actors apart from the GMC and GMDA include state-level actors such as the Government of Assam, Kamrup District Administration, Town and Country Planning Department and Water Resources Department (Figure 5.7). These state-level actors operate at roughly similar levels of governance. Apart from these three, the new institution of GMDA moving into the top ten actors from 2000–2019, due to its decision-making for day-to-day implementation.

Themes like funding, protests and corruption are often found only in relation to the water supply. Themes of pollution and judiciary action are seen only concerning river pollution. Across risks, among the number of actors involved, after the state government, the highest numbers belong to national actors and political actors, respectively. Few citizen groups were among the top ten during the 1980s and 1990s (Figure 5.7). However, the international CSOs increased in number and authority for the three risks post-1990s, can be attributed to the 74th Constitutional Amendment Act (74th CCA) of 1992 (Fanaian et al 2022, in review) which provided institutional, fiscal, and financial reforms to strengthen and giving autonomy to urban local bodies. Further, the rise in NGOs and private institutions within urban governance can be attributed to the larger systemic changes due to the rise in neoliberalism within India (Gopakumar, 2011; Sivaramakrishnan, 2011). But after this peak, the results also show a gradual decline in the involvement of other actors such as academia and judiciary (but not for private actors and International CSOs).

Further within the network, we also see certain actors that serve as either the intermediary for coordination (including the Chief Minister, Kamrup District Administration), and the overarching Government of Assam. Some actors behaved as intermediaries for specific risks, for example, the Kamrup District Administration was involved only with floods and river pollu-

tion. In contrast, the Chief Minister and Government of Assam were often involved in water supply, floods, and river pollution. Throughout the decades, the GMC (post-2000 GMDA), the Chief Minister, Government of Assam were the actors with the highest rating. However, this centrality does not indicate the same level of importance among these three actors (the reasons for this will be expanded more in the discussion). The Kamrup District Administration was among the top four actors from 1980–1989 and 2000–2010. In 2010 the GMC was replaced by the GMDA.

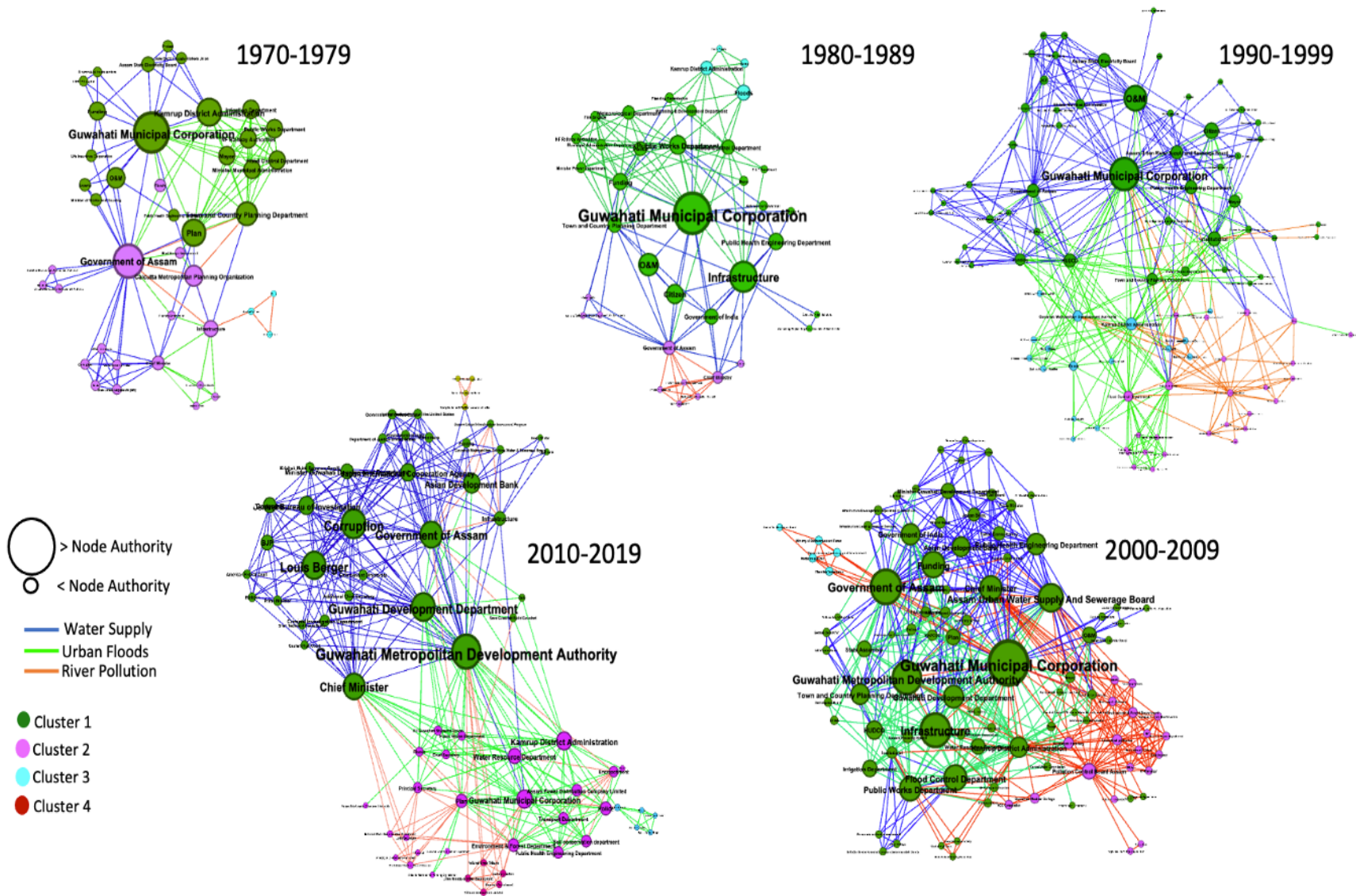


Figure 5.9: Decadal shifts in the governance structure(force atlas 2 visualization). The circle size is relative to the authority of the actor. The lines represent risk related interaction between actors, green for floods, blue for water supply and orange for river pollution. The node colours represent modularity metric based on statistical grouping, i.e., actors in the same cluster have higher interaction. Green-cluster 1 is the largest, Pink-cluster 2 second largest, followed by cluster 3-blue, cluster 4-red, respectively. Note: Cluster 4 occurs only between 2010 to 2019.

5.5 Discussion

This discussion section is organized in three parts. First, we assess the patterns of actor involvement and intensity of interaction. Second, we assess the shifts in trust levels between actors, authority, and the transaction costs actors face when governing the risks of water supply, river pollution and urban floods. Lastly, we expand on the broader implications of the results for future mitigation strategies in Guwahati with lessons for other intermediate cities in the Global South.

5.5.1 Changes in Actor Involvement and Interaction

In Guwahati, the overall governance networks grew exponentially post 1990 for all the risks (water supply, river pollution and urban floods) (Figure 5.9). This rise in local urban bodies was not unique to Guwahati alone. Across India, the Constitutional Amendment Act of 1992 worked to create and provide autonomy to urban local bodies (D. Kundu, 2014). This structural provision coupled the increasing wave of neoliberalization witnessed a growth in diversity of actors participating in governance processes (Gopakumar, 2012). However, we also witness a gradual scale back in numbers after 2000 (Figure 5.5). Post-2000, there was a rise in funding and private-public partnerships geared towards centralized large water-risk related infrastructure (Fanaian et al., 2022, In review). This structure of partnership and large infrastructure pulled in more centralized actors for decision-making and pushed out the smaller decentralized actors from decision-making. Further each of the three water risks display different patterns in how their networks grow and scale back.

The water supply network shows an almost linear pattern of increase in density of connections among actors. This density growth indicates improving coordination and information exchange. There is also an increase in focus and specialization, with a growing number of actors involved only on water supply (Figure 5.9) even as the number of overall actors decreased. Since 2000 there is also an increase witnessed in the level of coordination and resource provision towards water supply through expertise, intensive planning, and project funding for

water supply (Fanaian et al 2022, In review). River pollution actors, however (Figure 5.9), show low connectivity between themselves and high overlaps with flood and water supply related actors such as the Water supply board, the Chief minister, Guwahati Municipal Corporation, and Kamrup District Administration. There is also a gradual growing attention towards river pollution issues, which can be seen with the increase in density and number of actors. This increase in attention is seen in quotes such as, “*without a properly designed and maintained sewerage system that city cannot survive. Release of untreated sewage has been posing serious threat to several city water bodies*” (Assam tribune, July3, 2000). However, few local and state government actors do not consider river pollution a problem, whereas national actors and CSOs have taken judiciary action against the state’s negligence towards river pollution. Despite judiciary action and fund allocation within project plans (JICA et al., 2008; Tahal Group, 2010, Master Plan 1980, 1998, 2015), there is a relatively low state and local government involvement concerning river pollution.

For the first three decades (1970 to 1999), the government sector had the most important actors for decision-making and facilitating coordination, but this has shifted in last two decades (2000 to 2009) to include international CSOs (World Bank, JICA, ADB) and private actors. In addition to policy inclusions such as private-public partnerships, this shift towards CSO and private actors can be associated with the role of these new actors as resource (funding) and capacity providers (technical expertise for infrastructure). The involvement of these CSOs is visible within all water risks, for example, through assistance with changes in urban infrastructure plans and new institutional setups such as the Guwahati Metropolitan Water and Sewerage Board, project implementing units for transparency in infrastructure construction, and aiding in implementing disaster mitigation plans for flooding (JICA et al., 2008; Tahal Group, 2010). Such involvement is increasingly dictating how infrastructure and other measures are being set up to address water risks within intermediate cities, thus changing central actors for decision-making (Colenbrander et al., 2019; Millington et al., 2020). However, mandates of international CSOs are not static, and changes in their priority could shift the authority back to the government. For example, funding from Rockefeller “100 resilient cities” ended suddenly

due to a shift in focus of funding strategies (Bliss, 2019).

5.5.2 Low Trust Environments and Associated Governance Costs

The theme of corruption is steadily increasing and in three of the five decades examined for the risks of water supply and river pollution (Figure 5.6 and 5.9). Recurring corruption contributes to low trust environments and has a bearing on the future functioning of governance networks.

In the evolution of governance structures, low trust environments can increase chances of future defection among actors, reduce the willingness of future collaborators to get involved or invest, and increase transactional and coordination costs (Siciliano et al., 2021). Regarding the impact of low trust environments in Guwahati, a water infrastructure project manager mentioned, *“It’s like after a divorce you see, when new partners come, they don’t know who was wrong and who to trust... (similarly) new contractors are hesitant to take up the pending jobs”* (EPb2). A local government official also mentioned that this low trust environment is perpetuated at multiple levels. *“Contractors also face money extortion by locals and local thugs,”* increasing hesitancy in attracting new actors. A retired local government official mentioned, *“the funds (are) already exhausted, that is why the contractors who were allotted on a turnkey basis, have left. It is because for part of their work, they will not get any payment”*. This hesitancy is increasing costs in two ways, one that *“the contract process (for infrastructure) is difficult as the contractors have escalated rates due to past failures”* (EPb2). Second, there are multiple project offices set up by funding agencies to ensure accountability, requiring increased efforts of coordination and communication.

One way to resolve low trust is creation of a new institution, thus removing legacies of associated distrust, and therefore likely to garner support and lower the transaction costs of coordination (Lubell et al., 2017). An analogous example includes the shift in multiple responsibilities from Guwahati Municipal Corporation to the new Guwahati Metropolitan Development Authority. There are also other drastic shifts in authority and centrality such as a decline of the Pollution Control Board (PCB) for river pollution and the rise of the Kamrup District

Administration. Low trust environments can be one of the driving causes for change in institutions, in addition other factors such as urban expansion and expertise to address the growing complexities of the water risks.

Another avenue to overcome low trust environments is to bring in an established or trusted central leader or figurehead into the broader governance network (Ansell et al., 2020; Véron, 2010). In Guwahati, the Chief Minister of the state of Assam, and in the last decade, the Guwahati Development Department are consistently found to play a key leadership role across all risks. These three actors are also among the top authority figures in decision-making (Figure 5.7 and 5.9). However, these central leaders are often involved in multiple governance platforms such as health, transport, housing, livelihoods and more. Continued reliance on these central actors can eventually lead to oversight and delays in mitigating water risk governance (Scott, 2016). When asked about challenges linked to coordination of risks, an officer in the Guwahati Jal Board highlighted this issue, *“Top bureaucrats are heading the committees and it makes it difficult for the committee to convene regularly. Therefore, the contractors are running around for permissions which is difficult”*(GOLb19). To ensure effective decision-making and coordination there is preference for the involvement of a trusted or “higher-up” powerful actor. But there is also concern that authority alone is leading to hollowed out decentralized functioning as indicated by another bureaucrat, *“authority is there, but for an organization to be working, it requires officers to support it in terms of manpower for GIS mapping, engineers, environmental specialists, etc.”* (GOSb6) .

5.5.3 Implications for Other Intermediate Cities of the Global South

The conditions and dynamics in Guwahati are like other intermediate cities of the Global South including governance actors being overstretched and spread thin, lack of resources, and large gaps in coverage of basic services such and water and sanitation (Birkmann et al., 2016; Brown et al., 2012; Satterthwaite, 2017b). This study finds three key implications for Guwahati which are also applicable to other intermediate cities challenged by water risks.

First, we notice a growing high-level governance trend i.e., higher levels of government are increasingly involved in urban governance. Decentralization within intermediate cities is referenced as an opportunity for democratic and participatory environmental governance (Véron, 2010). Our empirical analysis shows that decentralization of responsibilities and liberalization policies resulted in more actors being involved post-1990. However, there is an imbalance as the local government's decision-making power is mainly limited to a narrow frame of state-defined operation and maintenance and day-to-day mitigation activities. While decentralization was encouraged in the post-1990 growth of actors, the responsibilities of local actors has not altered much in the past five decades for Guwahati. The top-heavy involvement is justified by local perceptions, as 40 percent (8 of 20) of the actors interviewed stated that better coordination of action to address water risks can be enabled if "higher-ups" are involved. This dependency can be linked to the ongoing delays in decision-making for implementation and fund allocation as mentioned by more than half of the interviewed participants. Further, a top-heavy centralized decision-making structure contradicts urban governance policy design of the Indian 74th Constitutional Amendment Act of 1992, which provided institutional, fiscal, and financial reforms to strengthen and give autonomy to local urban bodies (Gopakumar, 2012; D. Kundu, 2014).

Second, there is a financial resource dependency that reinforces the hierarchy in decision-making. Intermediate cities such as Guwahati have a strong dependence on external funding to address urban risks due to low internal tax revenues owing to low GDP of the city (Adelina et al., 2020; Bhardwaj et al., 2020). This observed perpetuation of the top-heavy governance structure conforms to a dependence on the higher levels of government for resources and funding (Becker, 2018; A. Kundu, 2014; Siciliano et al., 2021). Therefore, decisions such as, the type of infrastructure required (currently large, centralized infrastructures) are made not by city officials but by state or national actors (da Cruz et al., 2019). This is the case for larger cities as well, but they often have higher internal revenues, and local administrations are in central positions to broker local needs against a higher level of policy (Bhardwaj et al., 2020; Gandy, 2008; Gopakumar, 2011; Therrien et al., 2019). Though not all intermediate cities fol-

low this pattern of centralized dependency, a few cities through local leadership have aligned higher-level policy with local needs leading to co-benefits (Bhardwaj et al., 2020). However, as witnessed within Guwahati's short-term nature of local bureaucracy, leadership alone is not enough to sustain long-term change.

Third, there is an increasing role played by local civil society and international CSOs in shaping responses to water risks and building accountability. In larger cities, local citizens groups play a more substantial role, through building platforms for engaging citizens and planning for risk governance (da Cruz et al., 2019; Gandy, 2008). Citizen participation in intermediate cities, however, is limited to the periphery via protest or public hearings linked to issues such as tariff changes for water supply or complaint against disruption caused by water supply infrastructure construction. While the involvement of citizen groups is likely to grow as the city expands (da Cruz et al., 2019), the extent of influence exerted is still linked to local political dynamics (Gopakumar, 2011). For example, within Indian cities, sewage and its direct disposal in urban rivers is not a significant concern for the government (Dempsey et al., 2017). This gap is witnessed by weak pollution monitoring and follow-up systems throughout India and in Guwahati (Lele et al., 2018).

Attention to river pollution in Guwahati was only subsequently solidified in 2010-2019 through citizen groups, media, and international CSOs' involvement. A bureaucrat from the environment and forestry department reinforced citizens' role in conservation, *"the public has the most influence in changing anything. Citizen pressure groups and public support makes action for the environment much quicker. The public puts pressure on courts, and courts such as the NGT (National Green Tribunal) are powerful agents in the execution of plans"* (GOLb6). This trend shows potential for citizens and civil society to call attention to building transparency and urgent concern of river pollution issues.

5.6 Conclusion

This study seeks to address the gaps in understanding patterns of change as governance networks associated with water risks evolve in an intermediate Global South city. Assessing longitudinal network governance of intermediate cities is essential to understand governance patterns but often challenging to study due to lack of data. This research combined multiple methods to enable a robust approach to examine patterns of evolution within governance networks. Data from local news, triangulated with interviews and policy documents, as used in this study, is a consistent and reliable source to highlight important actors and governance dynamics. Further, in the absence of more robust longitudinal data sources, this method can be used to examine a plethora of different urban sustainability issues.

Based on empirical evidence, the study finds a growing diversity and specialization of actors involved in addressing specific water risks within Guwahati. At the same time, there are also consolidated important responsibilities such as decision-making and resource allocation among few top-level actors. Such centralized forms of consolidation might slightly diversify in the future as international CSOs are increasingly becoming resource providers for intermediate cities. However, the top-level government authority is likely to maintain a stronghold of power due to their centrality within the network, their regulatory authority, and general low trust environments within which the network actors operate.

The research also shows how urban trends in intermediate cities are different from prevalent notions of governance. For example, there is a high level of involvement and dependence of high-level actors and low negotiating authority of local actors. Further, there is an increasing participation of international CSO's and non-governmental actors in shaping the direction of future strategies to address urban water risks. And finally, as the governance of urban risks evolve, there is also an increasing specialized focus. This focus is leading to more nuanced mechanisms to address water related risks. However, it is uncertain whether this nuanced or specialized attention is yielding better results, specifically if there is a rise in situations that reduce coordination efficiency and perpetuate distrust such as corruption and political

protests.

Few questions arise for future research which are beyond the scope of this study: how do we reconcile the ideas of decentralization for intermediate cities with the often-top-heavy resource (decision-making) dependency to address future risks? In what way is the ongoing inefficiency and distrust in formal water supply enabling growth and persistence of private water supply enterprises? And how can citizen groups play a role in building accountability and defining the local criteria required to address future risks within a top-heavy governance structure?

Finally, as a recommendation for practitioners who are seeking to address urban water risk, this paper highlights the different in responsibilities among actors and the levels at which specific interventions can be applied. Further, attention to the dynamics between national state level governments and international CSOs is required to influence change in water risk governance for intermediate cities of the Global South.

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CHAPTER 6: Paper 3

CHAPTER 6

Paper 3

Framing decision priority: The relationship between local newspapers and water risk governance in an intermediate city in India

An edited version of this chapter has been resubmitted to Environmental Politics

Fanaian, S. Framing decision priority: The relationship between local newspaper and water risk governance in an intermediate city in India.

Abstract

Intermediate-sized cities in the Global South are fast-growing but with high vulnerabilities and limited resources. In water risk governance when faced with competing choices, there is little understanding of how urban decision-makers prioritize actions to mitigate water risks. Therefore, we study what drives the priorities of governance actors in mitigating water risks and how local media influence these priorities. We assess the three urban-riverine water risks emerging from Guwahati's connection to the Brahmaputra River in India. Analyzing 50 years of local newspaper shows increasing attention linked to inadequate water supply issues, with seasonal reference to urban floods and episodic mentions of river pollution. Such differential reporting leverages resource allocation and institutional engagement towards specific water risks. Studying local newspapers can help understand the priorities assigned within local governance processes when there are competing risks and limited resources.

6.1 Introduction

Small and medium-sized cities or 'intermediate cities'¹ in Asia and Africa are more in number and growing faster than large cities. Yet, there is limited insight into how risk and related vulnerabilities are addressed in these cities (Birkmann et al., 2016). Many of these risks and vulnerabilities are water-related and contribute to more than 74 percent of the global disaster-related damages (WMO, 2021). Further, the rate and unplanned nature of urban growth, coupled with water-related risks, easily overwhelm the administrative and financial capacities that are often already spread thin (Birkmann et al., 2016). Given limited time, resources, and information, decision-making to address urban water-related risk follows a precarious route between accrued information, perceived priority, political will, and influences such as media, that shape perceptions of risks, portrayed in news media (Rayner et al., 2005; Varma et al.,

¹What constitutes an [intermediate city](#) is fluid and dependent on the urban classification within a country. Such cities are also called second-tier, small to medium-sized. The cities can host populations anywhere between 20,000–2.5 million people. Among the terms available for this paper, I chose 'intermediate' city because it alludes to a middle status within an ongoing process (Adelina et al., 2020; Cohen, 2004; Satterthwaite, 2017).

2017). Additionally, decision-making for water-related risks is not limited to water issues but includes diverse and sometimes conflicting considerations, such as economic development, environmental goals, national urban agendas, etc. (De Loe et al., 2017). However, when urban decision-makers in intermediate cities face these conflicting priorities, little is known about what signals decision-makers to prioritize specific choices related to water risks (da Cruz et al., 2019) and what role local news media play in framing these priorities?

Local newspapers are a communicative space to share local occurrences and shape understandings of water risks by balancing information and perceptions to construct a relatable story (Feezell et al., 2019; Tewbskury et al., 2020). While citizens also access information through social media, local newspapers are viewed as a legitimate information source to obtain news and governance perspectives (Rinne et al., 2016). Through daily and repeated coverage, local newspapers build legitimacy and familiarity with repeated terms and phrasings, thus influencing beliefs about risks and policy preferences of decision-makers (Crow et al., 2017). Examples of such preferences can include an inclination toward specific large infrastructures or insufficient attention to daily operations and maintenance activities that may not be as visible as infrastructure developments (Adekola et al., 2018; Aerts et al., 2018; Bohensky et al., 2014).

Therefore, the research questions: What drives the priorities of governance actors in mitigating water risks? How does local media influence these priorities? The analysis is carried out within the case of Guwahati, an intermediate city situated in Northeast India, focusing on the water risks of inadequate water supply, urban floods, and river pollution. Guwahati is among the smaller or second-tier cities in India that aspire to reach the ideals of a global or “world-class” smart city (Hemani et al., 2017), while simultaneously struggling with gaps in urban planning, financial and human resource (Pawe et al., 2018). These challenges of Guwahati are not unique and are experienced by many similarly situated intermediate cities of the Global South (Cook, 2018; Dempsey et al., 2017).

This assessment contributes to the growing literature that lies at the intersection of media studies and environmental public policy, striving to understand the influence of media out-

lets on environmental governance processes (Crow, 2010; Henrique et al., 2019; Sadath et al., 2013). The paper structure includes a literature review linking news media and governance. Section 6.4 is followed by the theoretical framework and methodology used to analyse news media framing. Section 6.5 maps the results of research within sub-sections addressing the specific risks in Guwahati - inadequate water supply, urban floods, and river pollution. Section four assesses the implications of these changes in water risk governance processes. Finally, section five concludes with the relevance of this research for other intermediate cities of the Global South, limitations of this research, and future research applications.

6.2 Literature Review

A local newspaper is a consistent information outlet with a pervasive spread among city residents (Barbehön et al., 2016; Crow, 2011). For many cities, local news media is a primary source of information that connects urban citizens with governance processes and vice versa. Plus, local news is likely the only legitimate source that regularly covers local policy issues and problems for citizens. However, local news is not objective but rather curated based on a journalist's perspective, thus making specific issues more visible and relatable (Gillet et al., 2014; Keller et al., 2020). Further, decision-makers are also news consumers that influence and are influenced by content created in newspapers (Scheufele, 1999; Tosun et al., 2020).

The ongoing coverage of contextual specificity mirrors perceptions of urban citizens and has the potential to influence local decision-making processes (Barbehön et al., 2016; Crow, 2010). Therefore, we study how the framing of water risks within a local newspaper over time can create priorities towards specific risks, actors, and solutions within an intermediate city of the Global South.

Studies in mass communication and public policy have demonstrated the power of repetition and frequency of news framing in mediating public and political will (Crow et al., 2017; Enke, 2020; Lecheler et al., 2015; Rinne et al., 2016). Framing of water risks within media is tied

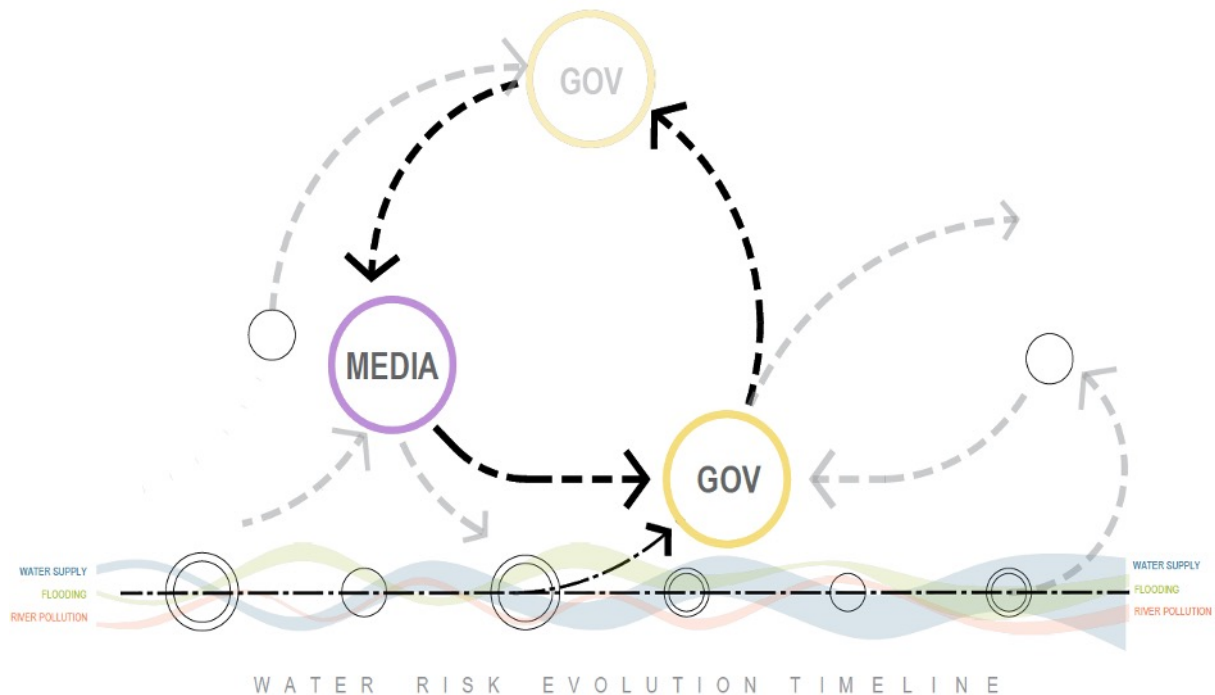


Figure 6.1: Conceptual visualisation of evolving media and governance. The feedforward and feedback influence on governance by increased visibility of specific risks such as water supply issues and intermittent attention to flooding issues. Water risk governance is also influenced by other aspects as indicated by the smaller empty circles. The water risk coverage although increases for water supply is intermittent but increasing for flood issues and recently there has been growing attention to the mostly neglected river pollution indicate rise in pollution concerns. (Diagram made by authors)

to highlighting and repeating certain aspects of risks, thus curating visible choices and creating a feedforward dynamic (as opposed to feedback loops) (Figure 6.1) (Reese, 2007). This feedforward dynamic is captured by the phrase “what you see is all there is”, introduced by Kahneman (2011) for assessing media-based framing (Kahneman, 2011, p. 86). This phrase implies that the most repeated or visible content is often at the forefront of the mind and overshadows other less visible content. Within the constraints of path dependencies, plus time and resources availability, the often-repeated framing and risk perceptions, due to their visibility, are preferred by decision-makers, and others not at the forefront are easily overlooked (Enke, 2020; Rayner et al., 2005).

Urban water risk governance involves unfolding processes over time with changing roles and responsibilities that often overlap and blur (da Cruz et al., 2019). Local news coverage of risks does not stop at just talking about the problem but often also includes who is responsible for addressing the risk and what has been done (Bohensky et al., 2014). This attribution of responsibility to a particular local body impacts how urban citizens perceive the institutional efficiency or failures, thus engendering accountability (Feezell et al., 2019). Further, to date, most analysis of local media has been limited to assessing public opinion and risk perceptions (Chong et al., 2007; Tewbskury et al., 2020; Wachinger et al., 2013). However, local newspapers can also highlight which issues are brought to the attention of decision-makers and political actors and how responsibility is attributed to specific decision-makers, specifically for intermediate cities where governance responsibilities are few, overlapping and often spread thin (Crow, 2010; Lecheler et al., 2015).

6.2.1 Case study

We used the case of Guwahati, the capital city of Assam, as emblematic of an intermediate riverine city facing multiple water risks and recourse strapped governance. While it is the largest city (1 million population) (Figure 6.2) on the Brahmaputra River, Guwahati is considered a smaller or second-tier city in India (Hemani et al., 2017; Pawe et al., 2018).

Guwahati was appointed (1970) and later (1974) became the capital of Assam (Nastar, 2014). Due to this new status as the capital of Assam, the city gained resources for housing and infrastructure, thus fostering urban growth (Bora, 2008). This growth also resulted in new institutional set-ups to improve governance, such as Guwahati Municipal Corporation (Fanaian et al., n.d.). Guwahati's selection as the capital of Assam is a critical period that galvanized the urbanization process. This time (1970) was therefore chosen as a starting point of this study. Further, we focus on the interconnected urban-riverine risks flowing from the river to the city, such as inadequate water supply and urban floods, and those flowing from the city to the rivers as river pollution (through urban waste). These water risks are governed with limited

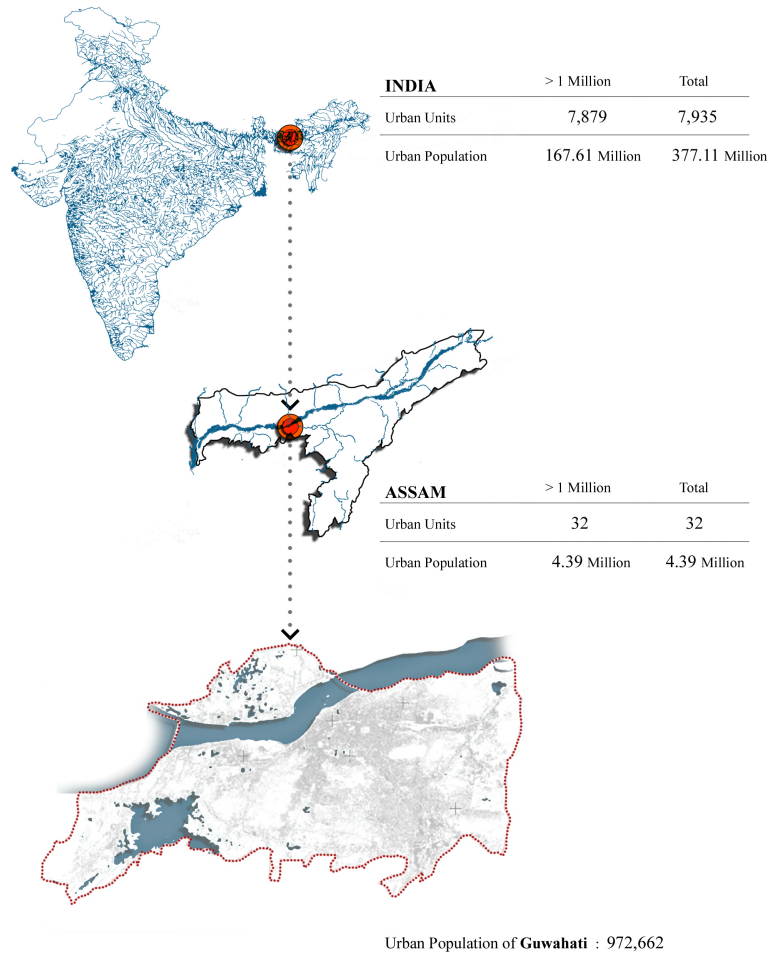


Figure 6.2: Location of Guwahati and Brahmaputra River (statistics from Census of India 2011)

resources, overlapping institutional structures, and multiple political interests (Hemani et al., 2016). Further, there have been numerous studies to understand the physical aspects of water risks in Guwahati, such as how floods occur in the city, strategies and plans to improve water

supply, and avenues to enable healthy river ecosystems (Chakraborty et al., 2016; Sarma et al., 2013; Tahal Group, 2010). However, many of these mitigation plans and studies are rarely implemented.

There are multiple media houses situated within Guwahati. One of the most prominent and highest circulated English-language dailies is Assam Tribune in Northeast India, running since 1939, with a circulation of more than 3 million. Other major newspapers include The Sentinel (established in 1983) and The Telegraph (launched in 1982). Assam Tribune's main headquarter is in Guwahati, thus reporting more Guwahati-centric news. This study focuses on the newspaper archives of Assam Tribune as other newspapers did not cover the period of interest, thus creating comparability challenges. Further, the non-automated nature (i.e., only physical copies available in archives) and limited access to other newspaper archives made cross-checking inaccessible.

6.3 Methodology

This research applies media framing theory (Scheufele, 1999; Tewbskury et al., 2020) through content analysis (Matthes et al., 2008) to understand how the differences in water risk framing can impact perceptions and decision-making. This paper draws on the most prominent and oldest local daily newspaper – Assam Tribune, to understand changes in water risk framing by exploring the terms associated with water risks, frequency of publication, the solutions listed, and the attribution of responsibility.

The focus on one newspaper over time aids in a consistent and deeper understanding of media influence on local decision-making (Crow, 2010). However, to address newspaper bias that may arise, we supplement and cross-triangulation the insights generated here with policy documents and peer-reviewed research (Angst, 2019). Further, we examine news articles linked to the three water risks arising from the urban-riverine connection, i.e., water supply, floods, and river pollution. Finally, the framing of these three risks is examined based on the following

conceptualizations.

6.3.1 Media Framing Theory

Media framing is concerned with how issues are reported (Jönsson, 2011) and differs from other media-based theories, such as agenda-setting or gate keeping. Media framing theory looks at how data is constructed into relatable stories, linking issues with actors and outcomes (Feezell et al., 2019; Stojanovic et al., 2016). Framing is also concerned with valence, i.e. when positive, negative, or neutral connotations are linked to particular ideas, actors, and recommendations (Feezell et al., 2019; Goffman, 1986). Such structure and value associations often signal and enforce priorities at the political or decision-making level and the individual or public (Adekola et al., 2018; Goffman, 1986; Tewbskury et al., 2020). In addition, this theory also allows assessing data sets with limited digital granularity (Chong et al., 2007).

There are a few crucial insights to consider within media framing, such as who is writing the news, where the news is placed (easily accessible or obscure location), and when the news is coming out. Knowing who is writing the news (e.g., journalist, policymaker, NGO representatives, academics, concerned citizens) plays a vital role in understanding the associated biases and positionality of the author (BryantMediaEdition; Adekola et al., 2018). Further, article placement (front page vs page seven) and frequency of occurrence or its repetition are proportional to the importance of a specific issue. Higher repetition leads to more chances of an issue remaining in memory and influences choices (Kahneman, 2011). Finally, particular periods or occasions also play a role in framing. For example, during monsoon floods, summer droughts, election time, or famous scandals, more content linked to that particular issue will appear in the news (Douglas Gould and Company et al., 2004).

We utilise content analysis of news articles to study how local media influences governance priorities linked to water risks. We assess how media frames evolve and which aspects of water risk receive more attention and influence decision-making choices.

6.3.2 Content Analysis and Framing

Content analysis is a qualitative (and quantitative) method frequently used to explore how media content is framed (Adekola et al., 2018). Qualitative content analysis includes identifying thematic patterns in-text. These patterns can be identified based on the meaning associated with a text which is coded by a researcher (Neuendorf, 2017). However, as with any qualitative research, there is a danger of bias based on what the researcher wants to see rather than what is in the text. Further, there is also a bias in deciding what content is extracted for analysis (Matthes, 2009). To mitigate these bias, follow recommendations by Matthes and Kohring (2008) and Matthes (2009) to improve the validity and reliability of content analysis for media framing.

The first important consideration to reduce bias is the need for a clear definition of a media frame. The widely accepted definition of a frame includes, “*To frame is to select some aspects of a perceived reality and make them more salient in a communicating context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation* for the item described.” (italicized in original) (Matthes et al., 2008, p. 264). The second consideration is clearly outlining how issue-specific articles are selected from the whole array of news articles. Finally, the most important consideration involves examining the repetition of the media elements (i.e., problem definition, causal interpretation, moral evaluation, and/or treatment recommendation) that form part of the framing (Matthes and Kohring, 2008: 264). Since multiple elements can simultaneously form part of the frame, it is recommended to code specific elements and how often they recur to examine patterns in content. A clustering of repeated elements can then reveal a frame.

Rather than coding the whole media frame (subject to researcher bias), we examine the elements (problem definition, causal interpretation, and treatment recommendation) and their repetition to understand patterns within media framing. We define the media elements within news articles as follows: Problem definition - how the risks are described., causal interpretation - i.e. risk-related interventions and outcomes are viewed as success or failure, and treat-

ment recommendation - i.e. the solutions prescribed to mitigate or adapt to the water risks. These three elements were selected for this research as they influence how framing occurs and also serve to answer the research question (Matthes, 2009). To link causal interpretation and treatment recommendations, we also included all the responsible actors mentioned within the framing.

We cluster elements based on their similarity to form “pattern frames” and then order them based on a hierarchy of their repetition and cross-examined across multiple articles (Matthes et al., 2008). This pattern frame clustering process reduces researcher bias in content analysis, as the examination of clustering and patterns is done after extracting the elements from a media frame. Cumulative insights from these pattern frames then serve to build accountability and to outline trends across time that can be used to test the hypothesis that— media framing through frequency and increased visibility can motivate political will to prioritize particular risks and treatment recommendations.

6.3.3 Data Sources

The data set for analysing media framing is collected from Assam Tribune (AT) from 1970 to 2019. The analysis was conducted based on 170,395 microfilm images (each image is a newspaper page) of the physical newspapers from 1970 to 2015. In addition, water risk-related articles from 2016-2018 were sourced from the e-newspaper on the AT website.

Methodologically speaking, using only one newspaper can pose a concern due to potential biases. The political bias of the Assam Tribune is unclear. Therefore to address any potential bias, we supplement and cross-triangulate trends derived from the newspaper with local policy documents, such as urban master plans and city development plans, and peer-reviewed literature (Angst, 2019; Barbehön et al., 2016).

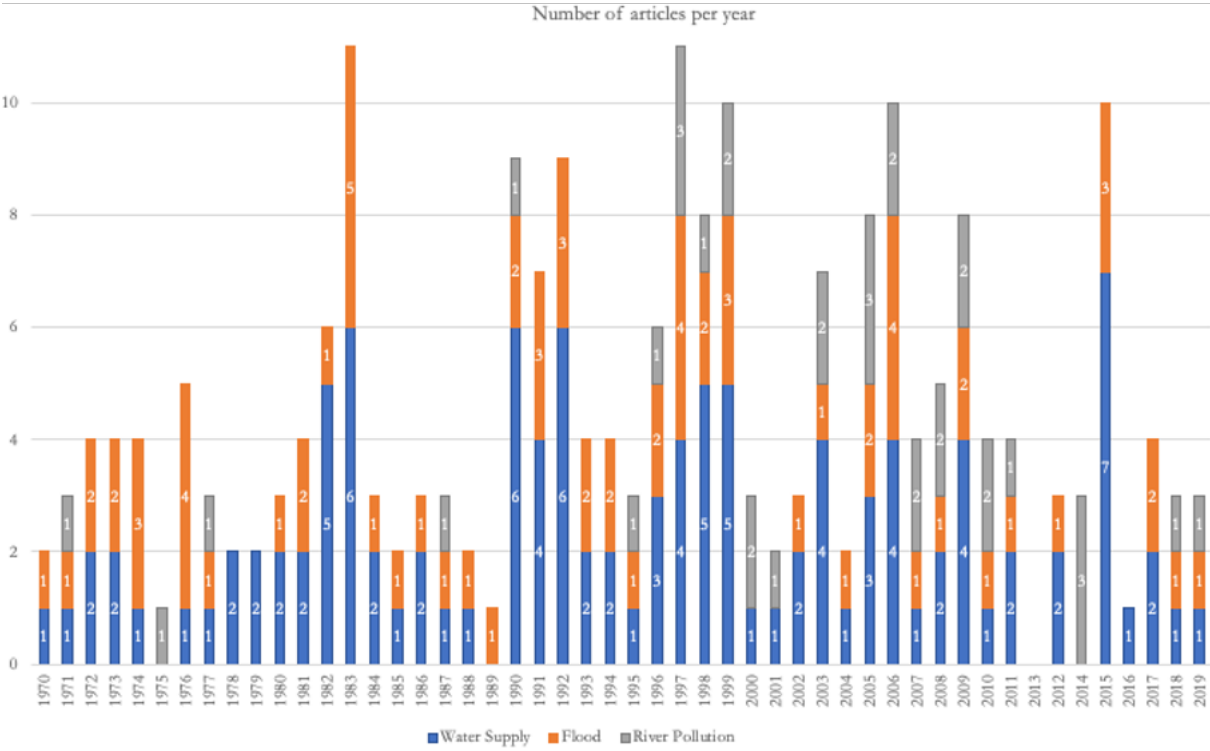


Figure 6.3: Water risk-related articles examined in Assam Tribune per year. Water supply linked articles - 113, Floods - 77 and River Pollution - 37

6.3.4 Data Sorting

The conversion from microfilm image to text was done using Optical Character Recognition (OCR) software. This conversion allowed only broad, page-wise digitization and the extraction of specific articles was not possible (Appendix 8.4 copy of a newspaper image). The R program (Version 3.4.1) (R et al., 2009) was utilized to discretize all the digitized documents into a dated and page-wise database (Figure 6.3).

The water risk mentioned on the front pages were isolated using a two-level keyword filtering approach. This approach narrowed down the relevant pages, which were then manually cross-checked. Boolean commands of AND/OR accompanied the keywords search filter. The primary filter of "Gauhati" AND "Guwahati" was applied to isolate Guwahati-related articles. Based on a preliminary review of more than 100 articles, words commonly associated with water risks were identified. These identified keywords formed the second filter. They include:

- Water supply: "water supply" OR "water tanker."
- Floods: "flood" AND "bharalu" OR "inundation" AND "bharalu."
- River pollution: "assam pollution control board" AND "river" AND "water" OR "river" AND "sewage".

A manual cross-checking was performed within the filtered pages to confirm the relevant content. After this, manual coding was carried out to identify changes in framing (Chong et al., 2007). The coding was based on the following questions. (i) How are the specific water risks framed? (ii) Who is assigned responsibility? (Local government NGO, academicians, state, national government, private companies, etc.) (iii) What solutions were suggested? Further, the messaging frequency was also noted as a proxy to signal priority and relative importance (Kahneman, 2011).

6.4 Results:Evolution in media framing of water risks

The temporal categorization of description for each water risk is based on the often-repeated content. As the water risks assessed are different, the urgency and tone of the news articles vary with each risk. Hence the description of media framing for each water risk follows a unique temporal tracking based on thematic changes in coverage of water risks (Table 6.1 summary).

6.4.1 River Pollution

River pollution has received the least media attention, with about 37 articles featured across 49 years (i.e., less than one article annually). This lack of attention can be attributed to low river pollution in the 1970s and 1980s, with reporting increasing as pollution escalated by 2019 (Figure 6.3).

"Sometimes cause inconveniences" (1970-1980): In 1971, even though extensive sewage

network and treatment plants were suggested in the master plan for sewerage and drainage and water supply (1971-2001), it was not undertaken. Based on the master plan, only one drainage lane was constructed (1985). Most domestic wastewater drains were directly connected to the local rivers and wetlands, which finally emptied into the Brahmaputra River (AT, June 01, 1971).

The river pollution-related concerns were mostly around industrial polluters (petroleum refinery), but complaints were sporadic and pollution sources were clearly understood. They included citizen complaints of waste released from the Gauhati Refinery into the rivers, causing a ‘floating fire’ on the Bharalu River (AT July 23, 1977). The complaint was followed with a promise that “the risk of pollution in the water of the Brahmaputra River from the Refinery effluent in the future will be eliminated” (AT, September 10, 1977). Urban citizens and industry were perceived as the actors responsible for solving the problem.

“heading for disaster” (1980-2005): The tone of problem framing across the 19 articles in this period was that of a disaster waiting to happen, in terms such as “looming” or “impending” disaster. Residents, citizen forums, and academics started to raise concerns about the Bharalu river and local wetlands due to household waste and waste generated from the refinery and hospitals. While worries about the Brahmaputra River’s pollution were raised, it was offset with an added note indicating that the river has “self-purifying” qualities (AT, June 24, 1997).

The number and types of actors involved in river pollution are diverse, including NGOs (21 percent), academics (26 percent), hospitals (37 percent), judiciary (16 percent), private industries (16 percent) and single references to various government departments and committees (10-12 departments) (figure 6.4). The Pollution Control Board Assam (PCB), since its formation in the 1980s, was the dominant actor mentioned in more than 60 percent of the linked articles. Additionally, more than 80percent of wastewater was reported to flow into the rivers and adjacent water bodies. This problem was blamed on the Guwahati Municipal Corporation (37 percent) and their inability to provide sewage connection and treatment.

More than 60 percent of news articles mentioned solutions to address the problem of river pollution. They involved raising awareness, judiciary action, sewage treatment plans, and integrated approaches. Integrated approaches were often suggested by academics and included multiple aspects such as the removal of encroachments on the riverbank and wetland floodplains, changing solid waste dumping sites, segregation of solid waste, sewage treatment plant, increasing urban green cover, stringent implementation of regulations, and improved regulation (AT June 10, 1996; July 30, 1997; June 23, 1997; December 12, 1999).

“Cesspool of filth” (2005-2015): There was a shift in the tone of framing on river pollution problem around 2005 from pending or looming disaster to highly polluted. The framing of river pollution started to indicate the urgency and magnitude of the issues through terms such as “pollution at alarming levels” or rivers being “cesspool of filth”. As of 2011, the Bharalu river was listed as one of the most polluted rivers in India, and the stretch of Brahmaputra River near the city was said to be unfit for swimming.

Pollution in the wetlands of Guwahati started appearing more often with framing linked to looming or impending disaster. There was also a rising trend of NGOs starting to raise calls for conservation and stricter enforcement of regulations to protect the wetlands due to the high ecological diversity that the wetlands support. As Guwahati’s rivers have become some of the most polluted in India (AT, October 24, 1998), the PCB took on a project and planned to revive the Bharalu river. Some mechanisms for protection included the provision of funds for the construction of a sewage treatment plant (AT, July 26 and July 31, 2010). These calls and regulations led several prominent hospitals and oil refineries to construct sewage treatment plants. However, no sewage treatment plants were built to address overall urban wastewater problems (AT, July 31, 2010).

“blatant lack of urgency” (2015-2018): While news coverage remained low on the front page (5 articles), these sporadic articles included framing linked to urgent calls for solutions and plans to address river pollution.

The Bharalu river was again cited as one of India's top ten most polluted rivers (AT, May 03, 2017). Due to inaction to mitigate pollution in Bharalu, a court case was filed with the National Green Tribunal. Addressing the court case, the PCB listed planned to rejuvenate the Bharalu river (AT, June 01, 2019). Further, the local government won a bid for the Government of India's program on smart cities. The smart city plans for Guwahati included sewage treatment plants, development of the Brahmaputra riverfront, and revival of the Bharalu river, Mora Bharalu River, and local wetlands (AT, November 11, 2019).

The solutions mentioned have narrowed to removing encroachment on riverbeds and wetlands and constructing sewage treatment plants, emphasizing sewage treatment plant construction. However, reporting linked to the state's failure to act continued through phrases such as "...blatant lack of urgency and utter failure to tackle environmental pollution" (AT May 16, 2019).

While the PCB was still the dominant actor mentioned in the news articles, the solutions were not linked to PCB anymore but to local departments such as GMC, Guwahati Smart City Pvt Ltd, and the District Administration. Moreover, the actors grew in diversity from 2015 to include new private consultancies, National Green Tribunal, and international

6.4.2 Urban Floods

Around 77 news reports were linked to the Guwahati floods between 1970-2018. More than 50 percent of these reports are featured in April and June to August. The frequency of urban flooding news reports is directly proportional to the flood intensity and severity. Severe flooding often makes the newspaper's front page; mild flooding gets allocated to later pages (e.g., inundation for a day, August 02, 1977, page 06). News articles linked to flood policy and related infrastructure plans occur year-round.

"Inundated by the Brahmaputra" (1970-1991): Urban floods were reported on the front page for the following years: 1970, 1974, 1980, 1981, 1984, 1985, 1988, and 1991. Among the eight

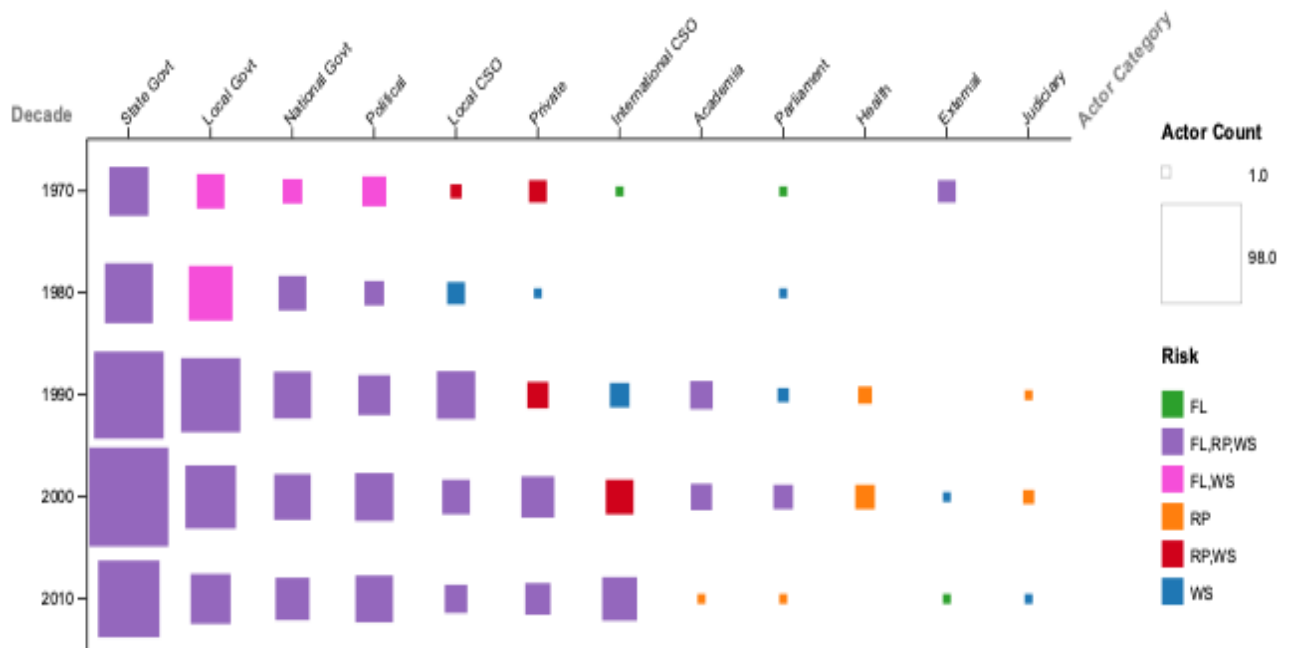


Figure 6.4: Count of actors within different categories and risks

flood events, five (1970, 1974, 1980, 1988, and 1991) were due to a rise in Brahmaputra River level coupled with high rain, resulting in back flow of the river into the city and inundation (AT, July 27, 1970; AT, June 21, 1974; AT Aug20, 1980, AT, Aug20, 1988; AT, July 11, 1991). These flood events were framed as the “worst ever” or “unprecedented flood”. All the “worst flood” reports were linked to high rainfall and an increase in river levels (Figure 6.5).

To resolve the floods, 40 percent of the articles listed infrastructure options such as sluice gates, river diversion, construction, and pumps as a solution to “control” floods. Again, the framing around “control” of floods was dominant. 90 percent of the actors listed were government departments, with less than 7 percent attribution to NGO involvement connected to capacity building and aid. Among the government departments, the District Administration (35percent) was mentioned most, followed by Brahmaputra Flood Control Department (28percent), after which mentions were dispersed equally among ten-eleven local, state, and national government departments (List of actors in 8.2).

“problem of chronic water logging” (1992-2002): In articles directly linked to flood events

(1998, 1999, 2000, and 2001) and their mitigation, the narrative around “water logging” was dominant. The problem of urban flooding was listed as water logging or inundation of the city due to encroachment, poor planning, and urban growth in more than 60 percent of the articles. The remaining reasons include heavy rainfall, the lack of funds, and the capacity to mitigate urban floods. Solutions centred on infrastructure drainage (storm water drain) schemes (80 percent), along with a focus on lack of funds and access to funds (20 percent) to implement infrastructure plans.

The actors involved changed during this time: About 60percent of the articles had references linked to citizen forums demanding accountability and mitigation of urban floods. The new local municipal administrative bodies were mentioned in 80percent of the news articles; they include Guwahati Municipal Corporation ([GMC](#)), Guwahati Municipal Development Authority ([GMDA](#)), and Guwahati Development Department ([GDD](#)) (GMDA and GDD were new institutions). The previously dominant District Administration reference dropped to less than 20 percent of articles. As infrastructure-related projects grew, the connections to the Town and Country Planning Department and Public Works Department grew. The news barely mentioned the Brahmaputra Flood Control Commission.

“City flash floods become more acute” (2003-2018): While the narrative of water logging and encroachment of flood plains continued, “flash floods” were repeated in almost all the related articles. While “flash floods” were mentioned in the past, they were not part of the dominant narrative. Flood events occurred in 2004, 2005, 2012, 2014, 2016, 2017, 2018. The flood in 2012 was the only one linked to the rise in the Brahmaputra River level and heavy rain. The remaining flood events were only linked to heavy rainfall.

The engagement of citizen forums continued as around 70 percent of the articles included references to local citizen forums. 50 percent also mentioned the local authorities, such as Guwahati Municipal Corporation and the Guwahati Development Department. The Water Resources Department and the District Administration were in 30 percent of the articles. Brahmaputra Board was rarely mentioned in the news articles.

The solution remained centred on infrastructure drainage (storm water drain) schemes (80 percent) but also started including upkeep, removal of encroachment, and maintenance (20 percent) of the existing storm water drains (local rivers), reducing plastic waste and solid waste dumping in the rivers. Encroachment of the wetlands and riverbanks was also frequently linked (30 percent) to urban floods. The flood of 2014 (due to heavy rains) resulted in eight deaths in the city (AT, June 28, 2014) and an extensive week-long drive to remove encroachment along the riverbanks ensued (AT, July 03, 2014). There were also plans drawn up for the “Mission Flood Free Guwahati.”

Urban growth and changes in a city’s environmental landscape, rainfall data, or river-level data are insufficient to inform an urban flood occurrence (Arabindoo, 2016). The information on flood events was then extracted from news reports and overlaid with rainfall and Brahmaputra river-level information to get an insight into urban floods experienced (Figure 6.5).

6.4.3 Inadequate Water Supply

There were roughly 113 news articles around water supply issues. Among the three risks, the highest reporting intensity is for water supply. The high frequency and negativity tone of articles were more pronounced during the summer season (March-April) and averaged during the rest of the year. From 1970 to 2018, the news framing linked to water supply mostly alternated between complaints of shortage or lack of water supply (85 percent of total articles) and announcements of a plan or inauguration of a new water supply scheme, interspersed with institutional failures and corruption charges.

“Erratic (water) Supply” (1970-1980): As a master plan for the drainage, sewerage and water supply was drawn up in 1972, it was found that the water supply schemes, while treating enough water, had networked piped systems connected to only 10 percent of the urban population (AT Apr12, 1972).

Among the water supply linked articles, more than 80 percent of problem framing was around

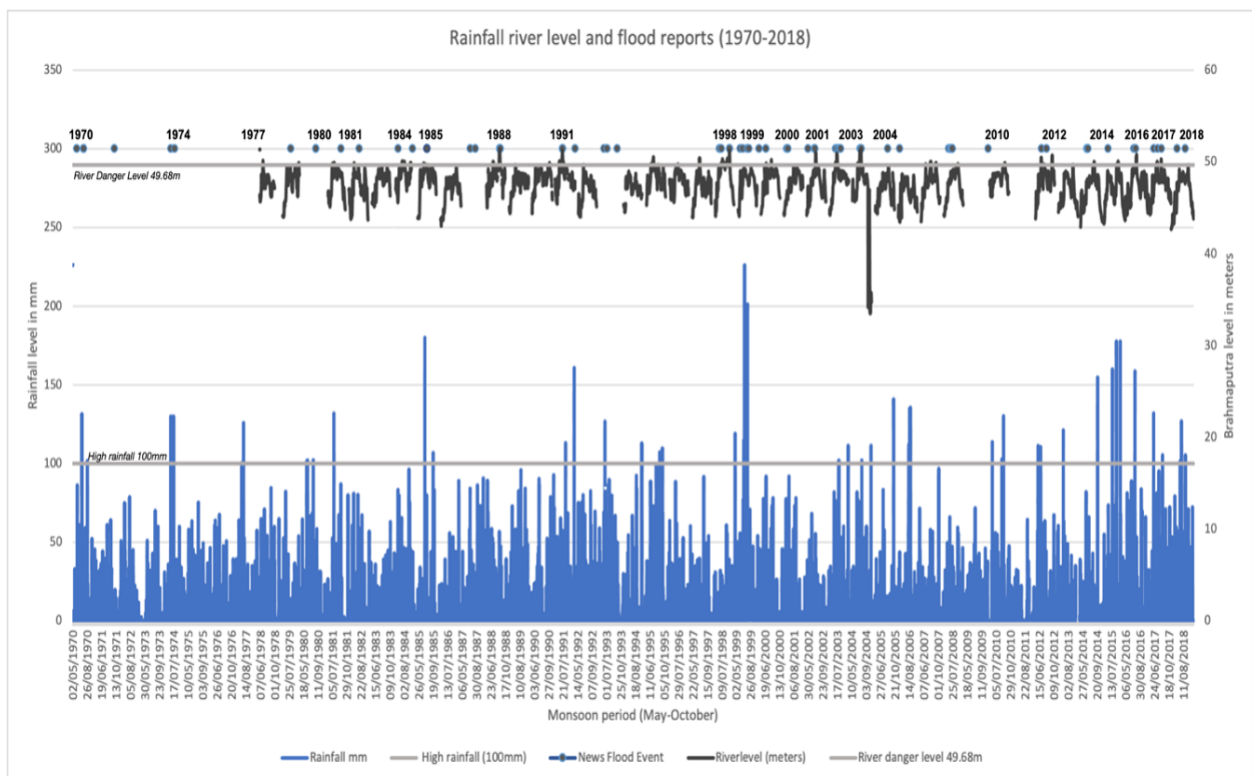


Figure 6.5: Daily rainfall, Brahmaputra River level, and news reporting(dots) linked to Guwahati floods. The rainfall data is for the monsoon season May-October from 1970 to 2018. The dot with the year mentioned indicates reported flood events, whereas just dots are news on flood-related policy and infrastructure

irregularities or lack of water supply or quality, followed by institutional challenges such as lack of funds or human resource (16 percent) and corruption (3 percent). When mentioning water supply problems, more than 50percent of the solutions suggested were linked to new infrastructure projects such as water treatment plants, deep tube wells, and piped water extensions. Other solutions included institutional strengthening and operation and maintenance of existing infrastructure.

Responsibility attribution was only within the government domain involving more than 19 organizations ranging from the local authorities to the central Government of India (GoI). The most popular and often named being the Gauhati Municipal Corporation (50 percent), followed

by the Public Health and Engineering Department (16 percent), the Government of Assam (16 percent), and others (Figure 03). Within these ten years, two instances of corruption were linked to water supply infrastructure attributed to ministers, legislative assembly members, and concerned authorities (AT, July 27, 1976; July 07, 1977).

“Adequate water supply in City from Winter” (1980-2007): While erratic or shortages of water supply were still an underlying theme (among 134 news articles), more than 45 percent were centred on commissioning new water supply schemes. These new schemes aimed for “adequate water supply” for all. However, approximately 40 percent of the urban population had access to the public water supply (AT, August 03, 1991). Even election manifestos highlighted drinking water for Guwahati as one of the big-ticket promises “The party would also take up schemes for the expansion of the existing water supply schemes...” (AT, May 05, 1995).

Shortage or lack of water supply was a recurring problem, especially during summers. This trend displayed growing frequency towards the end of this period. There were also references to institutional failure linked to the three institutions tasked with water-supply GMC, Assam Urban Water Supply and Sewerage Board (AUWSSB) and Public Health and Engineering Department (PHED). With more emphasis on the failures of the Guwahati Municipal Corporation.

New supply schemes dominated the solution landscape (around 45 percent). Funding sources were highlighted in about 21 percent of the articles with most funds being from different schemes under the Central Government of India. The reports also included international aid agencies, such as the Japanese government, the Asian Development Bank, World Bank, and other international agencies. The schemes ranged from large treatment plants with piped networks to decentralized water tankers. Another solution was accessing a private water supply. However, the references to accessing private water supply were negative, such as “taxpayers are forced to buy water at exorbitant rates from the private water tankers.” (AT, May 15, 1998).

Among the three institutions involved in water supply, the GMC was referred to in 69 percent of articles, and the PHED and AUWSSB were mentioned in only 19 percent and 13 percent, respectively. Among these elected representatives (primarily Minister of Municipal Administration or Guwahati Mayor) were mentioned in more than 40 percent of the articles. However, the link to ministers was ceremonial such as the inauguration of the water supply schemes (15 percent) and announcements on securing funding (21 percent). International aid agencies (9 percent) like the World Bank and the Japanese Bank were also involved. The taxpayer was also mentioned (19 percent) as an actor bearing the brunt of water shortage without much agency. Two protests in the city demanded regular water supply (AT, May 29, 1997; May 15, 1998) and one corruption case linked to water supply (AT, April 23, 1994).

“Round the clock water supply in the city by 2010” and “water scam of 2010” (2008-2018): The framing moved from adequate delivery to promises for round-the-clock, complete city coverage with 24/7 public water supply. But along with these promises, multiple mentions of corruption linked to water supply infrastructure also emerged. The primary framing alternated between funding 24/7 large new water supply schemes (38 percent) and corruption news (30 percent). The large water supply schemes were funded by GoI and international aid agencies such as the Asian Development Bank and the Japanese International Cooperation Agency.

The problem framing continued to be around gaps or lack of water supply (46 percent of articles) and an increasing and undesirable (based on the tone of framing) shift in private water supply due to a shortage in the public water supply. While the solution narrative involved a 24/7 round-the-clock water supply, the associated timeline of completion and delivery kept changing.

Table 6.1: Changes in problem and solution frames within news media over time for specific water risks

	Inadequate Water Supply	Urban Floods	River Pollution
1970-1980	“Erratic Supply” (1970-1980)	“Inundated by the Brahmaputra” (1970-1991)	“sometimes cause inconveniences” (1970-1980)
	<p>Framing</p> <p>“citizens of Gauhati are facing great difficulties due to scarcity of drinking water,” (Aug 13, 1974). “the taps trickle water in the morning for a short duration” (May 1974).</p> <p>Solution</p> <p>“Public health department will make provisions for the necessary water supply”</p>	<p>Framing</p> <p>Worst flood ever: “worst flood the city has ever experienced” (Jul 28, 1970); “the wrath of flood” (Aug 31, 1988): “water level has crossed records of flood marks” (Jul 22, 1974)</p> <p>Solution</p> <p>Divert the river: “scheme for diverting rain waters through Bharalu (river)”(Jun 01,1970)” taking control of the Brahmaputra flood control commission”(Sep 26,1971) “ take up schemes for controlling the river” (Apr 17,1975)</p>	<p>Framing</p> <p>Sometimes causes inconvenience:“effluent line sometimes causes inconvenience to the public” (Sep 10, 1975).; “the risk of pollution in the water of the Brahmaputra River from the Refinery effluent in the future</p> <p>Solution</p> <p>Infrastructure proposed: “Divert refinery effluents” (Jun 23,1977), “sewage treatment plant construction” (Sep 10, 1975)</p>
1981-1990	“Adequate water supply in City” (1981-2007)	“problem of chronic water logging” 1992-2002	“heading for disaster” (1981-2005):
	<p>Framing</p> <p>Institutional inadequacy, citizen suffering: “despite three different governate agencies ... huge gap between demand and supply in greater Guwahati.” (Mar 19, 2004).“the lackadaisical attitude of the GMC authorities, the people of the city have been pushed to the limits of endurance” (Sept 14, 1991). “thousands of residents are forced to buy water from private vendors at a premium.”</p>	<p>Framing</p> <p>Chronic problem: “these areas have also been facing serious water logging problems” (Mar 15, 1994). “water logging in Guwahati city has assumed alarming proportion” (Jul 03, 1998). “submerged due to waterlogging”. “to save the city from the problem of chronic water logging” (Apr 03, 2000)</p>	<p>Framing</p> <p>Heading towards disaster: “Bharalu may cause serious health hazard” (Jun 10, 1996) “Pollution levels in the Brahmaputra rising alarmingly” (Oct 24, 1998); “The environmental status of Guwahati city is heading for disaster” (Jun 05, 2005). “Wastes/water generated by any hospital in both urban and rural areas is pollutant substance... all other hospitals have so far failed to respond to the PCB directives” (Jan 13, 2001).</p>
1991-2000	Solution	Solution	Solutions
2001-2010	New institution & funds to supplement water supply: “activate the Urban Water Supply and Sewerage Board”(May 15, 1998). “new water supply constructed” (Dec 22,1998). “Constitution of a water supply board required” (Jan 26, 2003). “(funds) needed for augmentation of existing water supply” (Jan 02,2005)	Improve design & maintenance of river drains: “scientific management plan for the mitigation of artificial floods” (Jul 05, 1993). “ <i>beel</i> free from encroachments.” (Mar 15, 1994). “cleaning of drains and discharge canals”. “design the city drainage project as per city areas” (Jul 26, 1999)	Mixed solutions: “(need) to check the growing pollution” (Sep 21, 1987). “make people conscious of the threat posed to humanity by pollution” (Jun 06, 1990), “the self-purification capacity of the Brahmaputra is much more than any other river” (Jun 10, 1996).
	“Round the clock water supply in the city by 2010”	“City flash floods become more acute” 2003-2018	“cesspool of filth” (2005-2015):
2011-2019	“...water scam of 2010” (2008-2018)	Framing	Framing
	<p>Wide gaps in water supply conflated due to scam: “daily requirement of 243 million litres of drinking water in the city the existing arrangement supplies 73 million litres” (Jul 04, 2009). “Abysmal civic amenities including water supply in the city”(Mar, 20, 2012). “ involved in the water supply scam” (Jul 25, 2015).</p>		<p>Increased urgency: “pollution in Guwahati is growing gradually. However, (Guwahati) is not the most polluted city in the country” (Mar 14, 2007) “raised the wetlands pollution to alarming levels” (Jul 26, 2010). “cesspool of filth and poison” (May 30, 2008).</p> <p>Solution</p> <p>Infrastructure & regulations initiated: “Gauhati High court has taken suo motto cognizance of certain allegation of negligence”(May 26 2006). “waste disposal project of 27 lakhs of which incinerator is part includes ... waste disposal” (May 26, 2006). “ the Guwahati Water Bodies Bill, 2008...is for ... conserving, regulating and maintaining of wetlands” (Jul 19 2008).</p>
2011-2019	Solutions	Solution	Framing
			Solutions
<p>More funding to supplement infrastructural gaps: “Round the clock water supply in the city by 2010” (Oct 30, 2008). City drinking water woes to be over in 3 yrs (years).” (Feb 19, 2011). 24 hr water supply in the city by 2016” (Mar 30, 2012). “24x7 water supply projects to be fully commissioned in 2020” (Sept 03, 2018).</p>	<p>New infrastructure and maintenance of river drains: “floodwalls and 13 shutter sluice gates” (July 04, 2008). “earth from the Bharalu riverbed is removed better for a vast area of the city”(Apr 03, 2009). “suggested diversion of the Bharalu canal” (Aug 08, 2012). “diversion of the flow of the Bahini river” (Jun 27, 2017)</p>	<p>“blatant lack of urgency” (2015-2018)</p> <p>Framing</p> <p>Disregarding urgency: “blatant lack of urgency and utter failure to tackle environmental pollution” (May 16, 2019); “the steps taken for plastic waste management and biomedical waste management in the State were inadequate”(Jun 01, 2019). “ illegal releases and accumulation of wastes... is steadily demolishing the aquatic ecosystem system of the river Brahmaputra.”</p> <p>Solutions</p> <p>Demand for solutions: “prevent solid waste disposal into the rivers through River Bank Solid Waste Management and creating public awareness campaign” “GMC urged to shift dumping site”(Dec 14, 2014). “Brahmaputra riverfront development project in the first phase.”(Nov 09, 2018). “Guwahatians to rise in unison in support” (Nov 11, 2019)</p>	

Water supply remains a government-dominated sector; however, private consultancies in infrastructure planning and construction have increased. The Guwahati Development Department (31 percent) was the most often associated department with water supply. The Criminal Investigation Bureau (31 percent) was equally represented through their investigation of the bribery accusations linked to the water supply projects. The other actors mentioned included the Guwahati Metropolitan Development Authority (23 percent) and Louis Berger (a construction company). The Guwahati Metropolitan Drinking Water and Sewerage Board ([GMDWSB](#)) was seen in 8 percent of the articles. The Guwahati Municipal Corporation was also mentioned in 8 percent of articles, changing its dominance from the previous period. This shift in the actor's representation can be linked to a change in responsibilities for implementing large water supply projects.

6.5 Discussion

The results section captures the various trends in framing the three water risks – water supply, flooding, and river pollution. We uncover the implications of these trends and their influence on decision-makers' priorities and identified three main points of attention: The first point covers how the frequency of framing shapes perceptions of what is considered a priority. The second point highlights the risk frames that are becoming dominant over time (via repetition and frequency of mentions). Finally, we address how media framing of risk is also creating a feedback loop to build accountability.

6.5.1 Frequency of Framing Signals Priority for Political Action.

The frequency indicates the topmost priority for water supply action, followed by urban floods and the least for river pollution issues (Figure 6.5). Building political will and inclination of decision-makers in Guwahati is seen by uptake and repetition of dominant framing and ideas.

The language and urgency of action within policy and election manifestos follow similar language and the frequency as news framing. Promises for regular water supply delivery have

been on election manifestos of state and local political parties as early as the 1990s. In the early 2000s, due to the increase in the frequency of floods, flood mitigation measures (reducing water logging and inundation) started becoming a vital political agenda. River pollution issues get attention only when connected to urban floods and improved city drainage and, therefore, are not at the forefront of political awareness. Episodic framing, such as seen for river pollution, causes responsibility attribution to be specific to that instance alone rather than government and urban citizens.

6.5.2 The Growing Dominance of Infrastructure-Based Solutions

In addition to referring to water risk problems, around 75 percent of the news articles also include solutions for the perceived problems. Up to the early-mid 1980s, the solution framing was diverse and included multi-pronged approaches. However, over time the solution framing has narrowed down to infrastructure options.

This trend of growing infrastructure dominance is observed for all three water risks. Nearly 70 percent of the water supply-related articles focused on funding, construction, or inauguration of new central water supply schemes. Water-supply related infrastructure has been linked to corruption in at least four incidences. Similarly, flood mitigation solutions started as conserving flood plains and local wetlands, reducing encroachment in and around Guwahati, improving building regulation, and removing encroachment from floodplains. By the late 2000s, infrastructure-heavy options of dredging local rivers, building flood walls, and constructing sluice gates were carried out under the banner of flood mitigation.

Until the mid-1990s, solution framing for river pollution included changing construction regulations, improving conservation regulations, better monitoring structures, educating local citizens, domestic waste disposal away from rivers, judicial action, incinerators for hospital waste, and more. However, since the early 2000s, Sewage Treatment Plants (STP) have become synonymous with river pollution mitigation measures. Even though STPs were planned since the 1970s with finance assigned, the low perceived priority could be one of the invisible

forces responsible for inaction. This inaction also shows that finance is not the limiting factor for mitigation efforts (Millington et al., 2020).

6.5.3 Assigning Responsibility and Engendering Accountability

More than 90percent of the news articles also attribute responsibility when framing water risks. This attribution impacts how urban citizens perceive the responsible actors (specific government, private organizations, NGOs, etc.) and how decision-makers view the responsible actors (Feezell et al., 2019). For example, between 1980-2000, the Guwahati Municipal Corporation (GMC) was a dominant actor accountable for water provision (69 percent reference). However, towards the late 1990 and 2000s, the GMC was frequently associated with ‘failure’, ‘poor planning’, and ‘lackadaisical attitude’. By 2015, the attribution of water supply to GMC dropped to 8percent, and new urban water supply bodies were created as a solution to the GMCs ‘failure’.

Increasing attention is being given to civil society’s role and its coalitions in enabling policy change (Nastar, 2014; Thiel et al., 2019; Weible et al., 2018). Among the actors listed, from the mid-2000s, citizen forums (¿50percent attribution) started emerging as an active coalition of protagonists demanding action for flood mitigation and, to some extent, to address river pollution. The emerging coalitions demanding change and media attention propelled by a severe hazard event triggered the adoption and implementation of the previously nascent flood mitigation by the Government of Assam in 2016. The residents were the first to raise concerns about river pollution and demand improved river water quality. This involvement is visible in early 1976 over complaints of “floating fire” due to pollution from the local refinery and later with court action and news coverage in 2018 for the Bharalu river.

6.6 Conclusion

This research shows how local news framing can bring out the dominant concerns and differential preferences for specific water risks and solutions for an intermediate city in the global

South. In the analysis, water supply is shown to be given the most media attention with consistent policy actions and solutions undertaken. River pollution receives the least attention and even though pollution mitigation plans have been reported since the 1970s (AT, June 01, 1971; Alam et al., 2001), no measures have been enacted. While direct causality might not be established between local media framing and policy actions, there is enough information to understand the influence on political will and triggers for action.

Media framing deals with how media, based on framing the issues, assigns priority and provides a perception of the water risks experienced. Understanding the frequency of reporting and how local media frames water risks provides a contextual insight into what is considered essential for citizens and decision-makers. Water risk framing in local news can signal priority of actions, build political will, and engender accountability. As each intermediate city faces unique challenges, contextual insights into decision-makers' differential priorities can aid researchers in formulating and targeting policy interventions.

This research is an initial foray to understand the utility of local news media in framing priority and urgency for decision-makers when considering multiple water risks in intermediate cities of the global South. Further, this method is relevant for regions with limited data sets available to researchers. Such a contextual approach builds an understanding of the local nuances and cultural differences not easily obtained from hydrological data sets or policy documents (Mundoli et al., 2019). In addition, the information available allows the inclusion of historical accounts with more detail than recall through oral interviews (Hoffman et al., 1994).

News articles also prove useful in highlight relevant actors and identifying key players. Such information is rarely gleaned from policy documents in an atmosphere where power dynamics play a vital role. The framing processes also make visible the alternate arenas that can influence political will and decision-making (Crow et al., 2017; Nohrstedt et al., 2021). Media framing relate to policy outcomes, institutional strategies, and finance allocation. Further, obtaining consistent information on historical networks of actors is a challenge (Berardo et al., 2020). Such data can be extracted from news articles and used to analyze governance networks'

evolution.

Local news access has recently diversified through online newsletters, blogs, TV channels, and social media platforms. However, this diversity, while enhancing the information available, brings different challenges such as polarization through higher exposure to one-sided news creating "echo chambers" (Iyengar et al., 2009) and "sensationalization" of news to retain audience attention (Lecheler et al., 2015). Therefore, research with new data sets will need to include broader considerations such as target audiences, fake news, and more (Tewbskury et al., 2020). Despite media biases, local news media provides an abundance of information within data scarce regions such as intermediate and small cities in the Global South. There is ample scope to utilize local news media to build a contextual understanding of local priorities, political inclinations, and solution preferences of local water risks and their governance processes.

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6.9 Declaration of conflict of interest

The author reports no potential conflict of interest.

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FINAL CHAPTER: THESIS SYNTHESIS AND CONCLUSIONS

CHAPTER 7

Synthesis and Conclusions

Chapter Summary

In this chapter, I begin by summarising the research findings in response to broader questions presented in the introduction chapter. Subsequently, I consolidate the three main findings (7.1) into a broader context of challenges faced by intermediate riverine cities in the Global South. Following the research findings, I highlight the academic contributions and policy opportunities to improve the governance of water risks (sections 7.2.1 and 7.2.1). Additionally, while a coupled systems approach is operationally inclusive, it entails multiple challenges, which I outline in section 7.3. This research covers some critical facets of urban water risk governance but also generates questions requiring further research. These emerging future directions of research are outlined in section 7.4. Finally, I offer the conclusion of this research and the next steps in section 7.5.

7.1 Main research findings

My research asks the following questions— How has participation and (de)centralization of urban governance evolved in relation to different water risks in an intermediate riverine city in the Global South? This question is explored through a systems approach to uncover the co-evolution of water risks, the city and the governance processes. Viewing this evolution

through a multilevel and nested governance structure, I study the linkages between physical risks and governance trends, the network of actors (stakeholders) involved, and the external media influences (Chapters 4, 5, and 6). The first paper (Chapter 4), qualitatively evaluates the co-evolution of water risks and their governance processes. The second paper (Chapter 5), mapped the quantitative changes within stakeholder interactions in governance networks. Finally, the third paper (Chapter 6) explored how water risks are framed by local media coverage, thus influencing, and promoting specific priorities and visions of urban development. Together these three research papers build a composite understanding of the main question.

These research findings are explored the post colonial changes in the case of Guwahati, India. Guwahati serves as an example to examine the trends perpetuated within intermediate riverine cities of the Global South, where theory, policy, and infrastructure needs are shaped based on experiences from larger cities. The case of Guwahati provides inroads to uncover governance patterns and trends unfolding within such resource-strapped intermediate riverine cities. Such a detailed post-colonial exploration is vital as it expands on the infrastructure and governance structures of the recent past that are creating path dependencies and impacting current day decisions (Gopakumar, 2014).

How has participation and (de)centralization of urban governance evolved in relation to different water risks in an intermediate riverine city in the Global South?

The research follows the evolution of physical water risks, urban expansion –via built-up area, population growth and infrastructure– and the governance trends from when Guwahati was listed to become the capital city of Assam in 1970 till 2019 (present-day). The answer to the main research question begins by addressing the water risk related changes in ecological, technological systems, both built and infrastructure-based, and followed by detailing the concurrent complexities in social systems. This mosaic of insights is drawn pragmatically from the three research papers (Chapter 4, 5, and 6) to solve the research puzzle as raised in the introduction chapter.

Beginning with the evolution of the physical water risks (Chapter 4), I found water supply has been and continues to be an issue of utmost importance. More than 50 percent of the city to date lacks access to public water supply and the dependence on groundwater is increasing and its levels rapidly declining (Hazarika et al., 2016). Urban flood events have increased in frequency, even when climatic patterns, such as rainfall trends, have not shown significant changes. River pollution grew from an issue that was “sometimes of concern” due to waste spills from local oil refineries in the 1970s to become “a cesspool of filth” by 2018. The local rivers were also listed among India’s top ten most polluted rivers (CPCB, 2013).

On top of these issues, the built-up area and infrastructure of cities continued to expand and change the ecological form. One of the main problems being the reconstruction and diversion of river channels and fragmentation of wetlands for multiple projects (Chapter 4 figure 4.4). The governance involvement in mitigating and adapting to these water risks follows similar hierarchy of attention i.e., topmost for water supply followed by floods and least river pollution.

The multilevel and nested interactions amongst governance stakeholders also evolved as urban water risks and their related environmental pressures increased over time. To uncover these nested governance structures and their evolution, I mapped the influences and evolution of actor and discourses shaping policy priorities (Chapter 4 and 6) and quantitatively mapped changes in actors (Chapter 5). Chapter 5 demonstrates that concerted efforts to decentralize and devolve authority to local actors –for the three water risks: urban flooding, river pollution, and infrastructure diversion–, peaked between the 1990s and 2000s seen through the sudden rise in the number of actors for all water risks. This peak is theorized to be a result of national policy i.e., 74th Constitutional Amendment Act (74th CAA) of 1992 (Haque et al., 2018; Kundu, 2014; Sivaramakrishnan, 2011; Véron, 2010). This decentralization trend along with increasing private participation in the water and urban sector also fits with wider international trends promoted by international aid agencies (Bassi et al., 2012; Garschagen et al., 2019). However, this devolution started tapering by the 2010s. Further, even at its peak be-

tween 1990–2000s this devolvement and diversity was partial with an increased ambiguity of roles and responsibilities (Bhattacharya et al., 2014; Kalita, 2015).

This partial nature is seen across the three main Chapters (4, 5, and 6) in the way responsibilities are assigned. Important decisions on urban planning, resource allocation, and infrastructure choices that would mitigate water risks are kept centralized and reserved among high level actors (such as ministers) and national governments. Local actors (such as municipal corporation), in turn, receive the day-to-day implementation of plans (decided among high-level actors), but are often absent from the decision process.

Further, in such resource-strapped cities the increasing number of actors and ambiguity of responsibilities lead to reinforcing a centralized form of governance. Insights from Chapters 4 and 5 show that collaboration among the diverse local actors is sought through the organizing capacity of few centralized higher-level actors, such as, the chief minister or the district commissioner. Further Chapter 5 and Chapter 6 highlight how persistence of low trust environments and ambiguous responsibilities tends to reinforce reliance on these top-heavy “powerful” figureheads from the central government to broker trust and accountability (Scott, 2016).

However, this centralized coordination also leads to a mismatch between local needs and the decisions made, such as increased bias towards large infrastructure projects, often with higher political visibility, at the cost of reduced projects on daily operation and maintenance or coordination efforts required to effectively mitigate risks (Borie et al., 2019; Garschagen et al., 2019). Further, this pattern of governance reinforces involvements of higher levels of government, i.e., state, and national governments, leaving local actors with a small bandwidth to innovate or apply local learning.

In this context, an important finding was that these local entities are not entirely without agency and that they seek to apply change within their bandwidths. In Chapter 4, we see that local actors, within the narrowly defined day-to-day responsibilities and existing path depen-

dencies, find ways to juxtapose, circumnavigate or superimpose (Bhardwaj et al., 2020) local needs on externally defined policy. For example, as seen in Chapter 4, a dedicated Guwahati water board (Guwahati Jal Board) in 2009 was mandated by donors and state government for improved and efficient water supply for the city. The Jal Board was to take over and consolidate the water supply responsibilities from the existing multiple water supply entities (Guwahati Municipal Cooperation and Public Health and Engineering department, Assam Water Supply Board). But, to date, most of the water supply for the city is still provided by the Guwahati Municipal Cooperation and Public Health and Engineering department, in addition to other smaller entities and private vendors. A small fraction (less than 10 percent of supply) is covered by the Guwahati Jal Board. Further, gaps in human resources and delays in infrastructure completion also contributed to shifting this new Jal Board to the periphery.

Within this governance environment, there is also an increasing role played by the media, local civil society, and international Civil Society Organizations (CSOs) in building accountability and attention to overlooked risks. Chapter 6 shows that the more a particular risk adaptation (e.g., building floodwalls, deepening riverbeds, dredging) is repeated in newspapers, the more that option is likely to remain in memory, recognized as relevant when multiple choices are presented to policy makers (in addition to other aspects that influence decisions). Media and civil society's calls for attention to flood and river pollution issues often ensures action. This involvement builds a level of transparency and accountability within a system where responsibility is ambiguous and dispersed across different departments. For example, as seen in Chapter 5, media-reported instances of corruption assign responsibility to individuals and institutions which in turn deliver actions to demonstrate responsibility. Local civil society also uses media as a force for whistle-blowing when malpractices or neglect occurs. However, such demanded accountability can also lead to ad-hoc actions by politicians to demonstrate competence. Such citizens' call for action can trigger negative or positive feedback and change the political tide within the election of local governments. One such ad-hoc response to reduce floods and river pollution was the forceful eviction of vulnerable communities living in informal settlements on floodplains while large buildings and hotels in the same area remained

above reproach. On the other hand, a positive example was where continued citizen action reinforced by civil society in conjunction with judiciary efforts resulted in halt of the urban waste being dumped in rivers and wetlands of Guwahati.

Through ongoing negotiations between different forms of formal and informal processes and participation, I highlight the ongoing (de)centralization trends and participation visible in water risk governance for the intermediate riverine city, Guwahati. This involvement is different from those visible in large cities where policies are based on their collective experiences and local actors claim higher roles and responsibilities in decision-making (Gandy, 2008; Gopakumar, 2014).

7.2 Research Contributions

This research applies an integrated systems framework to examine urban water risks and their governance trends. Beyond advancing an integrated systems application, this research provides theoretical and empirical contributions (7.2.1), and urban policy recommendations (7.2.2).

7.2.1 Theoretical and Empirical Contributions

This research makes inroads into the empirical and theoretical gaps in understanding the evolving and participatory nature of water risk governance within intermediate riverine cities of the Global South.

7.2.1.1 Chapter 4-Paper 1 Contributions

Multilevel perspective MLP theory and historical institutionalism HI when applied in isolation have been critiqued as apolitical (Voß et al., 2011; Westman et al., 2019) or insular to only influence of policy makers (Pilon, 2021) when studying socio-technical transitions. The combined application of multilevel perspective theory and historical institutionalism by Roberts and Geels (2019) arose as a response to this ongoing criticism, hence, there has been limited

extension of this combined theory to understand evolution of governance and risks within cities. Further, Roberts and Geels (2019) highlighted few gaps for further exploration, the first include exploration of political dynamics at macro and meso level and their impact on transition. The second gap is uncovering complementary factors along with patterns and conditions that accelerate change. The third gap includes limited inclusion of policy-internal processes, i.e., internal, or horizontal level interactions across various categories of actors.

Chapter 4 (Paper I) expands this application of multilevel perspective theory and historical institutionalism to study intermediate riverine cities in the Global South and addresses these two gaps i.e., limited studies reflecting on institutional transitions (i.e., dynamics of uptake, decline and path dependencies) and second, uncovering patterns of change involved in this transition. The first contribution of my research is expanding the application of MLP and HI to uncover the influence of macro and meso political dynamics on local water risk governance. This is achieved by viewing cities as open systems (Bai et al., 2016) (detailed in the Chapter 2) that interact with and are influenced by multiple levels (i.e., local, state, national, and international). Exploring these dynamics allowed me to observe how mandated decentralization policy was renegotiated at different times by international, national, state, and local actors to arrive back towards centralization due to resource dependence and ambiguity of responsibilities. The second contribution includes the expansion of patterns and condition that accelerate governance transitions across three systems i.e., social (both formal policy-making processes and informal actors such as media and civil society, and social movements) ecological (via physical changes in water risks) and technological (through changes in built form and infrastructure). This expansion allows a holistic inclusion of the various pieces of puzzle that fit together to contribute towards governance transitions.

Finally, I draw on this combined theory to uncover the complex modes of internal (i.e., within the government) and external processes (i.e., actors outside government, social movements, and physical changes) that influence governance. Further, my paper demonstrates that this influence is defined on the one hand by ongoing path dependent negotiations or “making do”

via local governments, civil society, and informal actors, and, on the other, by centralized and bureaucratic decision-making systems (McDuie-Ra, 2016). This paper serves to outline the agency of local actors to innovate within norms that are externally set by an increasingly centralized nature of urban governance. The research also outlines the future challenges and opportunities to effectively address urban water risk in Guwahati by drawing on the interconnected governance challenges.

7.2.1.2 Chapter 5-Paper 2 Contributions

Chapter 5 (Paper 2) quantitatively explores evolution of networks of governance through network governance theory and the method of dynamic social network analysis. This paper empirically extends research on the differences in participatory governance trends between intermediate and large cities (Nagendra et al., 2018). One specific supposition included that local actors in second-tier cities (like Guwahati) may have lesser sovereignty in negotiating innovation and change than large cities (da Cruz et al., 2019). Further, empirically studying historical governance trends within intermediate cities of the Global South is difficult due to data scarcity and lack of access to regular databases as present within cities of the Global North (Nagendra et al., 2018). Finally, there is an ongoing research gap in study of evolution of urban governance networks (Bodin et al., 2019; Coelho, 2018; Rademacher, 2015).

Chapter 5 provides empirical contribution by quantitatively outlining the changes in network of actors and the patterns of evolution within multilevel and nested governance structures for the three specific water risks of flooding, water supply and river pollution. The empirical contribution also includes quantitatively mapping how a centralized and top-heavy governance structure within intermediate cities is reinforced by a low trust environment and a gap in the devolvement of decision-making authority. The research shows that efforts to decentralize governance contributed to an increase in number and types of actors, but the position of central decision-makers on important issues such as resource allocation remained almost same across the five decades. The consequence of this trend is the increasing dichotomy between local mitigation needs and perceived economic goals for urban development by the central

actors. This trend empirically proves the supposition raised by da Cruz et al. (2019) and supported by others (Gandy, 2008; Gopakumar, 2011) that local actors in large cities have more negotiating powers and sovereignty to innovate than intermediate cities.

Further, little research has quantitatively explored the temporal changes in governance networks within intermediate cities in the Global South (Lele et al., 2018). This gap is often due to the lack of consistent data sets (Berardo et al., 2020). This paper fills this methodological gap by creating a database by extracting names and responsibilities as listed within daily newspapers over 50 years. While tedious due to physical limitations (i.e., only paper copies and previous gaps in digitization of local newspapers), new tools for content digitization such as Optical Content recognition (OCR) reduce time required to extract governance interactions from local newspaper articles can provide a consistent data set for assessment. Finally, the theoretical contribution includes examining the conditions such as ambiguity of responsibilities and environments of distrust, which allow centralized governance mechanism to persist (Ansell et al., 2020). Further, the mitigation my research also shows approaches used by the informal sectors such as citizen groups, civil society, and the media to try to bring accountability. The research also fills an ongoing gap in network governance and public policy on how and why actors in power change within governance over time (Berardo et al., 2020; Reed et al., 2010).

7.2.1.3 Chapter 6- Paper 3 Contributions

In Chapter 6 I move away from institutional and actor analysis to check how media framing (within local news media) can prioritize specific water risks and vision for urban development in resource-strapped regions that face multiple water risks, such as intermediate riverine cities of the Global South. The chapter on water within the recent IPCC report (2022), highlights the need for transformative change in research to move towards an integrated understanding across multiple water risks. Media can signal attention or priority to specific aspect or solution option through repetition and creating a sense of urgency thus motivating political will (O'Neill et al., 2015). However, most studies on media framing of urban water risks are limited to the analysis of one water risk at a time, i.e., only floods or only pollution (Adekola et al.,

2018; Olofsson et al., 2018). Little known about the framing of different water risks within the same newspaper to understand the difference in priority attached to multiple water risks over time.

Through content analysis of media frames in newspapers, I cull out the framing of the risks, solutions to address risks, political dynamics and the *masala* or gossip that influence decision-making. In this case with water supply issues are given the most attention, followed by flooding issues, and the least for river pollution. This paper also provides insights into the triggers that allow specific solution options to prevail within politically contested, resource and time-limited decision-making processes. (Rayner et al., 2005). For example, particular types of infrastructure such as large visible centralized water supply get more bandwidth of attention rather than smaller invisible decentralized water supply infrastructure. Similarly, ideas for creating new institutions to resolve institutional inefficiency, e.g., specific new institutions, such as water boards, that are repeated often within the news due to their high visibility get quickly passed within parliament discussion (Borie et al., 2019). The high visibility in media and attention often creates a feedforward and self-reinforcing loop (Holland, 2012).

7.2.2 Policy Contributions

Urban water risks are the results of interactions between the ecological, social and built systems, and cannot be studied or managed in isolation (New et al., 2022). My case shows that, while unintentional, there used to be high overlap among actors that addressed water risks (mostly due to fewer human resources), thus encouraging a level of cursory cross-attention to the interconnected impacts. However, as resources and attention to specific risks grew, there is a concurrent disconnect and narrowed focus of actors on each risk. For example, the Guwahati water board only addresses water supply, disaster agency only at disaster like floods. These specialized organizations don't naturally intersect or address interconnected impacts. The result of this increasingly narrow attention is the fragmentation of mitigation efforts across all the three interconnected water risks (urban floods, river pollution and inadequate water sup-

ply).

Further, the findings show the growing cost of coordination can easily become too expensive in resource-strapped cities such as Guwahati. But continuing with a fragmented approach is also not a viable option as it results in expensive impacts, often borne by those who can least afford it (Christophers et al., 2020). Therefore, there is a need to find a balance between centralized and decentralized modes of governance for addressing the multiple water risks faced by intermediate riverine cities.

Further, drawing generalization for intermediate riverine cities of the Global South might be contentious prospect. However, following the conceptualization of Global South as defined in the literature review, one of colonial legacies especially in countries in Asia and Africa creates many similarities in how governance unfolds (Mohan et al., 2021). The new governance processes in these cities are entrenched in norms and vision that are based on colonial land-use and control-based, static urban plans designed for “good” urbanization (Watson, 2016). These trajectories lead to many similarities in how urban governance occurs across these Southern cities. There are four predominant consequences of this research on future urban risk and policy implications: (i) Mismatch in urban policy vs. reality of intermediate cities (ii) the growing grey infrastructure bias to mitigate risk; (iii) low trust governance environments and role of CSOs; and (iv) Involvement of formal and informal local actors within urban risk governance.

(i). Mismatch in urban policy vs. reality of intermediate cities.

Experiences of intermediate sized cities are different from those of large cities as seen through this research, but urban policy is modelled on experiences and innovations of large and mega cities. This trend creates mismatches in implementing policy to mitigate water risks, three of which come up in this research. This mismatch for smaller urban settlements was also listed in high agreement within the latest [IPCC](#) report on cities (Dodman et al., 2022). The mismatch stems from multiple factors.

Many urban policies and recommendations operate from the positionality of creating a new

institution to increase attention for specific risks (e.g., new water board to focus on improved public water supply) (Patterson, 2020). This trend is feasible when there is decentralized authority to facilitate coordination, as seen to a certain extent in larger cities (Gandy, 2008). However, in intermediate cities while there is some consideration given to how these new institutions will function within the wider governance system, the additional costs of building collaboration are often underestimated. This underestimation is because there is an ongoing reliance on few central actors for key decision-making and coordination and these actors are already spread thin (Adelina et al., 2020; Véron, 2010). This central reliance creates a bottleneck of delays, thus leading to lack of coordination and fragmentation of actions. Diversifying decision-making on important aspects such as resource allocation could be one way out of this bottleneck. However, devolving decision-making powers is politically contentious in smaller regions (due to smaller pool of resources), as seen when efforts to decentralize authority started rising in the late 1990s and then declining in 2010s in Guwahati (as seen in Chapter 4 and Chapter 5).

Further, there is a growing attention to ‘smart cities’ within India. While smart cities policy was conceptualized to nature-based and technological solutions in an integrated manner to leapfrog towards building sustainable cities (Praharaj et al., 2018). The experiences, as within Guwahati (and other intermediate cities) show a bias towards technical fixes while nature-based responses are postponed to future plans (Mukhopadhyay, 2018). Further, in implementation of the smart city technology aspects as well, there is a hierarchy of attention given to risks, with water supply getting most attention (e.g., water supply kiosks) and construction of sewage treatment plant (to mitigate river pollution) is postponed to the next urban plan. There is mismatch between the plan and reality of implementation (Bhan, 2019). This has been addressed by increasing citizen attention to issues such as conservation of river and wetlands. However, this accountability places additional burden on voluntary citizen groups (Chu et al., 2016). Further, there is ongoing research that suggest action of citizen groups are often targeted towards middle class problems, this might overlook vulnerabilities of those in lower income brackets (Olofsson et al., 2018).

(ii.) Grey infrastructure bias.

Over the last decade within Guwahati, decisions to address water risks have developed a strong grey infrastructure bias, regardless of the reasons that cause water risks. This bias is concerning for three reasons. Firstly, as seen in Chapter 5, infrastructure projects are related to corruption trends and lead to an environment of distrust within governance. This trend is not uncommon within cities of the Global South and has also been evident in some cities of the Global North (Biddle et al., 2019; Bigger et al., 2020; Millington et al., 2020). Such environments of distrust and corruption can easily result in inefficiency and higher costs in the future (Davis, 2004). Secondly, large infrastructures can create a lock-in of future solution options, therefore reducing the probability of alternative local measures to address risks (Bebbington et al., 2020; R. Brown et al., 2011; Marlow et al., 2013). For example, the channel streamlining efforts of the city that reduce reliance on and increases degradation of the existing nature-based solution, such as urban wetlands. Further, conserving such nature-based solution could reduce future hazards by giving water space to move, but the political dynamics of the real estate impede this actualization (Dodman et al., 2022). Finally, infrastructure can lead to spin-off feedback, or maladaptation, that can further exacerbate rather than mitigate risks (Millington et al., 2020; Schipper, 2020).

However, infrastructure gaps are also a reality of intermediate cities of the global south where more than 50 percent lack access to piped water supply. The IPCC report on water (Angela Caretta et al., 2022) cites that more than 440.05 million individuals living in cities will lack access to water supply by 2050 and the situation in the Global South is considerably more precarious than in the Global North. When compared to large and mega cities, the growing nature of intermediate cities with low lock-in into grey infrastructure offer a window of opportunity to explore alternate (e.g., low tech or nature-based) and small-scale forms of water risk mitigation infrastructure that can be supported by local actors without excessive intervention of higher-level actors. Further, leveraging small scale or nature-based infrastructure can also reduce the scope of corruption due to low investments required (Christophers et al., 2020).

(iii) Low trust environments in governance and role of CSO in increasing accountability.

Chapter 5 and Chapter 6 displays increasing corruption within urban water risk governance however, there is also a growing role of civil society and informal actors in building accountability. Growing corruption has ripple effects leading to low trust environment, increased transaction costs, inefficiency, and challenges in obtaining future funds and collaborations (Davis, 2004). One stance adopted previously to deal with the repercussions of corruption and resulting low trust environment is creating new institutions. However, new institutions don't often neatly step into the shoes of old institutions, thus leading to more overlaps in responsibilities, ambiguity, and funding requirements (da Cruz et al., 2019). Continued distrust can lead to an increase in transaction costs such that international and national funding can demand more paperwork and institutional oversight to ensure transparency and accountability. Further, acquiring new private and institutional collaborators will require higher incentives due to low accountability and transparency (Berardo et al., 2010; Ö. Bodin et al., 2020). Civil society and informal actors are increasingly stepping up (as seen in Chapter 5 and 6) to build accountability and call attention to important but issues of lesser priority such as river pollution.

(iv) Involvement of local actors.

This research identified the critical decision arenas that currently lock out local actors' participation. There is a growing focus on local municipalities within the fields of sustainable urbanization and risk governance (A. Brown et al., 2012; Mohan et al., 2021). My research brings an essential policy insight by highlighting that, while the decentralized local governance actors are promoted as agents of change, they are not in charge of decisions made for urban adaptation and mitigation plans. Further, essential urban funding and infrastructure decisions remain centralized to a narrow group of actors (usually at the chief minister level or national departments and not the local municipalities). As a result, the local actors must circumnavigate the existing plans that don't fit local requirements by reinterpreting or "making-do", whilst simultaneously navigating existing socio-political arrangements (Bhardwaj et al., 2020; Bigger

et al., 2020; McDuie-Ra, 2016). Overlooking the inclusion of these important actors can limit sustainable urban growth.

7.3 Research Limitations

Research boundaries: The framework of multilevel perspective theory and historical institutionalism was a challenge to use due to its limited applications to date. While inclusive of the different social and political aspects that could potentially impact governance, the framework also creates a problem of too much information. Where does one draw the line when examining all the different interactions occurring within external and internal dynamics? I had to create a boundary around my research to address this challenge. This boundary narrowed to the three water risks (urban floods, river pollution and inadequate water supply) that occur within the urban jurisdiction of Guwahati. The qualitative assessment then expanded to include all relevant interactions and occurrences at local, state, national and international scales concerning these water risks (Cairney et al., 2017; Holland, 2012). This insight allowed me to include the details while not getting lost in the data. This focus on the three risks was followed across the other papers.

Integration between water risks: While this research talks about an integrated systems approach within governance of water risk, I do not include the integrated impacts across the water risks or compound risks. Compound risks “arise from the interaction of hazards, which can be characterized by single extreme events or multiple coincident or sequential events that interact with exposed systems or sectors” (Simpson et al., 2021, p. 491). For example, the growing river pollution not only impacts water supply but also lead to health impacts and by clogging the local rivers exacerbates urban floods. Those vulnerable informal communities living on floodplains face compound risks as they are hit from all sides including health, home and safety. Building an assessment of such compound risks is a complex task beyond the bound of this research. While there is capacity to model scenarios on how compound water risks unfold, there is limited insight on how the multilevel and [polycentric](#) governance structure

can be leveraged to coordinate and co-produce strategies to mitigate the uncertainties involved (Dodman et al., 2022).

Network Analysis Challenges: There were multiple challenges in carrying out social network analysis [SNA](#), specifically when deciding which statistical metrics to use and how to sort the different periods. For example, much SNA-based research on governance is either carried out for a single period or within the context of the Global North's relatively stable and defined governance pattern (Berardo et al., 2020; Siciliano et al., 2021). However, there is recent growing attention on examining the evolution of governance (Albrecht, 2019; Li et al., 2021). Within these constraints and new learning, all the metrics were relevant, but would ultimately dilute and complicate the research results. Therefore, the metrics selected were ones that directly served to answer the research questions.

COVID-19: COVID-19 resulted in the cancellation of the final fieldwork, which was supposed to include a half-day consultation in September 2020 in collaboration with the Guwahati Development Department (local government). This consultation was part of the ongoing relationship built with the local government over two years of fieldwork and previous work experiences. The aim of this workshop was to build a participatory consultation that would have included recommendations and perceptions of the involved actors regarding how the governance of risks can be addressed and to explore what approaches are feasible. This plan was cancelled. These recommendations and the co-creation of knowledge would have served through the methods of a Bayesian model for decision-making under uncertainty. The insights from this consultation and Bayesian model were to serve as the third paper. Through the co-creation workshop, I had hoped to validate my research and get buy-in from local actors, as they play fundamental roles in co-creating strategies for future risk mitigation in their city. Due to COVID this plan had to be adapted to examining external influences on governance via news media.

However, I am working to organize a similar workshop in October-November 2022 with the relevant stakeholders in Guwahati. But the results from this participatory workshop will be

beyond the scope of this thesis manuscript.

7.4 Future Research Directions

No matter how robust an exploration, a complex socio-ecological system such as intermediate cities of the Global South can only ever be partially understood. Multiple areas of further examination can benefit from detailed research.

Most urban governance policies are aimed at reducing risk and vulnerabilities, however, there is limited insight on the co-evolution of vulnerabilities in response to changes in policies and risks within intermediate riverine cities. This insight is necessary to inform the implication of urban risk mitigation policies that are usually designed based on experiences of large cities where decentralized governance is more established than intermediate cities.

There is a need to understand the changes in vulnerabilities experienced as risk mitigation practices evolve in intermediate cities the Global South (Birkmann et al., 2016). As climate variability exacerbate increased migration is seen from rural areas to cities, and intermediate cities are poised to house most of these climate migrants (Singh et al., 2018). These migrants live in informal settlements often on precarious land such as open spaces near water bodies. These settlements are at the forefront in experiencing the impact of water risk and mitigation practices, either through floods or eviction processes in the name of risk mitigation (Taylor, 2015; Ziervogel et al., 2016). Often these communities bear the burden of developing coping strategies or at worse become part of collateral damage in the face of risk mitigation policy impacts (New et al., 2022). Therefore expanding insights into water risks vulnerabilities along with concurrent evolving impacts of governance trends experienced by these informal settlements will require further in-depth exploration. Within Guwahati, there are multiple communities living in informal settlements in low lying areas, hills, and floodplains.

An in-depth exploration through an ethnographic collection of stories and recollections of adaptation strategies to cope with water risk is one method of building such insights. Such

research can bring together the existing coping mechanisms and locally relevant factors required in building resilience. This locally sourced insights can add the required depth and contribute to equity within governance plans and policy (Eriksen et al., 2021).

The three papers show how the centralization of urban governance is seen to be a growing trend within Guwahati, with few central actors maintaining a hold on decision-making. While there is shift towards diversity in governance, the ensuing ambiguity consolidates decision-making power among a few (Swyngedouw, 2005). In large cities due to higher number of elite actors, financial decision-making power of local governments and stronger civil society engagement there is more demands on accountability (Cook, 2018; Mitra et al., 2015).

Therefore, another area of further research would include uncovering reasons why few central actors have continued to maintain a hold on decision-making processes despite multiple policies on devolvement of power and decentralization of responsibilities in intermediate cities. Such assessment can examine how these actors have managed to navigate mandates and re-orient responsibilities. Further, there is little incentive among the top-level or central actors to ensure transparency and accountability as low trust environments reinforce dependencies on few central actors (Ansell et al., 2022). This insight can help assess why specific governance choices have been made and where feedback is required to break such dependency patterns.

Lastly, the growing role of civil society (local and international) in building accountability and drawing attention of local urban governments to risks such as pollution is an area that can be strengthened. It would also be of value to examine the growing role of local civil society and citizen groups and international NGOs in shaping the direction of investment and attention to low government priority issues (such as river pollution or improving urban waste management strategies).

7.5 Conclusion

The research provides a post-colonial dive into water risks and their governance for an intermediate city to examine the divergences from prevalent notions of urban governance and where there is a confluence. Further, as there is a growing body of stakeholders beyond governments involved in urban governance, the research provides nuanced findings to improve future collaboration and mitigation of water-related risks in growing cities.

This research journey qualitatively and quantitatively uncovers multiple facets in the co-evolution of water risks and their governance processes for an intermediate riverine city of the Global South. My research focused on the risks that connect the city and the river, such as water supply inadequacies, urban floods, and river pollution. This co-evolution is also highly complex and not unique to only this case study of Guwahati. Water risks are growing with urbanization, and the governance processes are becoming increasingly complicated. Further, all the risks are not given the same priority; instead, the attention to risks is based on their governance position at the starting point and accompanied by political priorities.

Therefore, the research findings and the methodologies are valid not only for intermediate cities in India but also beyond. In addition to the points mentioned in the previous paragraph, the growing intensity and volume of interaction between stakeholders engaged in the governance of water risks in intermediate and large cities are of vital importance. While these stakeholder interactions are essential, they can increase the fragmentation of actions without adequate oversight and provide room for the obfuscation of responsibilities.

Intermediate riverine cities of the Global South are increasing at a face pace and putting both human and riverine ecosystems at risk. As these cities expand and become hubs of human congregation, it is necessary for urban planning and sustainability to become two integrated sides of the same coin (Angelo et al., 2020). The research provides insight into the little-studied post-colonial dive into water risks and their governance of an intermediate city in India. Creating sustainable urbanization requires this view of the past to build inclusive and proactive

governance of future water risks. However, as with any complex system, there are no simple solutions, and any option has probabilities for positive and negative feedback.

Most urban governance processes often handle multiple risks simultaneously, and with climate change now, there is also a need to address unforeseen risks. Understanding how the different actors interact with and rely on each other is valuable in building nuanced and agile systems to respond to water risks. Thus, a way forward for urban risk mitigation includes proactive, inclusive, and flexible governance processes with insights into vulnerabilities, access to resources, and the capacity of local actors to make needs-based decisions.

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APPENDIX

CHAPTER 8

Appendix

8.1 Authorship Statements

Details of Co-author Contributions

Article under review : ‘A tug of war between centralization vs decentralization: The co-evolution of urban governance and water risks in Guwahati, India’ Submitted to Environmental Research Communications, special issues -- Early Career Researchers: Environmental Science in South and Southeast Asia

Main Corresponding Thesis Sections: The paper serves as the Chapter 4 within the thesis manuscript.

Article co-authors and contribution

Farnoosh Fanaian (Independent Urban Designer and Architect)

- Assisted in data analysis and visualization.
- Reviewed article manuscript.

Co-author statement

I confirm that Safa Fanaian has led the research paper including the methodology design, data collection, results analysis and interpretation, and manuscript writing – with external contributions as specified above. Safa also managed the submission and revision process for the paper.



Farnoosh Fanaian

Date: 29 July 2022

Details of Co-author Contributions

Article under review: Fanaian, S, Khosla, R., Kaaronen, R., Garrick, D. “Too little, too much, too dirty?: The evolution of water risk governance networks in the intermediate city of Guwahati, India. Submitted to Global Environmental Change.

Corresponding thesis section: The paper serves as the Chapter 5 within the thesis manuscript.

Article co-authors and contribution

Dustin Garrick (Associate Professor, University of Waterloo)

- Supervision
- Research conceptualization
- Funding acquisition
- Reviewed and provided comments for the article manuscript

Radhika Khosla (Associate Professor, University of Oxford)

- Reviewed, edited, and provided comments for the article manuscript.

Roope Kaaronen (Postdoctoral researcher, University of Helsinki)

- Formal Analysis and methodology
- Reviewed and provided comments for the article manuscript.

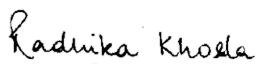
Co-author statement: We confirm that Safa Fanaian led the research paper including the conceptualization, methodology design, data collection, data curation, formal analysis, interpretation, and writing manuscript original draft – with our contributions as specified above. Safa also managed the submission and revision process for the paper.



29 July 2022

Dustin Garrick

Date:



27 June 2022

Radhika Khosla

Date:



1 July 2022

Roope Kaaronen

Date:

8.2 Research Paper 1: Supplementary Materials

The supplementary materials include:

1. List of policy, plan, institutions, and acts established from 1970 to 2019
2. Institutions involved in governance of water risks and their role (1970 – 2019)
3. Interviewee list for research paper 1
4. Documents used in historical analysis

Institutions involved in governance of water risks and their role (1970 – 2019)

Institutions involved	Their role in the period	Their origin
Gauhati Municipal Board (GMB)	Maintaining civic amenities. Main roles were on a voluntary and part-time basis	This was created in 1950s and in place until 1973
Gauhati Municipal Corporation (GMC)	Collect taxes, maintain civic amenities of water supply, check water pollution and construct and maintain drains for the city	GMC took over from the GMB in 1973.
Public Health & Engineering Department (PHED)	Responsible for water supply and water quality monitoring	Carryover from the British setup of government
Public Works Department (PWD) - Flood Control Department	Responsible for the construction of infrastructure. Flood control was through infrastructure.	PWD carries from the British setup of government. The Flood Control Department was under PWD following the National Water Policy for Flood 1954.
Irrigation and Flood control department	Responsible for dam, canals, embankments construction	A separate Irrigation and Flood Control Department was created in 1970.
Flood control department	Responsible for embankments and flood control measures	The flood control department was separated from the Irrigation department in 1974.
Assam Pollution Control Board (PCB)	Monitor water quality & issue no-objection certificates (NOC) for new constructions that could impact water quality.	A new institution was created in 1975 under the Act created by the national government, Water (Prevention and Control of Pollution) Act of 1974.
Guwahati Development Authority (1961)	To prepare plans for the city growth and oversee its execution	
Governor of Assam	Head of the legislative assembly of Assam	Carryover from the British setup of government from 1954.
District Collector and revenue department	Responsible for the district of Kamrup metro, which includes Gauhati city. Specifically, responsible for land allocation and district development	Carryover from the British setup of government from 1954
Japanese International Corporation Agency (JICA)	Funding large water infrastructure project, institutional setup for water supply in Guwahati, monitoring of project completion, and bidding processes. The largest funder of water supply infrastructure in Guwahati	JICA became involved in Guwahati due to a proposal of the Assam government submitted to the national government.
Asian Development Bank (ADB)	Funding large water infrastructure projects, monitoring of project completion, and bidding processes.	ADB became involved in Guwahati due to the proposal of Government of Assam submitted to the national government
UN agencies (through UNICEF)	Took on more prominence in Aiding the disaster mitigation plan of the state and also setting up the Assam State Disaster Management Agency	United Nations involvement in Assam was through the UNICEF office.
Multiple consulting/engineering firms (NJS, Gammon, Tata, Jindal, Vijaya, GKW consultants, Tahal engineering, etc.)	Drafting infrastructure plans and infrastructure construction for water supply	Involvement intensity grew after 2007 and steadily increased in numbers.

Indian Institute of Technology- Guwahati	Started gaining relevance for the provision of technical knowledge and support in decision-making	Further educational facilities and expertise in Assam
Assam State Disaster Management Agency	Implementation of disaster relief coordination, training, and programs.	
Guwahati Metropolitan Drinking Water and Sewerage Board	Take over water supply distribution from AUWSSB and draft tariff structure, regulations, and water supply distribution once new projects are completed.	Assam Urban Water Supply and Sewerage Board
Assam Engineering university	Third-party monitoring of functioning for GMC during floods	New inclusion
AMRUT special purpose vehicle	Office set up via consultants within the town and planning department for implementation of the urban infrastructure schemes.	This comes under the purview of the Ministry of Housing and Urban Affairs.
Guwahati Smart City Development Agency	Implementation of the smart city plans for Guwahati	The agency was created as a corporation (Special Purpose Vehicle) under the purview of the Guwahati Development Department

List of policy, plan, institutions, and acts established from 1970 to 2019

Policy/plans/institutions	Scale	Date	Implementation	Explanation
The Gauhati Municipal Corporation act	State	1971	Gauhati Municipal Corporation was operational in 1974	Assam Municipal Act of 1956
The master plan for Water Supply, Sewerage and Drainage for Gauhati for 1971-2001	Local	1971	The plan was expected to begin from 1971	Previous master Plan 1965-1985 highlighted the lack of drainage and sewage plans.
The Water (Prevention and Control of Pollution) Act	National	1974	Assam State Board for Prevention & Control of Water Pollution established in 1975.	No previous act on water pollution.
National Water Policy for Flood 1954.	National	1954	Flood control department created in 1954	No previous policy
Brahmaputra Flood Control Commission established	State	1970	Flood control department established in 1970	Follow-up from National policy
Brahmaputra Board Act	National	1980	The Brahmaputra Board in 1984	Brahmaputra Flood Control Commission, due to lack of capacity at the state level, the National government was invited.
Guwahati Municipal Development Authority Act (GMDA)	State	1985	Guwahati Municipal Development Authority 1992	Take over from Guwahati Development Authority (1961) to enforce & execute the Master Plan and schemes for planned development.
The Assam Urban Water Supply and Sewerage Board (AUWSSB) Act	State	1985	Assam Urban Water Supply and Sewerage Board est.1988	Took over the responsibility of urban water supply from the Public Health and Engineering Department (PHED).
Master Plan 1985-2001	Local	1985		Took over from the redundant Master plan for water supply, sewerage, and drainage (1971-2001).
Environmental (protection) Act (and rules)1986	National	1986	Responsibilities assigned to the Pollution Control Board in 1986	In addition to the water pollution act of 1979, the Act added environment conservation in addition to water conservation.
Guwahati Development Department (GDD)Bill	State	1989	Guwahati Development Department 1994	GDD created to bring coordination between all the Guwahati development-related departments (i.e., GMC & GMDA)
Assam Land Policy	State	1989	Revenue Department and District	Addition to the Assam land and revenue regulation1886. Created caveat on how wetlands and riverbank could be occupied.

			Collector (DC)1989	
74 th Constitutional Amendment Act (74 th CAA) of 1992,	National	1992	1992	Series of institutional, fiscal, and financial reforms in this Amendment were aimed at strengthening municipal level governance and improve urban amenities.
Indian Institute of Technology-Guwahati	National	1994	1995	Technical university to further sciences and improve education in Assam
Assam State Disaster Management Agency	National		2010	Agency became fully functioning quasi-governmental body in 2015
Guwahati Metropolitan Drinking Water and Sewerage Board Act, 2009	local		2009	Takeover from Assam Urban Water and Sewerage Board.
Disaster Management Act, 2005	State`		2005	State disaster agency started as a project with UNDP funding.
Revised building bylaws for Guwahati metropolitan area-2006	Local		2006	Bylaws had implications for construction permits on open lands and water supply and construction in flood-affected areas.
Master plan for Guwahati city 2025	Local		2009	Take over from Master Plan 1985-2001
Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	National		2005	The national government moved to a mission mode to address urban services.
AMRUT mission guidelines	National	2015	2016	A new program with national-level guidelines and locally adapted application plans.
Smart city mission guidelines	National	2015	2016	
Standard operation procedure for urban flood mitigation Guwahati	Local plan	2015	2015-16	The operating procedure was created to clarify and streamline the functioning of 16 government departments and other agencies working on flood mitigation

Interviewee list for research paper 1

Code: First capital letter is indicative of respective category, the following "a" indicative of first field visit (October to December 2018), "b" second field visit (August to October 2019). The number at the end is based on the viable interviews .

No.	Code	Institution	Category
1	Aa10	Gauhati University	academic
2	Aa2	Gauhati University	academic
3	Aa3	Gauhati University	academic
4	Aa4	IIT-Guwahati	academic
5	Aa5	IIT-Guwahati	academic
6	Aa6	IIT-Guwahati	academic
7	Aa8	TERI	academic
8	Aa9	Assam Remote Sensing Application Centre	academic
9	Aa6	IIT-Guwahati	academic
10	Ab1	Assam Engineering Institute	academic
11	Ab2	Gauhati University	academic
12	Ab3	Gauhati University	academic
13	Ab4	Cotton University	academic
14	Ab8	Gauhati University	academic
15	GOLa10	Guwahati Municipal Corporation	government
16	GOLa31	Smart City Ltd., Public Health and Engineering Department, Jal Board	government
17	GOLa32	Guwahati Municipal Corporation	government
18	GOSa4	Assam State Disaster Management Authority	government
19	GOSa5	Assam State Disaster Management Authority	government
20	GOSa6	Assam State Disaster Management Authority	government
21	GOSa7	Assam State Disaster Management Authority	government
22	GOSa8	Previously Brahmaputra Board, Assam Administrative Tribunal	government
23	GOSb1	Assam Urban Water Supply Department	government
24	GOLb11	Guwahati Municipal Corporation	government
25	GOLb13	Guwahati Metropolitan Development Authority	government
26	GOLb14	Guwahati Metropolitan Development Authority and Smart City Ltd.	government
27	GOLb15	Town and planning	government
28	GOSb17	Inland Water Transport department	government
29	GOLb18	Jal Board and Assam Urban Infrastructure Investment Program	government

30	GOLb19	Guwahati Water Supply and Sewerage Board	government
31	GOSb31	Inland Water Transport department	government
32	GOSb20	Public Health and Engineering Department	government
33	GOSb21	Public Health and Engineering Department	government
34	GOSb22	Assam Pollution Control Board	government
35	GOSb23	Public Works Department	government
36	GOSb24	Soil Conservation Department	government
37	GOSb25	Town and Country Planning	government
38	GOSb26	Town and Country planning	government
39	GOLb27	Guwahati Municipal Corporation	government
40	GOSb28	Water Resources Department	government
41	GOSb29	Water Resources Department	government
42	GOLb3	District Disaster Management Authority	government
43	GOLb5	Guwahati Municipal Corporation	government
44	GOSb6	Forest and Environment department	government
45	GOSb7	Guwahati Development Department	government
46	GOSb8	Guwahati Development Department	government
47	GOLb9	Guwahati Development Department	government
48	GONa1	Barak and Brahmaputra Board	government
49	GONa2	Central pollution control board	government
50	GONa3	Central pollution control board	government
51	GONa4	Central pollution control board	government
52	GONa5	Central pollution control board	government
53	GONa6	Central Pollution Control Board, North East Regional office	government
54	GONa7	Central Water Commission-North East Regional office	government
55	GOLb30	Atal Mission for Rejuvenation & Urban Transformation - AMRUT	government
56	GOLa11	Guwahati Municipal Corporation	government
57	GOLa12	Guwahati Metropolitan Development Authority	government
58	GOSa14	Public Health and Engineering Department	government
59	GOSa16	Public Works department	government
60	GOSa18	Water Resources Department	government
61	GOSa19	Water Resources Department	government
62	GOLa22	Guwahati Municipal Corporation	government
63	GOSa26	Water Resources Department	government
64	GOLa27	Guwahati Metropolitan Development Authority	government
65	GOLa28	Guwahati Metropolitan Development Authority	government
66	GOLa29	Jal Board	government

67	GOSa9	Assam Remote Sensing Application Centre	government
68	GOSa2	Assam Remote Sensing Application Centre	government
69	Ma2	Assam Tribune	media
70	Mb3	Prag News	media
71	Mb4	Prag news	media
72	Mb5	Pratidin Time	media
73	Mb6	Assam tribune	media
74	Mb7	Assam Tribune	media
75	Mb8	The Sentinel	media
76	NPa1	Freelance Journalist	media
77	NPa2	Development Researcher	NGO
78	NPb2	Assam Real Estate Association	NGO
79	NPb3	Save Guwahati Build Guwahati	NGO
80	NPb4	Senior Engineers forum for greater Guwahati	NGO
81	NPb6	UNICEF	NGO
82	NPb1	Aaranyak	NGO
83	GOSb16	Guwahati Development Department	politician
84	GOSb4	Politician	politician
85	GOSa30	Ex-Minster of state	politician
86	EPa7	Retired government official, consultant	private
87	EPa2	NJS consultancy	private
88	EPa3	Consultant	private
89	EPa4	Water Tanker vendor	private
90	EPa5	Consultant	private
91	EPa8	Consultant, retired government official	private
92	EPb2	NJS consultants	private
93	EPa6	NJS consultants	private
94	EPb1	GKW consultants	private
95	EPb4	Water Tanker vendor	private
96	EPb5	Water Tanker vendor	private

List of main documents used in historical analysis

Date	Relevant Risk	Data present	Type of data	Use permissions
1970-2015	Mixed	Includes, rainfall data of the Guwahati reporting of major events, controversies, flood damage reports; drinking water challenges faced in the city, wastewater issues.	Microfilms of newspapers (700GB of data)	Bought the data and free to use not share
1978-2017 (missing few years)	Floods	Brahmaputra River level during monsoon season (June-October) at Pandu (Station at Guwahati city)	Pdf and printouts	Oral permission to use data only for my DPhil research and not to be shared
1970-2009	Floods	Rainfall data	Daily mm rainfall data in digital format	Signed permission to use data only for my DPhil research the data can be shared once they publish their meteorological analysis results (within the next 5 months).
2015-2018	Floods	Rain fall data (from 18 stations in Guwahati)	Hourly data, including temperature and wind speed	Confirmed Oral permission to use data only for my DPhil research and not to be shared
2015-2018	Floods	Rainfall (different stations from DDMA), Brahmaputra river discharge at Pandu,	Digital hourly data	Confirmed Oral permission to use data only for my DPhil research and not to be shared
2015-2018	Floods	Flood damage reports Annual flood damage reports, Minutes of joint flood mitigation meetings	(documents)	Confirmed Oral permission to use data only for my DPhil research and not to be shared
1970-2015	Floods	Percentage built up area extrapolated from GIS maps	Decade wise % and Km ² land area built	Open source data
1998	Floods	Master Plan for Brahmaputra River	Image of the master plan	Confirmed oral permission to use data only for my DPhil research and not to be shared
1970-2009	Domestic Water Supply	Master plan for drinking water supply and waste water management for Guwahati city	Images of archival documents	Permission to use as long as a copy of the research is also submitted to the Assam State Archive.

1942-2018	Domestic Water Supply	List of the water treatment plants developed	Printouts	Open permission to use the data
1970-2010	Domestic Water Supply	Detailed Project Report (DPR) of the government for construction of water treatment plants (JNNURM project)	Scanned copy of the report	Confirmed oral permission to use data only for my DPhil research and not to be shared
2011	Domestic Water Supply	Contract signed by JICA and the Guwahati Municipality Development Authority (GMDA) for institutional capacity development to create water utility	Digital copy of the contract	Oral permission to use data only for my DPhil research and not to be shared
2010-2011	Wasterwater	Water quality data of Brahmaputra River from three different sampling sites along the city	PDF	Oral permission to use data only for my DPhil research and not to be shared
2008-2018	Wasterwater	Water quality data from Brahmaputra River and Bharalu river	PDF	Oral permission to use data only for my DPhil research and not to be shared
2010 & 2011	Wasterwater	Wetlands maps	PDF	Open source use
2008	Mixed	Detailed project report for Water supply, storm water drainage, underground sewerage and road restoration for Guwahati city	Reports PDF	Oral permission to use data only for my DPhil research and not to be shared
2009	Mixed	Master Plan for Guwahati City 2025	Report and images	Open source
2013	Floods	Climate Disaster Risk Tools in the Context of Urbanization in Guwahati, Assam	Report	Open source
2008	Domestic Water Supply	Background information on institutional roles, projects responsibilities and gaps in capacities	To get background information (Titled: JICA special assistance for project Formation (saprof) For Guwahati water supply project India	Detailed project report

8.3 Research Paper 2: Supplementary Materials

The supplementary materials include:

1. Questionnaire template for network assessment
2. Questionnaire template to get insights from citizens
3. Interviewee list for research paper 2
4. Count of Actors per category per decade
5. details of network statistics, per decade per risk

Questionnaire

Purpose of questionnaire: This questionnaire seeks to understand how different institutions and individuals work together to address the water-related risks of floods, water-supply, and wastewater released into rivers, for Guwahati and its rivers. The issues of role clarity, information exchange and communication are explored along with challenges faced in coordination. The results from this questionnaire will be used to create a map that visualizes the connections between institutions and individuals addressing the water-related risks.

Please fill the following:

Name:

Positions held (all positions held):

Departments/institutions affiliations (All formal affiliations):

1. Which issues do you work /are concerned on most: floods, water supply, wastewater release/river pollution? (It can be more than one issue).
2. For flood mitigation/water supply/water pollution what role do you play (what do you do to address the problem), (e.g. coordination Mitigation, reporting, research, action, etc)?
3. Who (person & departments) do you coordinate/work with most to address this problem (flood mitigation/water supply/water pollution)? (also do cross check with attached list of names government, academics, businesses, NGOs and media)

Fill out the following (in the attached comm_sheet):

- 3.1. Position of the person you work/coordinate with.
- 3.2. What is their role in the processes?
- 3.3. How often do you communicate with them (during which periods it is more before monsoon, monsoon, summer, winter)? Mandated meeting or self-organized?
- 3.4. How easy is it for you to work with those listed (grade: very easy; slightly easy; just OK; less than Ok; very difficult)

School of Geography and the Environment
Questionnaire #



Question 3 (Yellow1= Very difficult, Orange2=Less than Ok, Pink3=just OK, Green4=slightly easy, Blue5=very easy)

3. Institutions list, rate based on closeness (*often, **sometimes, ***very little)	3.1Position of the person you work with	3.2Role	3.3Communication frequency (before monsoon, monsoon, summer, winter) Mandated-non /mandated	3.4 Ease of work (Very difficult, Less than Ok, just OK, slightly easy, very easy)

	Institutions list	Who do you coordinate with (rate based on closeness)		
		often	sometimes/ normal	very little
Government	Assam State Disaster Management Authority (ASDMA)			
	Assam Water Research and Management Institute (AWRMI)			
	Health Services			
	Airport and Defence			
	Assam Power Distribution Company Limited (APDCL)			
	Assam State pollution control board (PCB)			
	Brahmaputra Board			
	Central Water Commission (CWC)			
	Civil Defence			
	Department of Environment and Forests			
	Deputy Commissioner of Police (DCP)			
	Development of North Eastern Region			
	District Commissioner			
	District Disaster Management Authority (DDMA)			
	Fire and emergency services (F&ES)			
	Flood and erosion management authority (FREMA)			
	Guwahati Development Department (GDD)			
	Guwahati Metropolitan Commission (GMC)			
	Guwahati Metropolitan Development Authority (GMDA)			
	Guwahati Smart City Limited			
	Indian Meteorological Department (IMD)			
	Jal Board			
	National Highway Authority of India (regional office)			
	North eastern space and remote sensing agency			
	Public Health and Engineering Department (PHED)			
	Public Works Department (PWD)			
Railways Department				
Revenue and DM Department				
Social Welfare Department				
Soil Conservation Division				
Town and country planning				
Water Resources Department (WRD)				

Priva	Downtown Hospital			
	Gammon Engineering			

	Good Health Institute of Neurological Science			
	Guwahati Waste Management Company Pvt. Ltd.			
	Indian Oil Refinery			
	NGS engineers			
	Private tanker businesses			
	Private water distribution network (private distributors authorized)			
	Tata consultancy			
	Jindal Engineering			

Academic	Assam Engineering College			
	Assam Cottons University			
	Guwahati university			
	IIT-Guwahati			
	Tata Institute of Social Sciences (TISS-Guwahati)			
	The Environment research institute (TERI)			
	Assam Science Technology & Environment Council (ASTEC)			
	Assam Science and Technical University			

Civil Society	Asian Development Bank (ADB)			
	Assam Real Estate and Infrastructure Developers' Association (AREIDA)			
	Japanese International cooperation Agency (JICA)			
	Save Guwahati Build Guwahati			
	Senior Engineers' Forum of Greater Guwahati			
	UN agencies (UNEP, UNICEF)			
	World Bank			
	Aaranyak			
	Institute of Engineers			

Media	Assam tribune,			
	The Sentinel,			
	The Telegraph			
	Gana Adhikar			
	Doordarshan			
	Radio			
	Protidin			
	Janambhoomi			

Purpose of questionnaire: Ask citizens of Guwahati questions to understand the people perspective on governance of water supply, floods, and wastewater released into rivers. The answers from this questionnaire will aid in supplementing information collected from government, private businesses, media, NGOs, and academicians for Ph.D. research on governance of water related risks for Guwahati city and its rivers.

Questions (Feel free to use additional paper if needed)

Name:

Brief address (your residential area):

- 1 Have you ever had problems with floods/water supply/ wastewater or sewerage pollution in *nallas*/rivers? (If you have not faced any problems, please disregard all further questions)

- 2 If yes to Q1, have you ever lodged a formal complaint about the water problem? (*If you never lodged a complaint*)
 - a. When you lodged a complaint, did you clearly know who(which department/person) to approach to resolve the problem?

 - b. Who did you approach to resolve the problem?

 - c. Did you know someone in the government department who could help you?

 - d. How often have you lodged a complaint?

 - e. Did you approach more than one department? If yes who all did you approach?

 - f. How much time did you spend in the complaint process?

 - g. How long did it take for you problem to be resolved? (few days / few months/ years /still ongoing)

3 In case your problem is still ongoing, what are you doing to address it? *(for example, For floods- invest money and time to fix it yourself, insurance, others? For water supply- buy bulk water, dig a borewell, other? For wastewater in nallas/rivulets- hire someone to clean it, awareness drive to keep it clean, ignore it, others)*

4 If you have never approached the government or lodged a formal complaint (due to whatever reason) what did you do to address the problem of flood/water supply or wastewater flowing in *nallas/rivers*?

I give consent for the information shared by me in this questionnaire to be used by Ms. Safa Fanaian in her PhD research.

I understand that my participation is voluntary and that I am free to withdraw at any time. I understand that research data collected during the study may be looked at by designated individuals from the University of Oxford where it is relevant to my taking part in this study.

I understand Ms. Fanaian and her team will have access to the data provided, the data will be stored in encrypted form and deleted the end of the project in 2023. I give permission for these individuals to access my data.

I give permission to be quoted directly in the research publication against my name/
OR

I give permission to be quoted anonymously in the research publication without use of my name

I agree to take part in the study.

Name of Participant

Mobile number:

Signature

Date

Interviewee list for research paper 2

Code: First capital letter is indicative of respective category, the following "a" indicative of first field visit (October to December 2018), "b" second field visit (August to October 2019). The number at the end is based on the viable interviews.

No	Code	Institution	Category
1	Aa5	Indian Institute of Technology-Guwahati	academia
2	Ab1	Assam Engineering Institute	academia
3	EPb1	GKW consult	private
4	EPb2	NJS Consultants	private
5	GOSa16	Public Works Department	government
6	GOLa27	Guwahati Metropolitan Development Authority	government
7	GOLb19	Jal Board	government
8	GOSb20	PHED, World Bank water supply Project	government
9	GOSb21	Public Health and Engineering Department	government
10	GOSb24	Soil Conservation Department	government
11	GOSb28	Water Resources Department	government
12	GOLb3	District Disaster Management Institute	government
13	GOSb31	Inland Waterways Department	government
14	GOLb32	Guwahati Metropolitan Development Authority	government
15	GOSb6	Forest and Environment Department	government
16	GOSb7	Guwahati Development Department	government
17	NPb1	Aaranyak	civil society
18	NPb2	Assam Real Estate and Infrastructure Developers Association	civil society
19	NPb3	Save Guwahati Build Guwahati	civil society
20	NPb4	Senior Engineers' Forum for Greater Guwahati	civil society

Count of Actor Category						
Decadal Timeslice						
Actor Category	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	
Urban Floods						
State Govt	10	25	32	46	29	
Private	0	0	0	2	1	
Political	4	2	4	7	3	
Parliament	1	0	0	4	0	
National Govt	4	6	10	7	1	
Local Govt	3	8	14	15	7	
Local CSO	0	0	13	6	5	
International CSO	1	0	0	0	1	
External	1	0	0	0	1	
Academia	0	0	3	2	0	
Sum	—	24	41	76	89	48

Count of Actor Category						
Decadal Timeslice						
Actor Category	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	
Water Supply						
State Govt	12	9	32	31	13	
Private	3	1	5	8	8	
Political	5	2	11	11	18	
Parliament	0	1	2	1	0	
National Govt	2	5	11	10	11	
Local Govt	9	22	37	16	13	
Local CSO	1	5	8	2	1	
Judiciary	0	0	0	0	1	
International CSO	0	0	6	11	17	
External	3	0	0	1	0	
Academia	0	0	1	2	0	
Sum	—	35	45	113	93	82

Data Source: Extracted from Assam Tribune newspaper 1970-2019

Count of Actor Category						
Decadal Timeslice						
Actor Category	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	
River Pollution						
State Govt	2	2	12	21	17	
Private	2	0	2	7	1	
Political	0	2	1	5	1	
Parliament	0	0	0	1	1	
National Govt	0	1	1	4	6	
Local Govt	0	0	4	9	5	
Local CSO	1	0	2	4	2	
Judiciary	0	0	1	2	0	
International CSO	0	0	0	1	1	
Health	0	0	3	6	0	
External	1	0	0	0	0	
Academia	0	0	4	3	1	
Sum	—	6	5	30	63	35

Overall Count of Actors						
Decadal Time Slice						
Actor Category	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	
State Govt	24	36	76	98	59	
Local Govt	12	30	55	40	25	
Political	9	6	16	23	22	
International CSO	1	0	6	12	19	
National Govt	6	12	22	21	18	
Private	5	1	7	17	10	
Local CSO	2	5	23	12	8	
Academia	0	0	8	7	1	
External	5	0	0	1	1	
Judiciary	0	0	1	2	1	
Parliament	1	1	2	6	1	
Health	0	0	3	6	0	
Sum	65	91	219	245	165	

Data: Sourced from Assam Tribune

Table 1: Statistics of the total decadal network slices and risk-specific quantification (*actors node totals are not summative due to overlaps between actors involved in multiple risks)

	Water Supply	Urban Floods	River Pollution	Total
1970-1979				
Actor Nodes	20	18	5	33*
Edges	76	70	9	156
Graph density	0.088	0.081	0.01	0.181
Network diameter	4	4	1	5
Leiden algorithm	0.951	0.97	0.967	0.945
Average clustering coefficient	0.864	0.893	1	0.837
Average degree	3.619	3.33	0.429	7.429
%Representation in network	48.7	44.87	6.41	
1980-1989				
Actor Nodes	17	19	5	32*
Edges	81	102	15	198
Graph density	0.115	0.145	0.021	0.282
Network diameter	4	3	1	4
Leiden algorithm	0.972	0.978	0.977	0.964
Average clustering coefficient	0.85	0.814	1	0.813
Average degree	4.263	5.368	0.789	10.421
%Representation in network	40.91	51.52	7.5	
1990-1999				
Actor Nodes	43	37	22	82*
Edges	297	207	73	577
Graph density	0.063	0.047	0.017	0.132
Network diameter	3	3	4	4
Leiden algorithm	0.959	0.956	0.948	0.923
Average clustering coefficient	0.814	0.819	0.897	0.809
Average degree	6.319	4.404	1.049	12.277
%Representation in network	51.47	35.88	12.15	
2000-2009				
Actor Nodes	41	36	40	89*
Edges	282	291	201	774
Graph density	0.135	0.056	0.055	0.15
Network diameter	3	4	4	4
Leiden algorithm	0.969	0.969	0.969	0.933
Average clustering coefficient	0.858	0.835	0.848	0.838
Average degree	4.247	5.706	5.529	15.176
%Representation in network	36.43	37.6	25.97	
2010-2019				
Actor Nodes	31	29	28	63*
Edges	287	159	121	567
Graph density	0.106	0.061	0.046	0.216

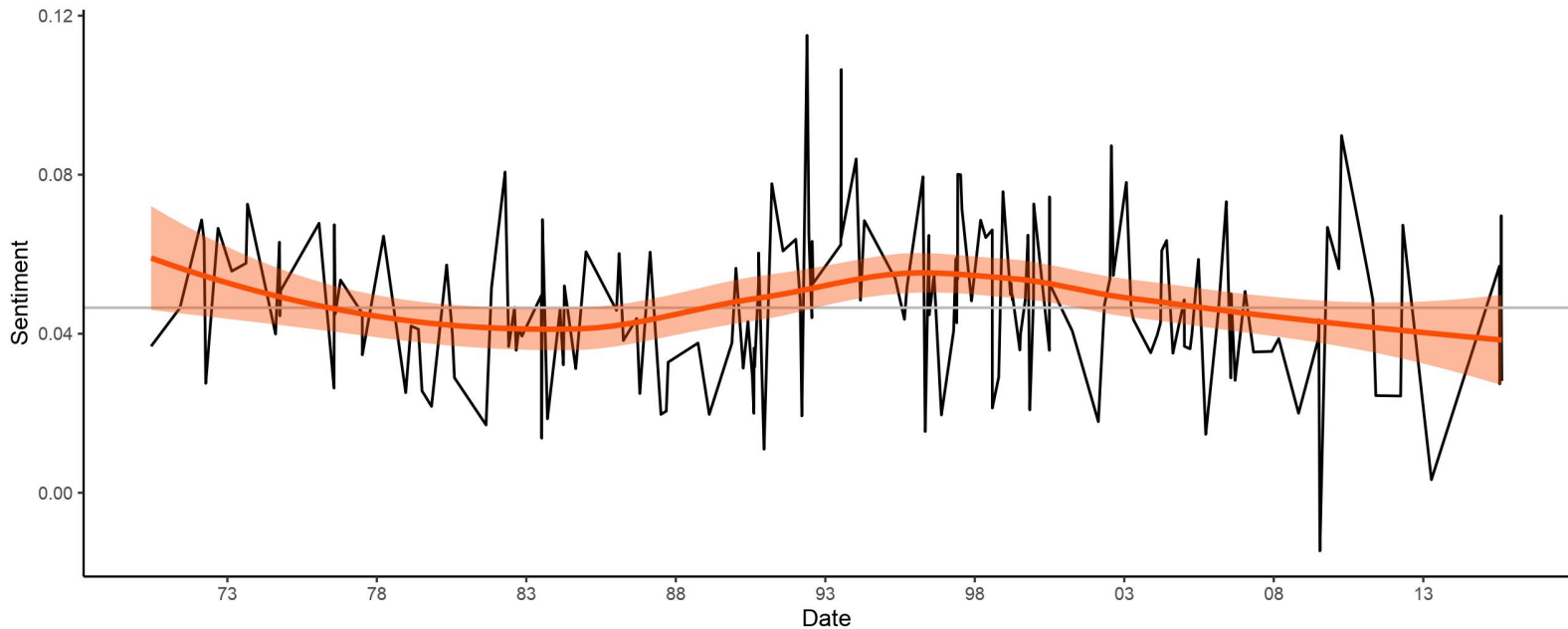
Network diameter	3	4	5	5
Leiden algorithm	0.979	0.969	0.961	0.216
Average clustering coefficient	0.819	0.869	0.908	0.835
Average degree	6.517	4.356	3.315	12.534
%Representation in network	50.62	28.04	21.34	

8.4 Research Paper 3: Supplementary Materials

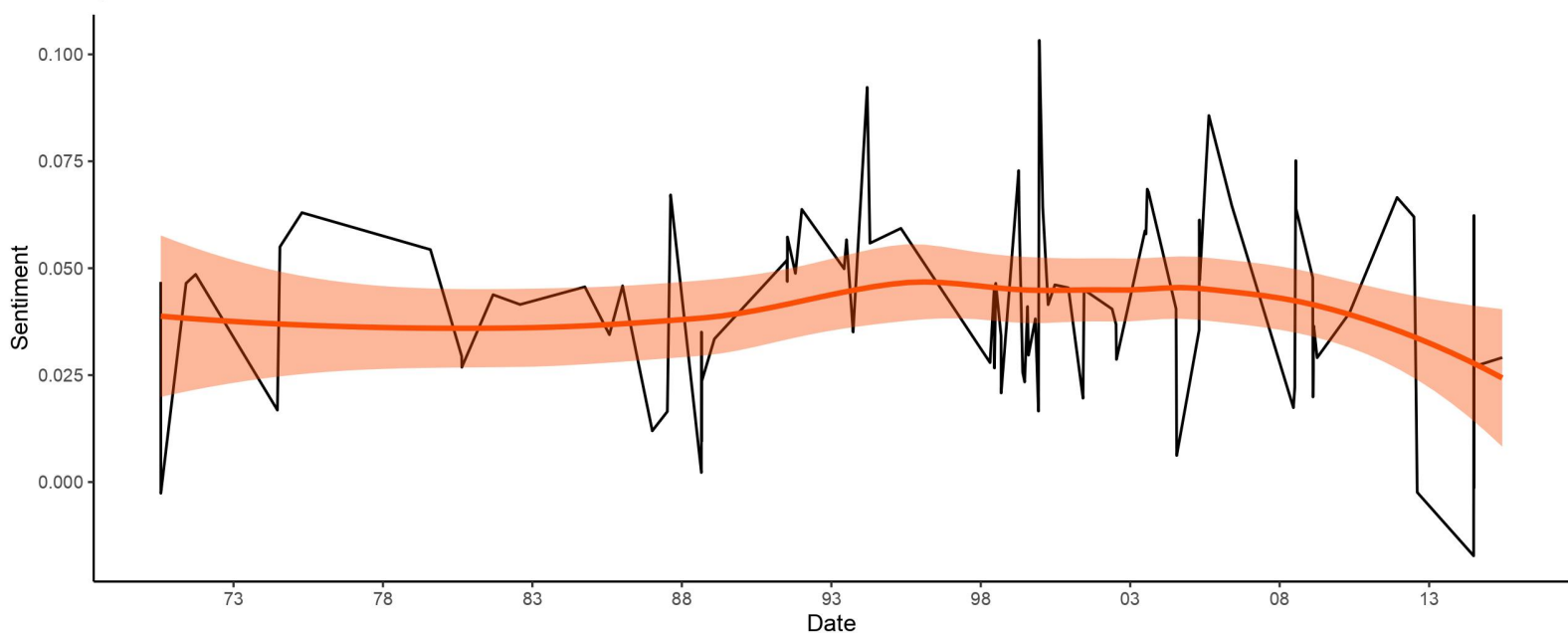
The supplementary materials include:

1. Sentiment analysis of newspaper articles in R
2. Example of the newspaper front page

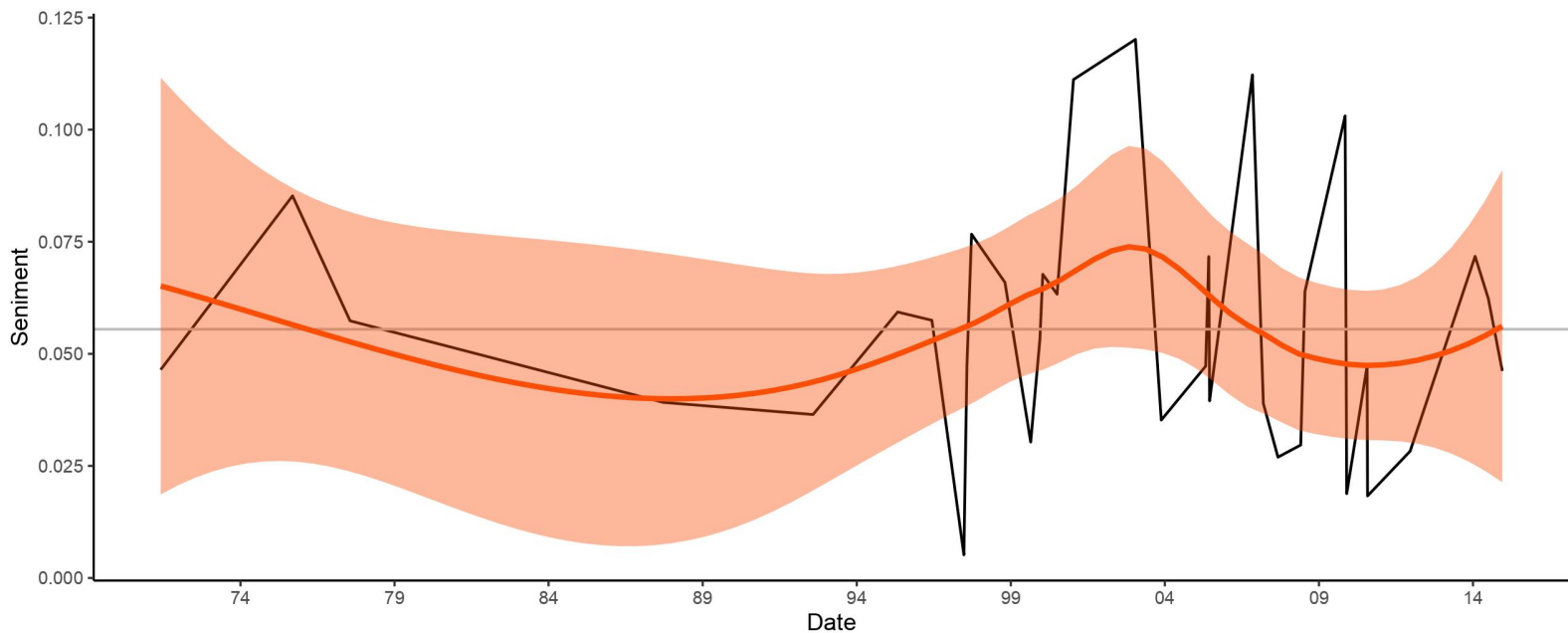
Inadequate Water Supply



Urban Flood



River Pollution





The Assam Tribune

Premier English Daily in North Eastern India

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Flood Situation Remains 'Critical' Over 12 Lakh People Affected

GAUHATI, Aug. 19—The fury of devastating floods of the Brahmaputra and its tributaries, which suspended train, ferry services and surface communications in the Brahmaputra Valley, remained "critical" today as all the rivers continued to be in high spate following torrential rains in the catchment areas.

Official sources here said the floods which took a toll of at least a dozen human lives, washed away hundreds of cattle head, besides affecting over twelve lakh people in seven out of ten districts of Assam.

The floods also caused extensive damage to the standing crops and thousands of houses in different places of the valley.

DHUBRI UNDER WATER
According to the latest report received from Dhubri, the Brahmaputra is flowing 1.15 metres above the red mark and it has surpassed the record of 1952 flood. The entire Dhubri town with around half a lakh population is under flood water. Affected people are taking shelter on high land and PWD roads. The 73,000 people have been affected in the Match Factory area also been suspended due to high flood.

According to the report over four lakhs people in 609 villages are retreating under high flood in Dhubri sub-division. The high flood of Brahmaputra also submerged the National Highway at Gauipur and Sonamukhi disrupting road communication. Rescue operation conducted by police, Home

Guards and BSF personnel is Dibruwarh, Sibsagar, Jorhat continuing in all the affected and North Lakhimpur, in Tinaripti. The entire Sukebari sub-division the current area in Maniachar circle is flood affected 45 villages with under high flood and severe a population of 13,000. About 800 people are still taking at Sukbar, Dewaneranga and shelter in 11 relief camps opened at various parts of the sub-division.

In South Salmara circle the flood, Patia and Sonowalgaon. The entire flood situation is also remaining unchanged in Golaghat. The overall flood situation is also remaining unchanged in Golaghat. The overall flood situation is also remaining unchanged in Golaghat.

According to another report received from Jorhat the devastating flood affected about 9,000 hectares of land with 21,000 people. The overall flood situation is also remaining unchanged in Golaghat.

MOHIGAOAN
The situation is also equally grave in Mohigaoan sub-division under Nowong district. Altogether 229 villages with over 73,000 people have been affected by the unprecedented flood. Large number of people are taking shelter in 7 relief camps opened at various places of the sub-division. Many affected people are taking shelter on high land and PWD roads. The high flood of Brahmaputra also disrupted in various parts of the sub-division due to over topping of PWD roads. The overall flood situation remained unchanged in Sadia.

J. Borooah's Birth Centenary Observed

By A Staff Reporter
GAUHATI, Aug. 19—The birth centenary of late Jnanadabir Borooah, a former President of the Assam Sahitya Sabha, has been observed at several functions held at Gauhati, the Central function organised by the Assam Sahitya Sabha was held at Nowong.

At Gauhati J. Borooah's birth centenary was observed at Bhagawati Prasad Barua Bhawan under auspices of the Gauhati office of the Assam Sahitya Sabha, at Government Law College and Jnanadabir Borooah Law College.

At the Sahitya Sabha function Sri Atul Chandra Barua, ex-President of the Sabha, hoisted the flag and narrated late Sri Borooah's contribution to the literary and educational fields of Assam. At the evening function the portrait of late J. Borooah was unveiled by Sri Tirtha Nath Sarma, another former Sahitya Sabha President. Floral offerings were made on behalf of Assam Sahitya Sabha, Sahitya Sabha Gauhati, Sahitya Sabha, Jenaki Sahitya Sabha, Gauhati Sanghet Sabha, Assam Freedom Fighters Association, Gauhati Lawyers Association, Geelanagar Samaj, Nursery Teachers Union, Gauhati Akhona Chakra, Rohitara, Rajajoyi Sahitya Samaj, Sarathi Sahitya Sabha, Rastha bhasha Karmi Sangha, North Gauhati Kristi Kareem, North Gauhati Sahitya Sabha and other organizations.

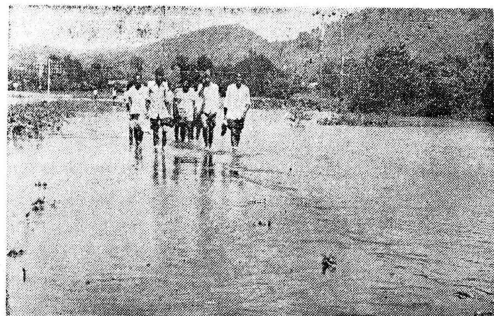
"Tomsons" presented a chorus and Sri Satish Chandra Choudhury, Sri Atul Chandra Barua, Sri Ramchandra Thakuria, Sri Sanjay Barooah, grandson of late J. Borooah, and Sri Prabhat Sarma addressed the meeting speaking on various aspects of his character and contributions. The president, Sri Sarma exhorted the audience to follow the ideals set by Sri J. Borooah. The centenary was celebrated

ed in the premises of the J. Borooah Law College, Gauhati by unfurling the flag in the morning. In the evening a memorial meeting was held under the presidency of Sri Bhimesh Chandra Barua, ex-vice President of Assam Sahitya Sabha. Prof. Pradip Kumar Shrivastava, IAS, noted educationist garlanded the portrait of late J. Borooah. The Chief guest was Dr Promod Bhattacharjee. From the audience speeches were delivered by Sri Sule Sarma, Sri K P Sen Advocate, and Sri Kamal Agarwala.

The centenary ceremony of late Jnanadabir Borooah was celebrated as per direction of the Assam Sahitya Sabha at the North Gauhati College premises, today principal M K Barooah presided over the meeting held under the auspices of the North Gauhati Sahitya Sabha. Several speakers including Prof. Bhriyomohan Goswami, Prof. Pradip Karmy and Prof. Bhairab Chandra Sarma addressed the meeting and dwelt at length on the life and teachings of late Borooah. Prof P C Barua offered vote of thanks.

The Government Law College teachers and students celebrated the birth centenary of the late Jnanadabir Borooah, founder Principal of the former Earl Law College, now known as Government Law College at the premises of the College in Cotton College New hostel, with a whole day programme.

In the morning, the flag of the College was hoisted by Sri Babendra Chandra Patra, former Chief Justice of the Gauhati High Court, in a solemn function. Later on Sri Saral Chandra Goswami Chairman of the Secondary Education Board, garlanded the portrait of late Borooah. Thereafter distinguished guests and teachers and students placed floral wreaths at (see page 6, col 2)



The Gauhati-Chandrapur Road beyond Narani is completely under water on Tuesday.

Large Areas Of Greater Gauhati In Grip Of Flood

By A Staff Reporter
GAUHATI, Aug. 19—With the Brahmaputra in high spate and the water spilling over the Gauhati-Chandrapur Road large areas of Greater Gauhati are in the grip of floods. Besides Narenghi, Panikhalhi, Bonda, both sides of the Zoo Road, Rehahari, Uluhari etc. have been inundated by the Brahmaputra water, how well above danger mark, has entered the city and this has further aggravated the situation. As the sluice gate of the Bhoroli is kept closed, the condition is unlikely to ease so soon.

The pumps have been pressed into service to pump out the water at Bharalumbh but the surging water has shown no sign of recession. Many people in Zoo Road area, Rehahari and some other localities have shifted to safer areas as their houses have been marooned.

The affected people say this is the worst flood they have experienced in living memory. The attendance in offices was thin as many employees could not leave their houses. The road to Chandrapur has been overtopped by flood water and the entire area of Bonda, Thakurkuchi, Khalihama, Bhoroli, Rajbari, Raj Nagar, Gopinath Nagar areas had to keep indoor. Scarcity of drinking water has become acute and most of the public wells and private water carrying electric motor pumps gone under water. Office-gangs from these places could not attend their office so far.

The condition of Rehahari, Pub Sarania, Lachit Natar and Santipur had also deteriorated. The water in those areas has stagnated for want of outlet. Many dwelling houses in Zoo Road, Nabin Nagar and Tarun Nagar areas are having one foot water inside. Neither the Gauhati Municipal Corporation nor the District administration have cared to see the living condition of the (see page 6, col 6)

PM Condemns Crime, Violence Committed In Name Of Religion
NEW DELHI, Aug. 19—The Prime Minister Sm Indera Gandhi today expressed her sadness that violence and crime were sometimes committed in the name of religion, reports PTI.

Emphasising the role of religion in the elevation of the individual she said "to me religion is liberation from narrowness and recognition of oneness with the cosmos".

The Prime Minister was speaking after releasing a volume of article on the tea colonies of Adi Sankara at a function on the lawn of her residence here. Entitled "Kanchi" 87 (87 in Kanchi) the publication has been brought out in honour of the senior Sankaracharya of Kanchi Kamakoti Peetham to mark his 87th birthday.

Sm Indera said in praise of the Sankaracharya that while some wished to imprison the wonderful concepts of enlightenment within the smallness of their own experience and comprehension the sage of Kanchi taught the people to look deep into themselves for "the truth to seek within" and see each and every man in nature and without which the world would not only be in (see page 6, col 2)

'Kaziranga—A Vast Sheet Of Water'

JORHAT, Aug. 19—The 166 square-mile Kaziranga National Park abode of famous one-horned rhinoceros in the world is in the grip of devastating floods of Brahmaputra and its tributaries forcing thousands of wild lives excepting rhinos, turtles and elephants to congregate to the adjoining Karbi Anglong district crossing the flooded National Highway-37.

A PTI correspondent who visited some areas of park (see page 6, col 5)

Two AIR Officials, Three More State Govt Employees Reinstated

GAUHATI, Aug. 19—The All India Radio authorities have revoked the order of suspension served on Sri Pramod Saikia News Reader-cum Translator and Sri Jamini Goswami Announcer on May 19.

They have been allowed to join their duties it is learnt. Meanwhile three more non-gazetted employees of Assam Government were reinstated today leaving only 11 suspended employees whose cases were pending review for their participation in the current movement of foreign nationals issue in the State, adds PTI.

Sri G C Baveja Adviser to the Governor of Assam told pressmen here today these pending cases are being reviewed by the administration.

Immediate Removal Of Sarin From Assam Demanded

From Our Shillong Office
SHILLONG, Aug. 19—The eight member delegation of the AASU and the AAGSP made it clear to the Union Minister of State for Home Sri Yogendra Makwana that the service of Sri H. C. Sarin, Principal Adviser to the Governor, was no longer required by the people of Assam.

The delegation in course of the discussions at Raj Bhawan here yesterday repeatedly protested against the presence of Sri Sarin in the talks. The protest was registered first at a separate meeting of the delegates, the Governor and the Minister. The delegates told Sri Makwana that Sri Sarin had been responsible for not yet being implemented the decision of the Centre as well as the announcement in Parliament on July 30 by the Home Minister. They complained that Sri Sarin had been engaged in surreptitious activities against the vital interests of the people of Assam. They referred to the remarks made sometime back by Sri Sarin before a Janata Party delegation against the womenfolk of Assam. They maintained that Sri Sarin was responsible for hold talks on the issue itself back by Sri Sarin before a Janata Party delegation against the womenfolk of Assam. They maintained that Sri Sarin was responsible for hold talks on the issue itself back by Sri Sarin before a Janata Party delegation against the womenfolk of Assam.

According to Sri L. C. State. The two leaders Rajkhowa, Adviser, AASU, condemned such move to the delegates yesterday. He held talks on the issue itself back by Sri Sarin before a Janata Party delegation against the womenfolk of Assam. They maintained that Sri Sarin was responsible for hold talks on the issue itself back by Sri Sarin before a Janata Party delegation against the womenfolk of Assam.

Call To Resist Bid At Division

GAUHATI, Aug. 19—The All Assam Students Union has called upon its anghali units and units of Gana Sangram Parishad and Volunteer Force to resist the bid of the political parties to foster unity and division by wrong interpretation of the current movement.

A statement issued in this connection said that in the parties are spreading disunity among different religious and linguistic groups. It was the duty of every citizen to resist these (See page 6, col 5)

'US Policy On Indian Ocean Has Far-Reaching Aims'

MOSCOW, Aug. 19—The United States is launching a reported programme of built the independent States locating the United States led there," the paper said. A recent statement by US Secretary of Defense Harold Brown that the programme yet another patent illustration of the fact that the is designed for many years American policy of military and in the next five years riation of the Indian ocean alone it would cost 20,000 of a durable character to 25,000 million dollars, is and pursues far-reaching ample testimony to American reports PTI.

The Soviet daily, says Tass, was commenting on reports that the US Defence Department has drawn up a new five-year programme for the further buildup of the American presence in the area of the Gulf and the Indian Ocean.

The programme envisages modernisation of bases in Oman, Kenya and the Egyptian Ras-Banas base on the Red Sea coast, the paper noted.

The American military assigns a particular place to its expansionist plans to bases on the Diego Garcia island, for the protection of which it is planned to spend one thousand million dollars. Pravda said.

The aim is to create in the region a well ramified network of permanent American forces in a bid to "subor-

Indefinite Curfew In Allahabad

ALLAHABAD, Aug. 20—An indefinite curfew was clamped here this morning reports PTI.

The curfew was clamped in the areas within the jurisdiction of Kotwali, Khalidabad, Alharsahi, Multighati and Kydang police stations. The curfew was imposed when tempers of the Minority community ran high following the alleged recovery of an object onable piece of meat in a Mosque.

Pay Commission Extends Time

GAUHATI, Aug. 19—The Assam Pay Commission has decided to extend the time for submitting replies to the questionnaire by one month, that is up to September 23, 1980.

In a Press Note the Special Officer, Finance (Pay Commission) Department, says the Commission had received requests from various associations/individuals for extension of time and hence the decision.

TEHERAN, Aug. 19—Ninety people were killed and at least 38 injured when dynamite intended for road-building blew up in a house in a southern Iranian village last night, state radio reported today, Rester.

Glossary

Actor Actor consists of those “active participants who process information and strategize in their dealings with various local actors, as well as with outside institutions and personnel” (as cited in Saravanan, 2008, p. 203. [144](#))

centralization Centralization alludes to instances when “regional actors use their political authority and resources to create institutional rules that either compel or provide positive incentives for local actors to cooperate (Lubell et al., 2021, p. 3). [18](#)

co-evolution Co-evolution is the evolution of one domain or entity that is partially dependent on the evolution of other related domains or entities, or that one domain or entity changes in the context of the other(s)Mitleton-Kelly, 2003. [27](#)

decentralization Decentralization of governance here indicates the opportunity given to local actors for “translating regional priorities and resources to local circumstances and encouraging more voluntary action among local stakeholders.” Lubell et al., 2021, p. 3. [18](#)

governance Governance includes all persons and groups trying to influence decision-making and actions taken toward policy outcomes. (Berardo et al., 2019; Chaffin et al., 2016; De Loe et al., 2017; Garrick et al., 2017; E. Ostrom, 2015). [134](#)

intermediate city What constitutes an intermediate city is fluid and dependent on the urban classification within a country. Such cities are also called second-tier, small to

medium-sized, or intermediary cities (The cities can host populations anywhere between 20,000–2.5 million people). Among the terms available for this paper, we chose ‘intermediate’ city because it alludes to a middle status within an ongoing process(Adelina et al., 2020; Birkmann et al., 2016; Cohen, 2004; Satterthwaite, 2017). [2](#), [174](#)

network Network is defined by “various contractual and cooperative undertakings” (V. Ostrom et al., 1961, p. 831) for service delivery (e.g., allocation agreements) and formal institutional attributes aligning different entities (e.g., a special district board that is appointed by the co-located municipality or elected independently) (Eger 2006) (as cited in (Scott, 2015, p. 1434)). [135](#)

polycentric Polycentric governance refers to those regions where multiple governing authorities work together across different levels and scales, rather than a single dictating authority (E. Ostrom, 2010). [92](#), [222](#)

risk Risk is defined as those “potentially catastrophic, manufactured uncertainties that are socially constructed, socio technically contested, and socio-politically criticized across institutional and discursive dynamics.” (Fischer, 2019, p. 1434). [2](#)

scale Scale is viewed “as the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon. For example, a “scale” can be national scale or local scale. the terms signify forms of hierarchy(Cash et al., 2006, p. 11). [140](#)

trust Trust (within governance networks) is considered “as the participating actors’ overall level of belief in the collaborative working environment to stimulate others to contribute in collective problem-solving, and conversely disincentives actors from seeking to achieve personal benefits that would be seen as illegitimate”(Bodin et al., 2020, p. 3). [137](#)

urban rivers Urban rivers can be considered as “rivers that have been folded into the pro-

cesses of urbanization, whether flowing through urban centers or not” (Evenden, 2018, p. 11). [66](#)