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Governance challenges of flood-prone delta cities: Integrating flood risk management and climate change in spatial planning

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ABSTRACT

Delta cities are increasingly exposed to the risks of climate change, particularly to flooding. As a consequence, a variety of new spatial development visions, strategies, plans and programmes are being developed by city governments in delta regions to address these risks and challenges. Based on a general conceptual framework, this paper examines the nature of visions, strategies, plans and programmes in the delta cities of Hong Kong, Guangzhou and Rotterdam which are highly exposed to flooding and connected through a network of epistemic communities. The paper follows two main lines of inquiry. First, it examines the terms, concepts, and dominant institutional characteristics associated with the development of these visions, strategies, plans and programmes as a way of constructing a conceptual framework for understanding and explaining their connectivity. Second, it explores how and why cities' spatial plans and governance dynamics are shaping climate adaptation responses. The systematic development of conceptual frameworks and in-depth analyses of varied, representative case studies is needed as their findings have important implications for vulnerability and adaptation to climate change in terms of policy options and cities as the optimal level for adaptation. The paper finds that dominant institutional characteristics critically affect the steering capacity of organisations/agencies (including their coordination capacity) to address climate-related risks. The findings have important implications for vulnerability and adaptation to climate change in cities, in general and delta cities, in particular.

1. Introduction

Climate change is currently viewed as one of the greatest threats to the economic viability, security, environmental health and territorial management of planet Earth (Adger, Barnett, Brown, & Marsh, 2013). Cities have been identified as among the most vulnerable human habitats to the effects of climate change (Stern, 2007; Intergovernmental Panel on Climate Change (IPPC), 2007). On the one hand, the accumulation of populations and assets in cities exacerbates their vulnerability (Hallegatte, Green, Nicholls, & Corfee-Morlot, 2013) while, on the other hand, their compact characteristics, including the ability to promptly access emergency facilities, makes them better prepared to respond. Different types of political systems, of legal-administrative structures, governance types, and levels of socio-economic development render cities and their populations unequally exposed and vulnerable to climate-related risks. Substantial differences in approaches to dealing with climate change and its consequences in cities are evident. The systematic development of conceptual frameworks and in-depth analyses of varied, representative case studies is needed as their findings have important implications for vulnerability and adaptation to climate change in terms of policy options and cities as the optimal level for adaptation.

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Delta cities are particularly vulnerable to the consequences of climate change such as floods (Aerts, Botzen, Bowman, Ward, & Dircke, 2012; Hallegatte et al., 2013; Nicholls et al., 2007). Before the urbanization of deltas, floods were not a threat but the driving force of the process of making delta landscapes. Today, urban infrastructures such as drainage systems, dikes and dams, together with accelerated processes of land reclamation and the training of rivers have disrupted the natural process of land-making, decreasing the capacity of delta cities to cope with excessive water (Meyer, Bobbink, & Nijhuis, 2010). These infrastructural-induced problems are compounded by climate change-related impacts such as sea level rise, rainfall, and increasing ratio of extreme weather events, such as storms, typhoons, tsunamis, and intense precipitation. 2014 saw record-breaking floods in Britain while 2015 is seeing severe floods affecting Accra (Ghana), East Malaysia, and Myanmar, among others. Together, infrastructural and climate-related problems threat the urban development and spatial quality of delta cities. The transition to climate-adaptive urban development is, thus, a major challenge facing delta cities across the globe, and one that urban planners, civil engineers and policy-makers need to address (Carter et al., 2015). Examining the governance challenges of spatial planning in flood-prone delta cities is, therefore, central to the future planning of some of the world's largest cities as this type of study has the potential for international reach and significance. The climate-related challenges facing delta cities inspire the following research questions to lead the literature review and analysis:

- *Q1:* What kind of *spatial planning strategies* exist or are emerging in delta cities? How are flood risk and climate adaptation being integrated in urban spatial planning strategies? (Section 3);
- *Q2:* What kind of *flood risk management practices* can be found or are emerging in cities? (Section 4);
- *Q3:* What are the dominant *institutional characteristics affecting the steering capacity of organisations* (including their coordination capacity) to address climate-related risks? What enabling and constraining factors influence the functioning of organisations and their different governance arrangements? What are the perceived effects and implications of these different governance arrangements for climate-related risks? (Section 5).

This paper has two lines of inquiry. First, it reviews the climate adaptation literature for the linkages between climate change, spatial structure, spatial planning strategies, flood risk, flood risk management, governance, and institutions. This conceptual link is often not apparent in the existing public policy/political science/spatial planning literatures, thus, the paper aims to fill this gap in knowledge by constructing a framework to analyse not only the infrastructural responses to flooding but, most significantly, the *institutional characteristics* (cognitive, normative and regulative—Scott, 2004, 2014) and the *governance arrangements* in response to climate-related floods. Second, the paper investigates the delta cities of Hong Kong, Guangzhou and Rotterdam where urban populations and assets are highly exposed to flood risk that is intensifying with climate change. Their climate adaptation-related actors are also connected through an informal epistemic community, Connecting Delta Cities (CDC) through which policies and practices are shared (Table 1). By studying the three cases, the paper illustrates how and why their spatial planning, flood risk management and governance dynamics are shaping climate adaptation decisions/responses. Existing studies of flood risks tend to be based on hydrological and climate models (Delgado, Merz, & Apel, 2014) which provide information about how the natural and built environments are affected and able to respond (for example, how flood defence, water storage and drainage infrastructures are able to cope with flooding) but not about how socio-political and economic processes may be affected and able to withstand impacts, such as how emergency search and rescue services, temporary sheltering and health facilities, or even law and order may be able to handle climate-related risks such as floods.

Table 1
Ranking of flood risk in top 20 cities by 2070 (*Source:* Nicholls et al., 2007).

Rank	Country	City/urban agglomeration	Exposed assets—current ($billion)	Exposed assets–2070s ($billion)
1	USA	Miami	416	3513
2	China	Guangzhou	84	3358
3	USA	New York-Newark	320	2147
4	India	Kolkata (Calcutta)	32	1961
5	China	Shanghai	73	1771
6	India	Mumbai	46	1598
7	China	Tianjin	30	1231
8	Japan	Tokyo	174	1207
9	China	Hong Kong	36	1164
10	Thailand	Bangkok	39	1118
11	China	Ningbo	9	1074
12	USA	New Orleans	234	1013
13	Japan	Osaka-Kobe	216	969
14	Netherlands	Amsterdam	128	844
15	Netherlands	Rotterdam	115	826
16	Vietnam	Ho Chi Min City	27	653
17	Japan	Nagoya	109	623
18	China	Qingdao	3	602
19	USA	Virginia Beach	85	582
20	Egypt	Alexandria	28	563

The paper begins with a discussion on key terms and concepts followed by a critical review of the relevant literature as a way of building a conceptual framework which links the concepts of spatial structure and planning, flood risk management, governance, and institutions in the context of climate change. The rationale behind and content of the conceptual framework and how this has been applied in the research methodology to structure the research analysis is also explained (Sections 2.1 and 2.2). Second, it outlines the case study approach and describes the research methods used to inform the analysis, namely, a review of policy documents and plans (Appendix B) complemented by in-depth semi-structured interviews (Appendix A) with the 31 key stakeholders involved in water and climate adaptation policy and planning in the three cities (Section 2.3). Third, in Sections 3, 4 and 5 the paper analyses the links and gaps between the cross-cutting concepts—spatial structure and planning, flood risk management, governance, and institutions in the three cities in the context of climate change. For spatial planning (Section 3), the analysis focuses on the impacts of urbanisation on flood risk (land making via reclamation, new developments and land use change, vulnerability of infrastructure, and evidence of climate change). For flood risk management (Section 4), both infrastructural and managerial approaches for dealing with various types of flooding are compared. Specific criteria are utilised for evaluating the effectiveness of flood risk management (environmental sustainability, spatial quality, economic feasibility, and adaptive capacity to climate change). For governance (Section 5), multi-level (geographical and political), cross-sectoral (public, private, people) and long-term issues involving a wide range of actors and interests are discussed. In each of these last three sections, the analysis of cases reconnects with the conceptual framework. Finally, the conclusions and wider lessons are drawn, and possibilities of more generic messages on climate adaptation for a wider international audience are advanced (Section 6).

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