

Aligning theory and practice in urban resilience: development of a roadmap for climate resilient cities in the Netherlands

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Abstract

Many cities around the world struggle to implement measures that make them more resilient to pluvial flooding. Scientific literature describing successful interventions in practice is scarce. Three case studies were carried out to analyse cities that have successfully managed to implement a resilience strategy. The findings from these case studies were used to develop a roadmap for climate resilient cities in the Netherlands. The roadmap provides municipalities with practical advice on how to develop an adaptation strategy and implement measures.

Key words: Climate adaptation, Resilient cities, Urban governance, Roadmap, The Netherlands

Introduction

The world is urbanising at a rapid rate. Currently, half of the world's population is living in urban areas, and this figure is expected to increase to 68% by 2050 (United Nations, 2018). Climate change can increase the vulnerability of these urban areas to floods, heat stress and drought (IPCC, 2013). Cities are already vulnerable to extreme rainfall due to the dominance of impervious surfaces. These impermeable surfaces (such as roads, roofs, etc.) are less capable of absorbing rainfall and therefore increase the intensity of rainfall run-off. Given these trends, pluvial flooding is likely to increase in both occurrence and intensity for many cities around the world (Hunt & Watkiss, 2011).

Therefore, drainage and stormwater systems need to be improved to counteract the effects caused by urbanisation and climate change. Studies show that extreme precipitation cannot be dealt with efficiently through conventional sewage systems alone, but that other approaches should be considered as well (Ahiablame, Engel, & Chaubey, 2012). This implies that public space should be designed in such a way that it has a beneficial impact on retention and infiltration capacities, calling for a more holistic approach to urban water management by integrating the entire water cycle into the urban design process. This includes promoting local stormwater retention and infiltration measures, reuse, and blue-green infrastructure (Wong, 2006). Ideas about ways in which cities could become more climate resilient are abundant. However, local governments struggle to put these theories into practice and lack guidance in developing concrete climate adaptation plans that are

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catered to their area's specific characteristics (Qiao, Kristoffersson, & Randrup, 2018). Moreover, actual implementation of measures remains troublesome (Aylett, 2015).

This gap between theory and practice is problematic for local governments because the available literature is not well aligned with the characteristics and contexts of actual projects carried out in urban areas. In general, cities need more information in three stages of the process to better align theory and practice: 1) knowledge about local effects of climate change and suitable solutions, 2) setting clear (future-proof) goals that are effective and feasible and 3) knowledge about how to successfully implement their plans (Tyler & Moench, 2012). This research aims to contribute to the domain of climate adaptation by proposing recommendations to bring theory closer to practice, improving the ability of local governments to develop solutions that are tailored to their specific characteristics.

Methodology

The objective of the research was to show how local governments can make their public space more resilient by developing a roadmap that clarifies how they can successfully implement sustainable stormwater management measures to decrease flood vulnerability. First, the most important barriers and drivers to municipal climate adaptation were distinguished from a literature study. Then, three cases studies were carried out in order to assess if these barriers and drivers were also encountered during the development of resilience strategies for the cities of Rotterdam (NL), Amsterdam (NL) and Hoboken (USA). The case studies consisted of a thorough study and summary of secondary data such as policy documents from each city, which was validated by conducting semi-structured interviews with city officials. The results of the literature study and the case studies were then compared using a 'pattern matching' technique (Cao, 2007). Pattern matching compares theoretical patterns (derived from literature) with observed outcomes from empirical research (the case studies). This led to the identification of matches and mismatches between theory and practice. These findings were then used as input for the development of a roadmap for climate resilient cities, of which the outline was jointly developed by Arcadis and a number of Dutch municipalities and water authorities over the course of three workshops.

Results

To distinguish the theoretical and empirical patterns for successful adaptation, the classification of barriers and drivers as defined by Measham et al. (2011) is used, as it specifically targets municipal implementation of climate adaptation. Three main categories are distinguished: information, resources and institutional arrangements. In total, 11 theoretical patterns were identified from literature. These patterns served as an *a priori* framework of analysis for the case studies. A number of similarities and differences between best practices from theory and everyday practice were identified. In **Table 1**, an overview of the pattern matching results is presented.

Table 1: Overview of matches, partial matches and mismatches between theory and practice (Source: Authors own)

	Theoretical pattern	Empirical pattern	Match?
Informat	Raise awareness through a public campaign.	Awareness was created not only through campaigns, but also directly after flooding took place (window of opportunity).	Yes

	Gather knowledge about (projected) climate change impacts and available solutions. Collaborate within established innovative networks.	Knowledge about impacts and solutions is gathered through internal and external networks. Collaboration takes place within established innovative networks.	Yes
	Assess exposure, sensitivity, and adaptive capacity to prioritise the most important impacts. Set up a decision-making framework to select and prioritise adaptation actions.	Extensive assessment of exposure and sensitivity has taken place. Adaptive capacity focuses on physical aspects, but not on governance. This impairs the implementation decision-making process.	Partly
	Design a monitoring and evaluation framework that uses both process-based and outcome-based indicators. Periodically review and update the plans.	Output-based indicators are often used, municipalities struggle to formulate outcome- and process-based indicators or use them only implicitly. Periodical review takes place.	Partly
Resources	Build organisational capacity to assess vulnerability, risk, and adaptation options by appointing a dedicated municipal adaptation team or department.	Building organisation capacity can take place through setting up one specialised municipal department, but also through smart internal networks ('mainstreaming') or by engaging with external parties.	No
	Ensure political commitment and financial resources by addressing the urgency and the positive effects of adapting on the short term.	Awareness and sense of urgency are key to maintaining political commitment and allocation of financial resources. Co-benefits are stressed to make the issue tangible.	Yes
	Facilitate implementation by involving private parties to gain access to money and experience.	Different approaches. Rotterdam and Hoboken have a history of implementing mainly large-scale, centralised solutions. This minimises the complexity of implementation, but also limits cooperation. Amsterdam co-designs with private parties and stimulates them to invest.	Partly
Institutional arrangements	Establish one clear team leader who connects all parties necessary.	One clear team leader who connects all parties necessary was established.	Yes
	Set clear goals, objectives, and targets, incorporating time and location. Develop them jointly with key stakeholders.	Goals, objectives, and targets are set, yet sometimes somewhat vaguely formulated. All cities prefer effect-oriented rather than normative approaches. Joint development of goals with external stakeholders does not take place.	Partly
	Explicitly investigate stakeholders and state with whom, when, and how to communicate and collaborate.	Detailed stakeholder analyses take place. Detailed communication plans are in place, but participation receives less attention in one case. Cities have trouble differentiating between informing, consultation, partnerships and co-creation.	Yes
	Establish tools and strategies for the integration of adaptation activities within municipal departments	Integration of adaptation activities depends on the way the programme is organised (centralised vs. network approach).	Partly

The pattern matching results indicate where the main gaps between theory and practice can be found. These gaps were addressed in the roadmap. In order to synthesise the findings from this research into workable advice for municipalities, two further steps were undertaken. First, workshops were organised with municipalities and water authorities to find a suitable way of representing the climate adaptation process. Secondly, based on the outcomes of the pattern

matching, tangible recommendations for municipalities were presented which were used during the development of the roadmap.

The roadmap distinguishes 8 steps, divided over two cycles: a strategic cycle in which policy development takes place, and an operational cycle that takes into account the actual implementation or construction of adaptation measures. The participants of the workshops indicated that the connection between these two cycles proved problematic in their current day-to-day routines. The roadmap incorporates loops to connect strategic (policy development) and operational (implementation) aspects. Furthermore, the roadmap provides concrete recommendations on how to utilise other drivers for successful adaptation, such as improving the adaptive capacity of municipal organisations and increasing citizen engagement. It is intended that the use of the roadmap is evaluated with its users to further improve effectiveness and applicability.

Conclusion

A large number of actions to successfully implement sustainable stormwater management measures have been identified from both literature and the case studies. Pattern matching proved useful to identify and understand differences between theory and practice in climate adaptation. A number of mismatches between theory and practice were found. In order to improve successful implementation of sustainable stormwater management measures, a number of recommendations were made to align theory and practice. These include three main takeaways for cities:

1. Focus on paradigm changes instead of meeting regulatory standards,
2. Assess governance as part of the adaptive capacity analysis and
3. Improve citizen engagement.

Main takeaways for researchers and policy-makers include acknowledging the context-specificity of climate adaptation to ensure efficient engagement and strategy development, and providing more guidance for municipalities in developing outcome-related adaptation indicators. So, in order to successfully align theory and practice, there are both challenges for science and local governments that need to be overcome. The challenges and recommendations that apply to municipalities were then incorporated into a roadmap for climate resilient cities, offering municipalities practical advice on how to develop an adaptation strategy and implement measures. Recommendations for further research include application of the methodology to more case studies in order to improve the validity of the research, as well as evaluating the use of the roadmap. This could possibly bring to light further recommendations on aligning theory and practice for policy-makers.

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