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Ecosystem-based approaches and citizen engagement in municipal climate adaptation in Scania, Sweden

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A person is walking on a beach at sunset. The sun is low on the horizon, creating a warm orange glow. The water is dark blue with many bright, shimmering reflections of the sun. In the background, a pier or breakwater extends into the sea. The sky is a deep blue gradient.

Adapting Cities

Ecosystem-based approaches and citizen engagement
in municipal climate adaptation in Scania, Sweden

EBBA BRINK

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Adapting Cities

Adapting Cities

Ecosystem-based approaches and citizen engagement in
municipal climate adaptation in Scania, Sweden

Ebba Brink



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DOCTORAL DISSERTATION

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Adapting Cities: Ecosystem-based approaches and citizen engagement in municipal climate adaptation in Scania, Sweden		
<p>Abstract:</p> <p>Even if current attempts to reduce global greenhouse gas emissions would succeed, society-wide adjustment to the harmful effects of climate change is urgently needed. This process is known as climate adaptation. Cities face particular risks from climate change, and there is increasing evidence that traditional approaches, which have often relied on technical solutions and top-down management structures, will not be enough. However, little is known about how new approaches and emerging actors are integrated into and exert influence in urban adaptation governance. In particular, there is a lack of research on citizens' role in adaptation in the Global North.</p> <p>This thesis investigates the role and potential of two approaches – ecosystem-based adaptation (EbA) and citizen engagement in adaptation – in reducing risk from adverse climate events at the local level. I do this by using an interdisciplinary and mixed methods approach, which entails reviewing scientific evidence from urban case studies worldwide, and empirically examining adaptation processes in south-Swedish municipalities. In particular, I examine how and on what basis EbA is applied in cities; how and for what reasons Swedish citizens engage in adaptation; and the implications of, and synergies between, the two approaches in local adaptation governance.</p> <p>The results show that although, in the main, EbA and citizen engagement have not occurred in explicit and deliberate ways, they can support municipal adaptation and address underlying risk drivers. On one hand, there are growing experiences with urban EbA in both the global and Swedish contexts. These are implemented under a variety of terms (e.g., ecosystem services, green infrastructure) and often lack a strategic, long-term climate risk perspective, such as assessment of current and projected future risks and vulnerabilities. On the other hand, citizens' engagement in adaptation – alone, together, and in interaction with municipalities – has had significant outcomes for local adaptation, but their efforts are poorly supported and/or channelled by municipalities. Citizens' personal experience of hazards is a strong driver of action; however, factors such as ecological values and identification with place also play a role. At the municipal level, the identified modes of citizen engagement are diverse, comprising collaboration (two-way dialogue), contestation (challenge and confrontation), compliance (enforcing mandatory citizen action) and choice (stimulating voluntary citizen action) – all of which were found to shape local adaptation. In addition, I reveal how responsibility for adaptation is shifting to citizens without any change in laws or policy, which risks hitting hardest against those most at risk. Finally, I also identify synergies between the two approaches, and suggest that EbA may serve as a better entry point for citizen engagement in adaptation than technical measures.</p> <p>Beyond the empirical insights about municipal adaptation processes in Sweden, this thesis makes three essential contributions: (1) it synthesises and assesses the field of urban EbA and identifies key research gaps; (2) it furthers theory on citizen engagement in local adaptation and presents an analytical framework for citizen–municipality 'adaptation interactions'; and (3) it contributes to the academic discussion on how transformational, rather than incremental, climate adaptation may look in practice.</p>		
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Adapting Cities

Ecosystem-based approaches and citizen engagement in
municipal climate adaptation in Scania, Sweden

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Preface

This is a book about people and disasters. As with many books, the journey to writing it began with unsatisfied curiosity. With my background in Engineering Mathematics and Risk Management, the topic of disaster risk became my pathway into climate adaptation and Sustainability Science. After doing quantitative assessments of environmental and industrial risks as an undergraduate student, I was curious about the less tangible aspects of risk: Who is at risk from disasters and why? Why do people not prioritise risk reduction in the way that certain theories or risk managers think they ‘should’?

This is also a book about knowledge: how different actors’ knowledge come together in the process of solving complex, or wicked, problems and whose knowledge counts. In particular, I became interested in how, as a scientist, one can combine knowledge on the ‘material’ aspects of risk with the realisation that risk is socially constructed and produced, to help reduce risk for society as a whole and for those most at risk in particular.

In September 2013 I embarked on the doctoral path with the question of how a more people-oriented kind of climate risk governance and adaptation planning might look. I started by reviewing the scientific literature to find out more about how Swedish municipalities and citizens were responding to climate-related impacts. At the time, virtually nothing had been written about Swedish citizens’ practices for climate adaptation and risk reduction. Instead, I had to look to other sources to try to identify and document these practices, including national and local newspaper articles reporting on past hazards. Similarly, I looked for accounts of when municipalities’ and citizens’ efforts for adaptation had interacted – either in synergistic or confrontational ways.

In contrast to citizen engagement, my focus on ecosystem-based adaptation – and its potential appeal to citizens – emerged through repeated interaction with the field. In the spring of 2013, I participated in a ‘research circle’ on spatial planning under climate uncertainty with planners from nine municipalities in South Sweden (Båstad, Eslöv, Helsingborg, Hässleholm, Höör, Kristianstad, Lomma, Simrishamn and Östra Göinge). I was mainly an observer during the monthly meetings, but I did enquire about the role of citizens. While none of the municipalities had examples of working directly with citizens in adaptation, several planners spoke of a problematic trend of homeowners paving over their gardens, which increased stormwater runoff

and thus the aggregate flood risk during heavy rain. In this context, one civil servant suggested that the ‘ecosystem services’ concept was a useful tool for adaptation-related planning and coordination, including for engaging citizens.

In 2014 I continued working alongside Scanian municipalities in a newly launched ‘transdisciplinary’ research project on the conditions for implementing ecosystem services in municipal planning (ECOSIMP). ECOSIMP brought together civil servants from Båstad, Helsingborg, Kristianstad, Lomma, Malmö, Simrishamn and Trelleborg, and researchers from four different, mostly local universities. I was part of a work package that focused on the use of ecosystem services for climate adaptation, also known as ecosystem-based adaptation (EbA). The project team did not include regular citizens, but their role was repeatedly discussed (and researched), e.g., as landowners, users of recreation areas, and recipients of/agents in flood protection.

In 2015 I carried out my first conventional fieldwork in Scania focusing on adaptation-relevant interactions between citizens and municipalities. Limiting the scope to Malmö, Helsingborg and Lomma, I used local newspaper archives, policy documents and my municipal contacts to try to map out where such interactions had occurred in practice. I quickly realised that municipalities were still struggling with coordinating adaptation internally, and there were few, if any, examples of explicitly engaging with citizens. However, I identified 17 relevant interactions that emerged from other local processes, including stormwater management, property management, coastal planning, and the aftermath of actual flood and storm events – revealing the subtle integration of climate adaptation into local governance and the diverse modes of related citizen engagement. In many of the interactions, EbA seemed to play a role in collaborative or synergetic adaptation.

As the thesis process unfolded, I joined unexpected collaborations and let my research questions be inspired by the field; I often felt as if I did not know where I was heading. I wondered with an increasing sense of alarm when I would have time to start my actual PhD work, namely, all those things I had written in my (completely unrealistic) research plan. Later, it would turn out, that I was actually doing my PhD – I had been working on it all along.

While the concept of transformation had been part of the research since the outset, it was only in 2017 that I decided to give it a role in the kappa. I saw it as an avenue for conceptually linking and contrasting the two topics of EbA and citizen engagement. In addition, I was curious to explore the more analytical dimensions of transformation, including: were my findings indicative of transformational adaptation, and/or what would that look like in a Swedish, Scanian context?

The result is the thesis before you.

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Abstract

Even if current attempts to reduce global greenhouse gas emissions would succeed, society-wide adjustment to the harmful effects of climate change is urgently needed. This process is known as climate adaptation. Cities face particular risks from climate change, and there is increasing evidence that traditional approaches, which have often relied on technical solutions and top-down management structures, will not be enough. However, little is known about how new approaches and emerging actors are integrated into and exert influence in urban adaptation governance. In particular, there is a lack of research on citizens' role in adaptation in the Global North.

This thesis investigates the role and potential of two approaches – ecosystem-based adaptation (EbA) and citizen engagement in adaptation – in reducing risk from adverse climate events at the local level. I do this by using an interdisciplinary and mixed methods approach, which entails reviewing scientific evidence from urban case studies worldwide, and empirically examining adaptation processes in south-Swedish municipalities. In particular, I examine how and on what basis EbA is applied in cities; how and for what reasons Swedish citizens engage in adaptation; and the implications of, and synergies between, the two approaches in local adaptation governance.

The results show that although, in the main, EbA and citizen engagement have not occurred in explicit and deliberate ways, they can support municipal adaptation and address underlying risk drivers. On one hand, there are growing experiences with urban EbA in both the global and Swedish contexts. These are implemented under a variety of terms (e.g., ecosystem services, green infrastructure) and often lack a strategic, long-term climate risk perspective, such as assessment of current and projected future risks and vulnerabilities. On the other hand, citizens' engagement in adaptation – alone, together, and in interaction with municipalities – has had significant outcomes for local adaptation, but their efforts are poorly supported and/or channelled by municipalities. Citizens' personal experience of hazards is a strong driver of action; however, factors such as ecological values and identification with place also play a role. At the municipal level, the identified modes of citizen engagement are diverse, comprising collaboration (two-way dialogue), contestation (challenge and confrontation), compliance (enforcing mandatory citizen action) and choice (stimulating voluntary citizen action) – all of which were found to shape local adaptation. In addition, I reveal how responsibility for adaptation is shifting to citizens without any change in laws or policy, which risks hitting hardest against those most at risk. Finally, I also identify synergies between the two approaches, and suggest that EbA may serve as a better entry point for citizen engagement in adaptation than technical measures.

Beyond the empirical insights about municipal adaptation processes in Sweden, this thesis makes three essential contributions: (1) it synthesises and assesses the field of urban EbA and identifies key research gaps; (2) it furthers theory on citizen engagement in local adaptation and presents an analytical framework for citizen–municipality ‘adaptation interactions’; and (3) it contributes to the academic discussion on how transformational, rather than incremental, climate adaptation may look in practice.

Abstract in Swedish

Även om vi skulle lyckas minska de globala utsläppen av växthusgaser, så finns det ett angeläget behov att anpassa samhället för att kunna motstå klimatförändringens skadliga effekter. Denna process kallas klimatanpassning. Städer står inför särskilda risker från klimatförändringen och nuvarande tillvägagångssätt, som ofta förlitar sig på tekniska lösningar och toppstyrd implementering, bedöms inte vara tillräckliga. Trots detta vet vi lite om hur nya tillvägagångssätt och aktörer införlivas och utövar inflytande i styrningen av städers klimatanpassning. Det finns speciellt lite forskning om medborgarnas roll i klimatanpassning i höginkomstländer.

Denna avhandling undersöker hur två metoder – ekosystembaserad klimatanpassning (EbA) och ökat medborgarengagemang – kan bidra till att minska risken för extrema väderhändelser på lokal nivå. Jag använder en tvärvetenskaplig och blandad kvalitativ och kvantitativ metodik för att empiriskt undersöka klimatanpassningsprocesser i sydsvenska kommuner, och granska vetenskapliga bevis från urbana fallstudier över hela världen. I synnerhet undersöker jag hur och på vilken grund EbA tillämpas i städer; hur och av vilka skäl svenska medborgare engagerar sig i klimatanpassning; och vilka påföljder de två företeelserna fått i styrningen av lokal klimatanpassning.

Resultaten visar att EbA och medborgarengagemang huvudsakligen inte har skett på ett explicit och avsiktligt sätt, men kan stärka kommunal klimatanpassning och ta itu med underliggande riskfaktorer. Å ena sidan finns det växande erfarenheter av EbA i stadsmiljö både globalt och i det svenska sammanhanget, men dessa implementeras under olika termer (t.ex. ekosystemtjänster, grön infrastruktur) och saknar ofta ett långsiktigt strategiskt klimatriskperspektiv, såsom risk- och sårbarhetsanalyser i förhållande till nuvarande och framtida förhållanden. Å andra sidan identifierar jag hur medborgares engagemang i klimatanpassning – enskilt, gemensamt och i samverkan med kommunen – har haft betydande resultat för lokal klimatanpassning, men deras insatser har ofta dåligt stöd på kommunal nivå. Personliga erfarenheter av extrema väderhändelser är en stark drivkraft för aktiva medborgare, men faktorer som miljöengagemang och identifiering med plats spelar

också roll. Medborgarengagemang i kommunens klimatanpassning kan se väldigt olika ut och innefattar samarbete (*collaboration*), tvistigheter (*contestation*), regeluppfyllande (*compliance*) och fria val (*choice*); alla visades påverka den lokala klimatanpassningen. Dessutom visar jag hur klimatförändringen kan skifta anpassningsansvar till medborgare utan någon speciell lagändring, vilket förmodas slå hårdast mot de som redan är mest riskutsatta. Samtidigt fann jag flera synergier mellan EbA och medborgarengagemang, och föreslår att EbA kan vara en bättre utgångspunkt för engagemang i klimatanpassning än tekniska åtgärder.

Utöver de empiriska insikterna om kommunala klimatanpassningsprocesser i Sverige gör denna avhandling tre viktiga bidrag: (1) den syntetiserar och bedömer forskningsområdet EbA i städer och identifierar viktiga kunskapsgap; (2) den utvecklar teori om medborgarengagemang i lokal klimatanpassning och presenterar ett analytiskt ramverk för 'klimatanpassningsinteraktioner' mellan medborgare och kommuner; och (3) den bidrar till den vetenskapliga diskussionen om hur transformativ, snarare än inkrementell, klimatanpassning kan se ut i praktiken.

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1. Brink, E., Aalders, T., Ádám, D., Feller, R., Henselek, Y., Hoffmann, A., Ibe, K., Matthey-Doret, A., Meyer, M., Negrut, L., Rau, A.-L., Riewerts, B., von Schuckmann, L., Törnros, S., von Wehrden, H., Abson, D., and Wamsler, C. (2016). Cascades of green: A review of ecosystem-based adaptation in urban areas. *Global Environmental Change* 36, 111–123.
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3. Brink E., and Wamsler, C. (2018). Collaborative governance for climate change adaptation: Mapping citizen–municipality interactions, *Environmental Policy and Governance* 28, 82–97.
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Author contributions

1. EB, TA, DA, RF, YH, AH, KI, AMD, MM, LN, ALR, BR, ST and LVS performed research and collectively drafted the paper. CW, HW and DJA developed the research design, framed the paper, and supervised the research process. ALR and MM facilitated the quantitative review process. EB, TA and ST prepared the final manuscript, with EB taking the lead.
2. EB conceived the idea for the paper, selected the conceptual framework and took the lead in writing the paper. BN, CW and IJ gave additional support in paper framing, and SS and ThB in data collection. All the authors contributed actively to applying the conceptual framework, providing case-based information, and internal review of the manuscript.
3. EB and CW jointly developed the research idea and analysis framework. EB took the lead in collecting and analysing the data and writing the paper. CW contributed with additional data, and structuring and reviewing the manuscript.
4. EB and CW jointly developed the research idea and analysis framework. EB took the lead in collecting and analysing data and writing the paper. CW contributed through discussing, structuring and reviewing the manuscript.

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List of abbreviations

CBD	Convention on Biological Diversity
ECOSIMP	Implementing the Ecosystem Services Concept at the Municipal Level
EbA	Ecosystem-based Adaptation
IPCC	Intergovernmental Panel on Climate Change
KLIMP	Climate Investment Programme
LIP	Local Investment Programme
LUCSUS	Lund University Centre for Sustainability Studies
UNISDR	United Nations Office for Disaster Risk Reduction

Introduction: Setting the scene

A real-world challenge: adapting cities to new and existing climate

The climate is changing, posing a major threat to cities, their inhabitants and ecosystems. Many of the changes observed in the climate system since the 1950s, including warming of the atmosphere and the ocean, are unprecedented in decades or even millennia (IPCC, 2014). In the same period, there has been a notable increase in the number of extreme weather events, including heatwaves, extreme sea levels and heavy precipitation events; scientists predict continued severe and irreversible climate impacts on people and ecosystems (IPCC, 2014). Urban areas, now home to more than half of the world's population and most of its physical and economic assets (Revi et al., 2014), face particular challenges. For example, climate change impacts in cities cause serious disturbances to the complex and interdependent infrastructure systems and services on which citizens rely (Wamsler, 2014).

Even if current attempts to reduce global greenhouse gas emissions were to succeed, society-wide adjustment to (actual and expected) climate and its potentially harmful effects is urgently needed (IPCC, 2014). This process is referred to as *climate adaptation* (or merely *adaptation*). It translates into actions by people or organisations to prevent, reduce vulnerability to, respond to and recover from adverse climate impacts now and in the future (UNISDR, 2009; Wamsler, 2014).

In the context of adaptation, the intensifying impacts of climate change are challenging current approaches to hazard management and the related division of responsibilities among public and private actors (Adger et al., 2013). In much of Europe, the main way of dealing with hazards like flooding has been an expert-driven engineering approach, which aims to keep hazards at bay through the use of hard physical structures (Newig et al., 2014). However, with increasing climate variability and extremes, it may not be enough – and is certainly costly and inflexible – to merely increase physical protection (Doswald et al., 2014; IPCC, 2014). In addition, local governments (a term here used interchangeably with municipalities) are key actors in adaptation, as they are often accountable for land-use planning, stormwater management and emergency services (Granberg and

Elander, 2007; Roberts et al., 2012; Storbjörk, 2007). However, the limited capacity and resources of public authorities translate into an increased need for private and civil society action (Adger et al., 2013; Klein et al., 2017; Tompkins and Eakin, 2012). There is thus a need to consider how new and complementary approaches to adaptation could be integrated at the city level, and how these could work together with existing structures to reduce climate risk in a more holistic way (Wamsler, 2014).

Ecosystem-based adaptation and increased citizen engagement¹ are two approaches that are increasingly advocated in this context in both theory and practice (Few et al., 2007; Jones et al., 2012; Revi et al., 2014; Scarano, 2017; UNFCCC, 2015). Ecosystem-based adaptation (EbA) has emerged as an umbrella term for complementary approaches that entail the support and restoration of ecosystems to improve natural protection against hazards (e.g., vegetation that can provide shade or retain water during floods), while they also provide secondary benefits in cities, such as air filtration, social meeting places, and recreation (Doswald et al., 2014; Geneletti and Zardo, 2016; Grimsditch, 2011; Laros et al., 2013). Similar approaches are being implemented under different terminology, including *green and blue infrastructure*, *ecosystem services*, and *nature-based solutions* (Thoni et al., 2017).

Meanwhile, engaging citizens in adaptation is described as a necessity, given the intensifying climate impacts (i.e., increased measures needing to be taken and the costs borne by citizens), and also as a method to promote more efficient, relevant and fair adaptation (Adger et al., 2005; Lemos and Agrawal, 2006; Mees et al., 2014a; Renn and Schweizer, 2009; Tennekes et al., 2014).

However, knowledge as to whether and how EbA and citizen engagement can be successfully implemented at the municipal level, and the potential synergies between the two approaches, is currently scarce and fragmented (Hegger et al., 2017; Laros et al., 2013; Vignola et al., 2009). First, despite increasing use of related approaches in practice, EbA in urban areas has been relatively little studied (Laros et al., 2013; Revi et al., 2014). Second, there is little research overall on citizens' role in adaptation in the Global North, and specifically, on their related interactions with urban governments (Klein et al., 2017; Mees et al., 2014a; Sarzynski, 2015).

¹ In this thesis, I use the term engagement to denote citizens' own adaptation actions as well as their participation in adaptation processes at the municipal level.

Theoretical gaps for governing or transforming adaptation

In the last decade, echoing the general sustainability field, the urban adaptation debate has seen a shift in focus from merely *governing* cities and the risks posed by climate change, to *transforming* urban systems and addressing in-built vulnerabilities in response to climate change.

Around 2010, much of the literature on urban adaptation used a governance lens (e.g., Birkmann et al., 2010; Corfee-Morlot et al., 2011; Djalante et al., 2012; Juhola and Westerhoff, 2011; Kuhlicke et al., 2011; May and Plummer, 2011; Pahl-Wostl, 2009; Pelling, 2011). High-income nations were generally assumed to have a high capacity to adapt to climate change (Costello et al., 2009; Gagnon-Lebrun and Agrawala, 2006). However, increasing evidence suggested that such capacity did not necessarily translate into effective adaptation (O'Brien et al., 2006; Wolf, 2011); in fact, a systematic review of adaptation in developed nations identified mostly short-term risk reduction (focus on impacts) rather than strategic planning; and there was, moreover, little focus on vulnerable groups (Ford et al., 2011).

The governance perspective, in particular multi-level governance, was first a way of expanding the focus of climate responses from the national level to cities (Bulkeley, 2010; Corfee-Morlot et al., 2011). After cities became part of mainstream sustainability discussions, literature on urban climate governance also started to focus on the myriad of actors emerging and active in urban development processes (Bulkeley and Castán Broto, 2013). Many of these studies, however, focused on climate change mitigation² rather than adaptation (Alber and Kern, 2008; Anguelovski and Carmin, 2011), did not move beyond categorical divides such as public/private or state/non-state actors (Bulkeley and Schroeder, 2012), and did not generally consider citizens at all (Sarzynski, 2015).³ Contemporary studies (e.g., van der Heijden et al., 2018) point to *friction* as being a missing piece in governance scholarship, with questions like: what novel agents have emerged, how do they act, how is authority given/taken away, who gains and who loses, and how can (dis)empowerment in urban climate governance be studied?

Transformation as an adaptation option emerged from an increasing consensus that incremental adaptation or 'adaptation as usual' would be inadequate for tackling the magnitude of environmental change facing humanity (Kates et al., 2012; O'Brien, 2012; Park et al., 2012; Pelling et al., 2014). While incremental adaptation aims to

² In contrast to adaptation, which addresses the *effects* of climate change, climate change mitigation tries to limit the *magnitude or rate* of climate change through interventions to "reduce the sources or enhance the sinks of greenhouse gases" (IPCC glossary, p 1769).

³ An exception are studies from the perspective of risk governance (Newig et al., 2014).

“maintain the essence and integrity of a system or process at a given scale” (i.e., doing ‘more of the same’), *transformational* adaptation changes “the fundamental attributes of a system in response to climate and its effects” (i.e., doing things differently, addressing underlying dysfunctionalities in current systems) (IPCC, 2014, p. 1758). As used in this thesis, transformation refers to a deliberate (yet not fully steerable) change in a normative direction (Feola, 2014). Related scholarship stresses that adaptation to climate change will have little long-term effect if it is treated only as a technical or managerial problem (O’Brien and Selboe, 2015).

Both ecosystem-based approaches and citizen engagement have been raised as potential pathways to transformational adaptation (O’Brien, 2016; Pelling et al., 2014). In this context, scholars emphasise the potential of linking adaptation, mitigation and sustainable development by giving a central role in urban planning to ecological values and to EbA (Pelling et al., 2014; Roberts et al., 2012). Likewise, individuals and civil society are framed as ‘action spaces’ for transformation, for instance, by contributing to innovation in established institutions through informal experimentation, and for holding the values, beliefs and worldviews that shape openness to change and learning (Frantzeskaki et al., 2017; O’Brien and Selboe, 2015; Schicklinski, 2015). However, empirical investigation into approaches that produce transformational, rather than incremental, adaptation is scarce (see e.g., Few et al., 2017), and scholars have called for more “precision in identifying the conceptual borders of what transformation means in different studies” (Feola, 2014, p. 10).

Aim and research questions

Against this background, my PhD research investigates the role and potential of ecosystem-based adaptation and citizen engagement in urban adaptation governance. By reviewing scientific evidence from urban case studies worldwide, and empirically examining adaptation processes in municipalities in south Sweden, I answer the overarching research question:

- How does the use of EbA and citizen engagement at the local level contribute to reducing risk from adverse climate events, and what are related drivers, barriers, gaps and synergies?

I break down the main research question into the following sub-research questions, where the first two focus on (conditions for) implementation and the third on effects:

1. How, and on what basis, have ecosystem-based approaches been applied in urban adaptation?

2. How, and for what reasons, have Swedish citizens engaged in urban/local adaptation?
3. What have been the implications of EbA and citizen engagement for how adaptation is governed locally, and can synergetic effects be observed?

Based on the results, I discuss whether and how EbA and citizen engagement can contribute to transformational adaptation in practice.

Sustainability Science as a disciplinary home

Sustainability Science is an emerging academic field that seeks to bridge the natural and social sciences in order to find creative solutions to today's complex sustainability challenges. It thereby encourages methodological plurality and collaboration with concerned disciplines and stakeholders (inter- and transdisciplinarity), as well as analysis across spatial and temporal scales (Jerneck et al., 2011; Kates et al., 2001).

A sustainability scientist's task consists of addressing sustainability challenges as interconnected problem syndromes through three main activities: building scientific understanding, scrutinizing social goals, and identifying pathways and strategies for implementation (Jerneck et al., 2011). A typology of scientific knowledge production for solving sustainability problems that I have found useful in my work and come back to throughout this thesis, is *systems knowledge* (a descriptive understanding of socio-ecological systems), *normative knowledge* (the desired pathway or target state, comprising different values and interests), and *transformative knowledge* (how to achieve change in practice) (Abson et al., 2014; Jahn et al., 2012; ProClim, 1997).

To me, Sustainability Science is a science that does not back away from breaking academic disciplinary conventions, from taking normative (value-laden) perspectives or from *acting* in society alongside – or even as a means to – the study of societal processes of change. Instead, it finds ways of working that make such research-related choices not only visible but also part of the theoretical and methodological discussion. In this context, some talk of a “constructive tension” between Sustainability Science's descriptive-analytical and transformational mode (Wiek et al., 2012, p. 5), or between critical and problem-solving research (Jerneck et al., 2011).

Doing this thesis in Sustainability Science has allowed me to study how local climate risk is created through a number of interacting systems (e.g., global climate, local ecological, political and social conditions) as well as how it can be reduced if those systems are appropriately addressed. Based on the normative standpoint that

risk is an unwanted product of current development, the work aspires to generate transformative knowledge on how to actively tackle this situation. It is problem-solving in that it seeks to contribute to climate adaptation by finding solution options and directly engaging with involved stakeholders who are in a position to implement them. Meanwhile, it is critical (see Jerneck et al., 2011) in terms of scrutinising suggested solutions and their potential to address the underlying causes of urban climate risk.

It should be noted that by focusing on citizens, the research does not depart from the value-laden assumption that citizens *should* get involved in adaptation or that responsibility for adaptation should be transferred from public authorities to the individual. Rather, it examines *what conditions and mechanisms* drive citizen engagement, and, in this way, sheds light on the shifts in responsibilities that are already occurring, even without any deliberate change in policy or legislation.

To study this complex sustainability challenge, my research spans geographical and jurisdictional scale levels from local households to global cities (see Figure 1). The recurrent protagonist is, however, local government and its interactions with other actors that are emerging in local adaptation governance.

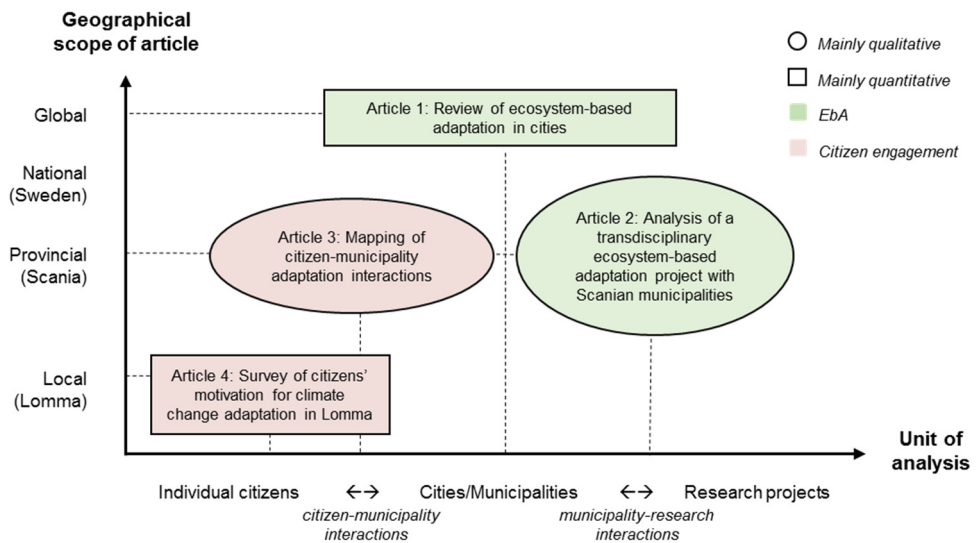


Figure 1 Geographical and thematic scope of the four PhD papers

The papers are shown with their geographical scope on the y-axis and their main focus/unit of analysis on the x-axis. Round shape denotes an emphasis on qualitative methods, while rectangular shape denotes a quantitative focus.

How to read this thesis

This PhD thesis is a compendium of this introductory and synthesising section, *kappa* (Swedish for ‘coat’), and four papers in peer-reviewed journals.⁴ The kappa follows a traditional thesis structure. After the present chapter has set the scene, the Conceptual Framework presents the theoretical foundations to this thesis, including my ‘risk’ perspective on climate adaptation. The Empirical Background that follows introduces the geographical focus area and provides an overview of how the issue of climate adaptation has developed in Sweden. In Methodology, I describe and motivate my mixed-methods research approach. Next, in Results, I synthesise and elaborate on my findings from the individual articles to answer the overarching research questions. This entails introducing some new material, which is not found in the articles. After a brief Discussion of results and limitations, the Conclusion summarises my contribution to science with this thesis.

The reader is referred to the papers for more empirical and theoretical detail. The relation between the papers and the overarching research questions is shown in Table 1.

Appended at the end of this book, Article 1, “*Cascades of green: A review of ecosystem-based adaptation in urban areas*” examines and contrasts peer-reviewed research on EbA in 112 cities globally. It develops a conceptual and analytical framework that provides the background for a systematic review of EbA research in urban environments to investigate which climate hazards, ecosystems and concepts are discussed, how different stakeholders are integrated into EbA research and planning, and what the related knowledge gaps are.

Article 2, “*On the road to ‘research municipalities’: Analysing transdisciplinarity in municipal ecosystem services and adaptation planning*”, analyses transdisciplinary work on ecosystem-based approaches in local governance and adaptation, in a project with seven Scanian municipalities (Båstad, Helsingborg, Kristianstad, Lomma, Malmö, Simrishamn and Trelleborg). It is a methodological paper in the sense that I critically reflect on the transdisciplinary context in which I conducted part of my PhD research; it presents standalone results on transdisciplinarity (not included in thesis framing).

In Article 3, “*Collaborative governance for climate change adaptation: Mapping citizen–municipality interactions*”, the geographical scope is reduced to three Scanian municipalities (Malmö, Helsingborg and Lomma). The article develops a conceptual framework to analyse citizen–municipality interactions for climate adaptation (including EbA), and then uses it to map and assess what types of

⁴ Paper 4 has been submitted but not yet published.

adaptation interactions can be identified in practice, the division of responsibilities involved, and the role of such interactions in fostering climate adaptation at the municipal level.

Finally, Article 4, “*Citizen engagement in climate adaptation surveyed: The role of values, worldviews, gender and place*” zooms in on Lomma municipality, a coastal community at risk from climate hazards such as floods and storms. Based on a survey of hazard-affected and non-hazard-affected households, it investigates the external/material (e.g., hazards, resources, public support) and inner/subjective aspects (e.g., beliefs, values and worldviews) that have shaped people’s engagement in and for adaptation, and discusses its links to EbA.

Table 1 Contribution of PhD papers to overarching research questions

	RQ 1: EbA	RQ 2: Citizen engagement	RQ 3: Implications and synergies
Paper 1: Review of global EbA cases			
Paper 2: Analysis of EbA research project			
Paper 3: Mapping of adaptation interactions			
Paper 4: Survey of at-risk households			

Conceptual Framework: Climate adaptation meets the city

This chapter presents the theoretical and conceptual framework for my research. I begin by introducing the concepts that inform my understanding of climate adaptation, which lies at the core of this thesis and all its articles. On this basis, I define and deconstruct EbA and citizen participation in adaptation, which are key concepts of the thesis and the operationalisation of which is especially important for answering research questions 1 and 2 in terms of their manifestation in practice. I then position myself in the literature on governance. For a more detailed account of the specific conceptual and analytical frameworks used, e.g., the ecosystem services cascade model (Paper 1) and design principles for transdisciplinarity (Paper 2), the reader is referred to particular papers.

Bringing ‘adaptation’ to the ground

My understanding of adaptation at the local level combines theory from climate adaptation and disaster risk reduction. Research in these two scholarly fields, of which disaster risk reduction has a longer history especially with regard to action at the community level, were initially carried out separately. However, more recently, disaster and risk perspectives have moved into mainstream adaptation debates, an important milestone being the IPCC special report *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)* (IPCC, 2012). Their integration is also supported in the IPCC’s definition of adaptation as “the process of adjustment to actual or expected climate and its effects [...] to moderate or avoid harm or exploit beneficial opportunities” (IPCC, 2014, p. 1758).⁵ The inclusion of adverse effects related to the *actual* climate is important in this thesis, and reflects the fact that many cities are not well adapted to the current climate (Klein and Juhola, 2014).

⁵ Note that by using the lens of disaster risk reduction and extreme events, I place less focus on slow-onset climate impacts (such as gradual erosion) as well as harnessing the potential benefits of a changed climate, which are also part of adaptation (IPCC, 2014).

Using an integrated lens means that, on the one hand, I understand climate adaptation as a gradual process of long-term adaptation to irreversible climate change, such as rising sea levels and global warming (IPCC, 2014). On the other hand, drawing on the disaster risk literature, I understand adaptation to be a continuous and cyclical process in which risk reduction relates to discrete weather events, before (development context), during (response) and after (recovery) they occur (UNISDR, 2009; Wamsler, 2014).⁶ Analogous with how *disasters* are defined, I conceive of adverse climate impacts as “the outcome of continuously present conditions of risk” (UNISDR, 2009, p. 9). They can further be seen as

a result of the combination of: the exposure to a [climate] *hazard*; the conditions of *vulnerability* that are present; and *insufficient capacity* or measures to reduce or cope with the potential negative consequences. (UNISDR, 2009, p. 9, my emphasis)

Hazards arise from both climate extremes and variability (Wamsler, 2014). Climate-related hazards in urbanised areas include rising sea levels and storm surges, heat stress, extreme precipitation, inland and coastal flooding, landslides, drought, increased aridity and water scarcity (Revi et al., 2014). In the adaptation literature, the term *hazard* is often used interchangeably with *extreme event* (e.g. IPCC, 2012). However, from a disaster perspective, a hazard will not cause adverse impacts (i.e., disasters) if it does not meet conditions of vulnerability (such as people or infrastructure that are susceptible to such hazard). Conversely, a hazardous climate event does not have to be extreme in the statistical sense to have adverse or disastrous impacts (for instance, if vulnerability is high) (UNISDR, 2011). Vulnerability thus emerges as a key concept of this study.

I use the term *vulnerability* following the risk literature, where it is defined as “the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard” (UNISDR, 2009, p. 30).⁷ This framing has been deemed especially suitable for case study research and for understanding the socio-political processes underlying risk, and it is also known as the ‘contextual’ or ‘starting-point’ vulnerability in adaptation literature (O’Brien et al., 2007). While vulnerability is highly context-dependent and also comprises biophysical factors, characteristics that are known to make individuals or groups vulnerable to hazards include poor health, old (or very young) age, low income or unemployment, immigration status, single parenthood and dependence on social services (Cutter et al., 2003).

⁶ At the local level, this cyclical process entails a continuous shift in responsibilities and resources, such as between planning and emergency response authorities (Runhaar et al., 2015).

⁷ This differs from the adaptation literature, where vulnerability was initially formulated as the *product* of exposure, sensitivity and adaptive capacity (cf. ‘output’ or ‘end-point’ vulnerability) (O’Brien et al., 2007).

The insufficient capacity cited above (UNISDR, 2009, p. 9) (sometimes seen as being part of vulnerability) relates here to the lack of structures and mechanisms in place to enable an adequate response to, and recovery from, climate-related hazards (Wamsler, 2014).

The relationship between these concepts can be expressed in the following way (cf. IPCC, 2012; UNISDR, 2004; Wamsler, 2014):

$$\text{Risk} = \text{Hazards} \times \text{Vulnerability} \times (\text{Response capacity})^{-1} \times (\text{Recovery capacity})^{-1}$$

Based on this understanding of risk, in order to reduce the risk associated with adverse climate events, one can try to (i) avoid or reduce hazards, (ii) reduce vulnerability to them, or increase preparedness to (iii) respond to and (iv) recover from them as they occur (Wamsler, 2014). The reduction of vulnerability can target both immediate settings (unsafe conditions) and systems and processes more distant in space and time (dynamic pressures and root causes) (Wisner et al., 2004) (see Figure 2).⁸

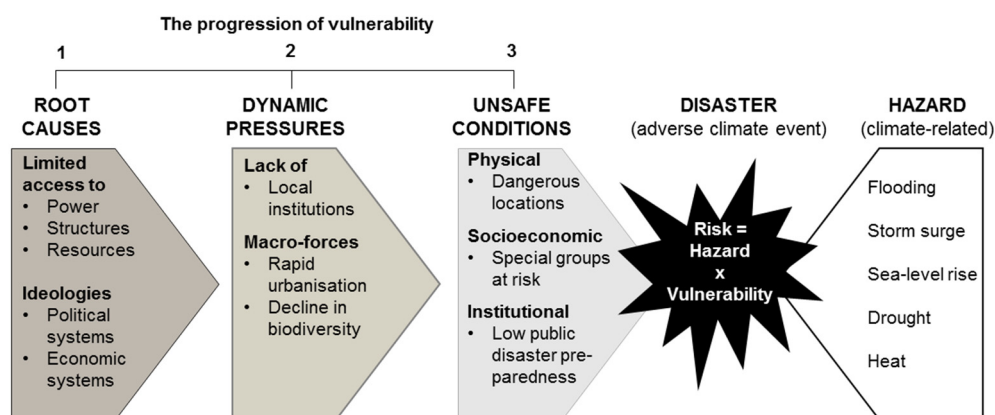


Figure 2 The Pressure and Release (PAR) model

The PAR model explains how disasters (here, adverse climate events) are shaped by structures and processes distant in space and time. Adapted from Wisner et al. (2004).

A holistic approach to climate adaptation will target all these risk factors, using diverse measures: physical (e.g., sea walls and drainage structures); ecosystem-based (e.g., planting trees to regulate heat or floodwater); social (e.g., educational

⁸ While the term ‘resilience’ became very popular during my time as a PhD student, I consciously avoid using it, as having its roots in ecology, I personally did not find it useful as an analytical concept for explaining processes of vulnerability or changes in municipal organisations (see also Olsson et al., 2015).

and informational measures, evacuation); economic (e.g., insurance schemes); and institutional (e.g., creation of local adaptation groups) (Wamsler, 2014).

Institutional change is important to ensure that measures are carried out on the ground as part of routine development; this is sometimes referred to as *mainstreaming* adaptation (Archer et al., 2014; Uittenbroek et al., 2013). Originating in environmental policy integration and risk reduction (Benson et al., 2007; Kok and de Coninck, 2007; LaTrobe and Davis, 2005), mainstreaming refers to the strategic integration of a topic (horizontally and vertically) into an organisation, and includes changes in regulations, policies, working structures and mechanisms (Wamsler et al., 2014; Wamsler and Pauleit, 2016).

Taken together, my operationalisation of adaptation translates into actions by people or organisations to (create structures and mechanisms that) prevent, reduce vulnerability to, respond to and recover from adverse impacts in current and future climate situations.

Deconstructing ecosystem-based adaptation

Ecosystem-based Adaptation (EbA) is a particular type of climate adaptation, which utilises the protective and regulative functions of ecosystems to buffer against climate-related hazards. It is based on the linking of adaptation with *ecosystem services*, a concept increasingly used in urban research and planning to emphasise people's and cities' dependence on nature (Bolund and Hunhammar, 1999; Luederitz et al., 2015), and which describes the “conditions and processes through which natural ecosystems [...] sustain and fulfil human life”) (Daily, 1997, p. 3). Ecosystem services include both adaptation-related services, such as water and temperature regulation, and other services, such as noise reduction, recreation, or a beautiful view (sometimes referred to as ‘co-benefits’ when the primary focus is on adaptation) (Geneletti and Zardo, 2016; Wertz-Kanounnikoff et al., 2011).

To the Convention of Biological Diversity (CBD, 2009, p. 41), EbA implies using

the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most appropriately integrated into broader adaptation and development strategies.

This definition has three implications for urban EbA: it describes the range of practices (e.g., sustainable management, conservation and restoration of ecosystems – among which some count the creation of new, ‘constructed’ ecosystems); it puts

at-risk people at the centre; and it places EbA in a broader framework of urban adaptation and sectoral work (cf. FEBA, 2017).

In this thesis, EbA denotes all ecosystem-based approaches to reducing the risk of climate-related hazards, regardless of the terminology used; however, its conceptual roots emphasise participation and knowledge integration (cf. Brink et al., 2016). EbA first emerged as a concept in around 2008 (Mercer et al., 2012; Wertz-Kanounnikoff et al., 2011) and was initially discussed in a Global South context, often with the rationale that poor communities in newly industrialised countries are more directly dependent on the environment (Forsyth, 2014; Jones et al., 2012; Vignola et al., 2009). In this reading, EbA is “mutually supportive” with community-based adaptation (IUCN, 2008, p. 2). It stresses, on one hand, participation, transparency, cultural appropriateness and “actively embracing equity and gender issues”, and on the other, (the integration of) “the best available science and local knowledge” (Mercer et al., 2012, p. 1910). Links to citizen engagement are thus apparent in the original EbA literature.

Recently, scholars have started to apply the EbA concept more generally to climate adaptation using ecosystems in the Global North (e.g., Jones et al., 2012; McCarthy, 2013; Wamsler et al., 2014). This is likely to be a partial consequence of the popularity of the ecosystem services concept and approach (see Brink et al., 2016; Luederitz et al., 2015). EbA-like approaches have also been carried out using terminology such as green (and blue) infrastructure (Carter and Kazmierczak, 2010; Derkzen et al., 2017), nature-based solutions (Frantzeskaki et al., 2017), integrated coastal zone management (Storbjörk and Hedrén, 2011), or simply ‘working with nature’. Common to the approaches using ecosystem services, green infrastructure and nature-based solutions is that they are deployed to provide benefits or solve problems including, but not limited to, adaptation and climate-related risk. While still anthropocentric, i.e., premised on nature providing services to society, they are thus wider in scope than EbA (see also Thoni et al., 2017).

Deconstructing citizen engagement in adaptation: from participation to privatisation of risk

Why ‘citizens’?

Different words are used thorough the scientific literature to refer to people and their role in adaptation and risk reduction. They include human (Brace and Geoghegan, 2011; Orlove, 2005), individual (Grothmann and Patt, 2005), household (Guldåker, 2009; Linnekamp et al., 2011), resident (Akerlof et al., 2016), homeowner/house owner (Glaas et al., 2015b), private [actor] (Klein et al., 2017; Tompkins and Eakin, 2012), [the] public (Newig et al., 2014; Taylor et al., 2014), community (Archer et al., 2014; May and Plummer, 2011), civil society (Adger et al., 2013), and citizen

(Boyd et al., 2015; Mees et al., 2017, 2016). The terms used emphasise different aspects of the context and scale in which adaptation takes place; for instance, a focus on ‘residents’ stresses housing and adaptation of the living environment, ‘individual’ generally places more focus on aspects like motivation and cognition, and ‘community’ or ‘civil society member’ tend to emphasise group engagement.

I have chosen the term citizen because it does not presuppose a level of analysis, but rather acknowledges links between the individual, the ‘other’, and (here: local) government. In its traditional sense, citizenship is conceived as a contractual relationship (sometimes referred to as a ‘social contract’⁹) between the citizen and the state, in which citizens agree to be ruled by the state, including paying taxes and seeking work when unemployed, in exchange for certain privileges and protection (Dobson, 2000; Purcell, 2003). More contemporary perspectives, such as ecological citizenship, means a reframing or ‘disruption’ of traditional citizenship to place focus on people’s *duties* rather than their rights – including duties towards other citizens who may be strangers in space and time (Dobson, 2000). Closed membership (e.g., of a nation state) thus becomes less relevant. I take a position somewhere in the middle, acknowledging that citizens have rights and duties, and belong to some kind of political community; in this case living under the jurisdiction of a local government (independent of national citizenship status). The term citizen also fits well with applications in environmental stewardship relevant to this research: ‘civic’ practices (Krasny et al., 2014), active citizenship (Buijs et al., 2016; Stern et al., 1999) or civic/citizen science (Bäckstrand, 2003; Boyd et al., 2015).

Participation and diverse roles

As the literature on citizen engagement in adaptation is still in its infancy (see e.g., Klein et al., 2017), my inquiry into this area was guided (mainly) by two other theoretical perspectives: (community-based) disaster risk reduction and participation. The former, introduced above, elucidates how citizens’ differential risk exposure and risk-reduction options are mediated through hazard exposure, vulnerability and capacity – including power aspects such as gender and access to resources, and cognitive aspects such as risk perception and perceived control (Enander, 2008; Larsson and Enander, 1997; Wisner et al., 2004) (see Figure 2). It emphasises citizens’ roles as both *exposed to risk* and *agents for risk reduction* (which do not always coincide, see Figure 3 below). While, to date, there has been little theorisation of the interactions between citizens and governments in adaptation in Western societies,¹⁰ the participation literature sheds light on the potential type

⁹ Early work on transformational adaptation used social contract theory as a lens, as it can reveal public assumptions about rights and responsibilities and whether these correspond to governments’ capacities and (legal) responsibilities (Adger et al., 2013; O’Brien et al., 2009; Pelling, 2010).

¹⁰ The social contract literature introduced earlier is useful for examining changing responsibilities, but provides less insight into types of interaction and flows of information. Community-based

or intensity of such engagement (often presenting intense participation as more desirable). Participation emphasises citizens' role as *affected* by public adaptation and risk reduction (see Figure 3). Related literature has allowed me to see citizen engagement in adaptation on a scale from passive participation (including one-way communication), consultative participation (people giving opinions on pre-determined issues), interactive participation (people participating in joint problem analysis) to self-mobilisation (people taking independent action) and catalysing change (people influencing other groups to take action) (Arnstein, 1969; Conde and Lonsdale, 2015; Few et al., 2007). Important to my understanding, the latter acknowledges the fact that contestation, social mobilisation and dissonance also play important roles in environmental policy and raising the political profile of risks (Hajer, 1997; Healey, 2006a; Pelling et al., 2014; Stepanova and Bruckmeier, 2013).

Privatisation of risk and 'responsibilisation'

As a counterweight to theories emphasising participation and collaboration, I also understand citizen engagement in adaptation against a background of increasing neoliberalism and privatisation of risk, which has prompted me to use the term engagement in a neutral (rather than normative) way. Privatisation of risk is a more-or-less conscious policy that lets individuals suffer impacts that are reasonably predictable, "without creating effective mechanisms to share the burden, let alone reduce the risk" (Calhoun, 2006, p. 257). This can be observed globally in the privatisation of social institutions such as healthcare, insurance, pensions and schools. Healey (2015) describes an increase in citizen-driven initiatives in the welfare sector that *directly provide goods and services* (rather than participating in public policy) in response to public deficiencies which she ascribes to financial constraints, political ideology and failure of market delivery of quality welfare services. Similarly, in flood risk management, Geaves and Penning-Roswell (2016) note how previously public goods have become private, 'club' goods, triggering increased public engagement. In this context, risk scholars question whether citizen engagement in adaptation is a process of 'empowerment' or rather of 'responsibilisation' (i.e., transferring the burden of risk and responsibility to citizens) (e.g., Klein et al., 2017; Kuhlicke et al., 2011)

adaptation (Archer et al., 2014; Forsyth, 2014) is widely used in development literature, but provides little theorisation of the citizen–municipality relation. Other recent studies have used concepts such as (risk) communication (Blennow et al., 2013; Glaas et al., 2015a), collaboration (May and Plummer, 2011; Wamsler, 2016) and co-production (Mees et al., 2017, 2016).

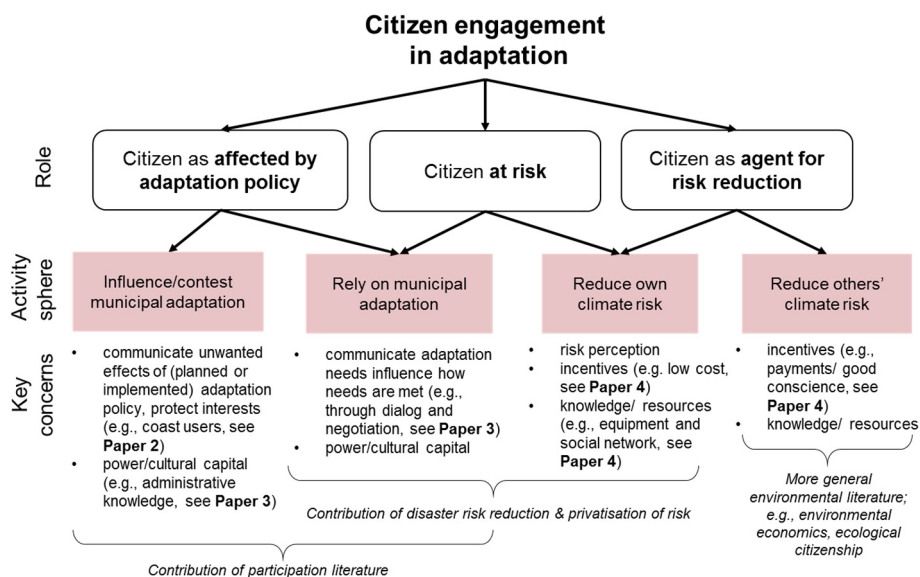


Figure 3 Typology of citizens' role in adaptation

Shows how different theoretical perspectives have informed my understanding of citizen's roles and activities in adaptation. Note that this simple typology does not differentiate between individual or collective engagement; however, collective engagement is likely to influence the concerns listed in the bullet points e.g. through social learning, norm-setting and mobilisation.

Governance of adaptation: navigating a many-faceted concept

In this section, I describe the ways in which the governance concept is employed and how it has informed my research. I primarily use the term in its most general sense to denote the “processes of regulation and mobilisation of social action” (Healey, 2006b, p. 302) at the local level, for instance, in the framing of my research problem. I also draw upon and position my findings in relation to the literatures on (urban) climate governance¹¹ (e.g., Bulkeley, 2010), risk governance (e.g., Driessen et al., 2016; Renn and Schweizer, 2009) and (hitherto less common) adaptation governance¹² (e.g., Dzebo and Strippel, 2015).

¹¹ Although climate governance is concerned with the mechanisms and measures “aimed at steering social systems towards preventing, mitigating or *adapting* to the risks posed by climate change” (Jagers and Strippel, 2003, p. 385, my emphasis), its focus has predominantly been on mitigation.

¹² Not to be confused with the more established term adaptive governance (see also co-adaptive management), which is traditionally not concerned with climate adaptation, but learning-by-doing

Scholars further differentiate between the *descriptive* and *analytical* use of the concept, the former denoting the empirical phenomenon of non-state actors' growing importance in governing, and the latter comprising related academic theories, frameworks and ideal types (Healey, 2006b; Hoff, 2003). A third form is the *normative* use, which presupposes that there is a 'right' or 'good' way to govern based on underlying values (e.g., fairness or transparency) or problem framings (e.g., regarding causes of unsustainability and risk) (Adger and Jordan, 2009). As outlined below, I have engaged with different dimensions of the concept during the course of my project.

The descriptive and normative dimensions of governance provide important, but different, rationales for my study: one reveals the emergence of new actors in environmental and risk governance, and the other posits that their interaction or collaboration may be beneficial, or even necessary. The descriptive use of governance denotes a shift in the mode of steering from hierarchal 'government' to multi-level and multi-actor 'governance' structures; which provides an important backdrop to my research (cf. Empirical background). It describes, in the European context, a particular transformation from modes of government associated with a bureaucratized welfare state to the more 'entrepreneurial' modes of governance (Healey, 2006b; Kuhlicke et al., 2011). Regarding the normative use, I have engaged with literature on collaborative (closely related to inclusive, participatory and interactive)¹³ governance, which is based on the normative belief that the socio-political engagement between actors (including citizens) makes environmental governance more effective, legitimate or fair.

Finally, regarding the analytical use, my framework for analysing adaptation interactions in Paper 3 draws heavily on the governance literature (Alber and Kern, 2008; Ansell and Gash, 2008; Healey, 2006b). Healey (2006a), in examining changes in urban governance, differentiates between three levels: governance *episodes*, *practice*, and *culture*. In line with this, I see adaptation interactions as governance episodes – periods of concentrated attention to governance – that can catalyse change at higher levels (or vice versa). Based on Alber and Kern (2008), I

through socio-ecological feedbacks in resource systems, often in rural settings or a specific ecosystem (e.g., Baird et al., 2014; Plummer, 2013).

¹³ In this context, 'inclusive' risk governance is based on the "normative belief that the integration of knowledge and values can best be accomplished by involving those actors in the decision-making process that are able to contribute all the respective knowledge as well as the variability of values necessary to make effective, efficient, fair and morally acceptable decisions about risk" (Renn and Schweizer, 2009, p. 174). 'Participatory' governance emphasises the democratic engagement of citizens (Fischer, 2012; Gustafson and Hertting, 2017), while 'interactive' governance emphasises interactions between state, market and civil society as important factors in the success or failure of governance approaches (Kooiman and Bavinck, 2013).

categorise municipalities' engagement in adaptation interactions as either governing 'by authority', governing 'by provision' or governing 'by enabling' (see Paper 3).

Empirical Background: Adverse climate events, ecosystem services and citizen engagement in Sweden

A number of factors make Sweden an interesting choice for the empirical work of this thesis. Sweden has a long history of decentralised environmental and climate policy work, and since the 1970s, the country has had a strong focus on active citizenship and transparency, and participation and influence in local governance (Montin and Granberg, 2013; SymbioCity, 2011). Adaptation is a more recent priority at the local, regional and national level (Langlais, 2009), and has provided an opportunity for this thesis to study related change and learning in municipalities. In addition, a recent national-level interim target for environmental goals requires all decision-making to consider the contribution of ecosystem services by 2018 (Miljödepartementet, 2014), which has increased the incentives for EbA.

This section provides a background to how the adaptation issue has developed in Sweden, with special mention given to ecosystem-based approaches and citizen engagement. Before this, I briefly introduce role and mandate of the municipality (in Swedish, *kommun*) in the Swedish political system, and general climate governance.

Strong municipalities and initial focus on climate change mitigation

Based on the historical principle of municipal autonomy (in Swedish, *kommunalt självstyre*), Sweden can be seen as a decentralised welfare state, with strong municipalities and a strong central state (Granberg and Elander, 2007; Montin and Granberg, 2013). Under this principle, the country's 290 municipalities have considerable scope for action to handle local and regional issues (including spatial planning and climate-related issues) and tax their inhabitants to finance their activities (SKL, 2015). The autonomy principle is based on the normative idea that decentralised power is more *democratic* (i.e., municipal citizens 'govern

themselves’) and *efficient* (i.e., municipal administration becomes cheaper and more purposive) (Montin and Granberg, 2013). In the 1970s, Swedish municipalities were shaped into the complex welfare institutions that they are today, with different local sectors (e.g., child care, culture, traffic, and spatial planning) to implement the national reform politics. This ‘sectorisation’ has been subsequently criticised, and while initiatives have been taken to build horizontal links between sectors (one of the first being to integrate social aspects into physical planning), these have largely served to reinforce sectorisation – not least due to the different professions created through the educational system (Montin and Granberg, 2013). At the end of the 1980s, New Public Management – a new model for public governance, inspired by the private sector – was introduced and ideas about public–private cooperation, especially as regards regional development and growth, led to intensified cooperation and networking between and among municipalities and the private sector (Montin and Granberg, 2013). In the early 2000s, democratic renewal became high on the municipal agendas. This led to changes in the municipal law (e.g., increased transparency of municipal corporations), and higher expectations regarding citizen participation in decision processes between formal elections (e.g., through different kinds of citizen dialogues) (Montin and Granberg, 2013; Tahvilzadeh, 2013).

While Sweden is often seen as a pioneer in environmental governance, climate mitigation rather than adaptation has long been the dominant focus of climate work (Granberg and Elander, 2007; Langlais, 2009). Municipal action on climate change began in 1996 with Local Agenda 21 (Granberg and Elander, 2007), which had an explicit focus on engaging various municipal actors and the general public in sustainable development. In 1997, stimulated by the Kyoto Protocol and subsequent national grants, mitigating greenhouse gas emissions started to become a more explicit part of municipal policies (Langlais, 2009). These grants included the Local Investment Programme (LIP) and Climate Investment Programme, (KLIMP), which encouraged a focus on energy and networking between municipalities. In 1999, the national government formulated an environmental goal for reduced climate emissions.¹⁴ However, on the whole, the role of the state in environmental policymaking has consisted more of “enabling and guiding rather than steering and control” (Granberg and Elander, 2007, p. 541), and it is clear that climate action competes with other issues, and has been seen to recede in times of crisis.

¹⁴ See <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Sveriges-miljomal/Miljokvalitetsmalen/Begransad-klimatpaverkan>.

Gudrun and onwards: thirteen years of adaptation research and policy

In recent years, Sweden has seen a growing interest in adaptation at all policy levels. While climate mitigation was mainly introduced in a top-down manner, via the national government and its participation in international contexts, adaptation has had a strong bottom-up component in terms of actual hazard events and initiatives from pioneering (and risk-exposed) municipalities (Palo, 2013; Wamsler and Brink, 2014a). In early 2000, a national consensus was beginning to form to the effect that more concrete action was needed on adaptation (Langlais, 2009; Rummukainen et al., 2005) – an important wake-up call regarding society's vulnerability to climate conditions in modern times was the winter storm Gudrun which hit the south of Sweden in 2004 (e.g., Guldåker, 2009). Consequently, in 2005 a government team was appointed to investigate impacts, vulnerability and possible ways forward for Sweden in a changing climate. The resulting report 'Sweden facing climate change – threats and opportunities' (SCCV, 2007) highlighted the increased risk of flooding, landslides, erosion, heatwaves, dry spells and fires and made several suggestions for improving Sweden's robustness to future climate change, including regional coordination of adaptation issues, possible funding alternatives, and extended liability for spatial planning (Glaas, 2013; SCCV, 2007). An interim national report on adaptation was published in 2015 by the Swedish Meteorological and Hydrological Institute (SMHI) (Andersson et al., 2015). It acknowledged recent advances in climate adaptation initiatives, including the establishment of a National Knowledge Centre for Climate Adaptation (led by SMHI), the creation of county-level climate change action plans, and landslide risk mapping in the Göta Älv River. However, it stressed the need for more integrative approaches, including the adaptation of laws and regulations, consideration of ecological factors and land-use change, and clarifications of roles and responsibilities among actors.¹⁵ A new assessment report, aiming to clarify responsibilities between municipalities, county councils and central government for all types of land and climate impacts, was published in 2017 (SOU, 2017). There is a growing body of research on the institutional interplay for adaptation in Sweden (e.g., Glaas, 2013; Glaas and Juhola, 2013; Hjerpe et al., 2015; Hjerpe and Glaas, 2012; Storbjörk, 2010, 2007; Storbjörk and Hedrén, 2011; Storbjörk and Hjerpe, 2013; Ugglå and Storbjörk, 2013).

Despite these developments, national guidelines for adaptation have generally been vague and not sufficiently supported by guiding principles, policies and laws (Granberg and Elander, 2007; Langlais, 2009; SOU, 2017). Sweden lacks a national adaptation policy (Glaas, 2013; Granberg and Elander, 2007); rather, the current

¹⁵ Research conducted during the early phase of my PhD (Wamsler et al., 2014; Wamsler and Brink, 2014a) partly contributed to identifying these gaps.

governmental structure for adaptation is that it should ‘permeate’ society and that no particular authority has overall responsibility for it (SOU, 2017). In practice, municipalities have a large practical responsibility for adaptation, but they face different conditions in terms of size, budget, staff, knowledge and past experience of hazards, and the approach taken is often shaped by where in the organisation the adaptation issue has ‘landed’ (e.g., with risk engineers, environmental or planning department) (Wamsler and Brink, 2014a). While national authorities such as the Contingency Agency (MSB), the Meteorological and Hydrological Institute (SMHI), Swedish Geotechnical Institute (SGI), the (Boverket) and County Administrative Boards (regional representation of national government) have produced important and sound decision support, its application in municipal planning is hampered by high cost, limited accessibility, and poor coordination between authorities (SOU, 2017). Pioneering municipalities and other authorities facing increasing climate challenges have instead increased networking with each other and turned to private consultants and research programmes and networks at the EU level (Storbjörk and Hedrén, 2011; Wamsler and Brink, 2014a).

In this context, the study region Scania, located in the southernmost part of Sweden, is expected to be among the Swedish regions hardest hit by climate change (Hall et al., 2015), with the largest share of buildings, infrastructure and beaches at risk from flooding, coastal erosion and sea-level rise (SCCV, 2007).¹⁶ For instance, coastal erosion was long dismissed as a localised ‘Scanian problem’¹⁷ rather than a national concern, which frustrated municipal and technical staff of the region and led to the creation of local constellations of actors addressing adaptation issues (Hanson et al., 2006; Storbjörk and Hedrén, 2011).

Ecosystem-based approaches and citizens in municipal governance and adaptation

Sweden has a tradition of physical and technical approaches to adaptation. For instance, the first national assessment report (SCCV, 2007) largely left the ecological issues aside. However, there are initial examples of EbA both at the local and national level (Boverket, 2010; Rolfsson, 2008; Thoni et al., 2017; Thorsson, 2012). In addition, there is increasing interest in ecosystem-based planning in general (Beery et al., 2016; Schubert et al., 2017). For instance, an ‘Interim Target’ to fulfil the national environmental quality objectives was established in 2012,

¹⁶ Due to post-glacial rebound – the slow rise of land masses after being depressed by the weight of ice layers during the last ice age – sea-level rise will be slower or close to zero in large parts of Sweden; notably also in Stockholm, the centre of decision-making power. In the Scania region, however, sea-level rise is expected to be on a par with global levels (SOU, 2017).

¹⁷ See e.g. <https://www.svd.se/lat-inte-skanes-sandstrander-forsvinna>

which requires the importance of biodiversity and the value of ecosystem services to be widely-known, and integrated into economic and political considerations and societal decisions by 2018 (Borgström, 2013; Brink et al., 2018; SEPA, 2012).

Before the adaptation ‘turn’, citizens’ practices in response to local hazards were described in the academic literature on Sweden in terms of public attitudes and actions for disaster preparedness (Larsson and Enander, 1997), social vulnerability in extraordinary events/ disasters (Nieminen Kristofersson, 2007) and households’ emergency management capacity (Swedish, *krishanteringsförmåga*) in the face of storms (Guldåker, 2009). In recent years, other studies on Swedish citizens in adaptation have been published, although these have generally targeted specific groups such as forest owners (Blennow et al., 2013; Blennow and Persson, 2009) and house owners (Glaas et al., 2015b, 2015a). In this context, Glaas et al. (2015a) highlighted information deficits concerning how to address context-specific barriers and driving forces for adaptation – how homeowners generally had low risk awareness, viewed climate change as a distant phenomenon, and were confused about the activities and objectives of climate adaptation and mitigation.¹⁸

¹⁸ Detailed examples and classifications of Swedish citizens’ actions for climate adaptation, resulting from initial literature review, can be found in the supporting papers to this thesis (Wamsler and Brink, 2015, 2014b).

Methodology

In this section, I describe the ontological and epistemological starting points for this research. I then introduce my general research strategy, and finally, the specific methods and techniques used in the four different papers (see Figure 4).

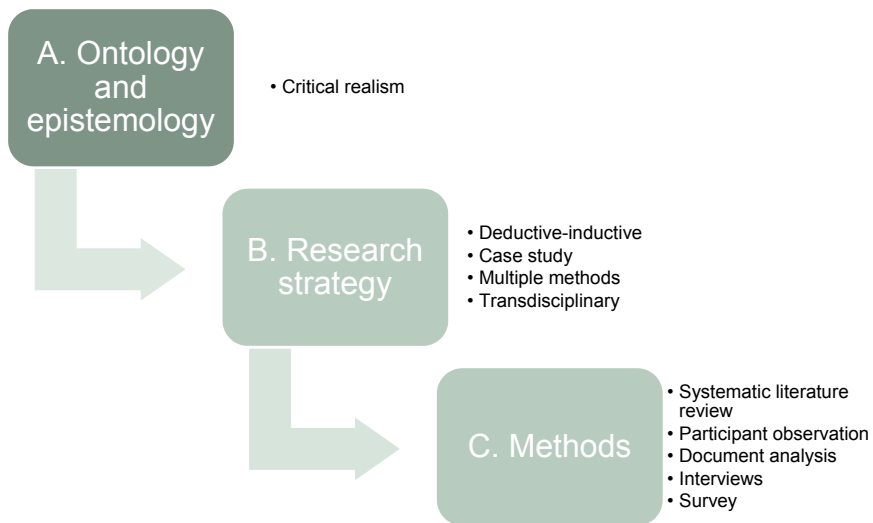


Figure 4 Overview of the methodology

Ontological and epistemological starting points

Ontological and epistemological assumptions (even when tacit) influence the research process. As I come from a background of Engineering Mathematics, such philosophical considerations were not so familiar to me; however, during the course of this PhD, and especially working in inter- and transdisciplinary settings, it became evident how disciplinary worldviews have direct, practical implications for

researchers working towards a shared goal – for instance, (dis)agreement about the rigour of different methods.¹⁹

My ambition to combine the material aspects of risk with the notion that it is socially constructed and produced attracted me to the idea of critical realism, a position midway between positivism and constructivism. The focus of critical realism is on explaining the (sometimes unobservable) causal mechanisms of social phenomena, and this makes it a productive tool for analysing and suggesting solutions to real-world problems (Fletcher, 2017). However,

a critical realist's belief in 'causes' is not as clear-cut as a positivist's: causes do not simply *determine* action; instead:

What causes something to happen has nothing to do with the number of times we have observed it happening. Explanation depends rather on identifying causal mechanisms and how they work, and discovering if they have been activated and under what conditions. (Sayer 2000, p. 14, quoted in Grix 2010, p. 87, original emphasis)

Like positivism, critical realism acknowledges the existence of an objective ("real") world, but like relativism, it maintains that it cannot be objectively measured (Grix, 2010). In my research, this translates into the use of different or mixed²⁰ methods to inquire into different stakeholders' perspectives and comparing and contrasting these throughout the process, in order to try to construct a picture that best reflects reality. The use of theory is thus indispensable; if the real is impossible to know, then it is only through the constant use and revision of theory (and trying the explanatory power) that we can assess whether the picture constructed by the researcher is close to the "real".

Critical realists, despite their focus on uncovering causal mechanisms, refuse the positivist idea that the goal of research is to identify generalisable laws; they seek rather to uncover context-specific tendencies (Shannon-Baker, 2016) or mechanisms that are activated under certain conditions (McEvoy and Richards, 2006). This has spurred me to formulate research questions that go beyond the descriptive accounts of EbA and citizen engagement, and that also look into why

¹⁹ This was the case in our university–municipality collaboration, where social scientists wished to use workshop discussions with selected municipal staff to collect/create data, while environmental scientists emphasised the need to objectively measure the described phenomena in the field through quantitative surveys (see Paper 2).

²⁰ While the mixed (i.e., quantitative + qualitative) methods literature has traditionally advocated pragmatism as the philosophical perspective, critical realism is increasingly being discussed in this context (e.g., Creswell and Clark, 2011; Maxwell and Mittapalli, 2010; McEvoy and Richards, 2006; Shannon-Baker, 2016).

they occur and under what conditions they can reduce risk and address its underlying causes (see Figure 2 in Theory section).

General research strategy

This thesis builds on a deductive–inductive, multi-method and transdisciplinary case study approach (see Figure 4). This approach was key to ensuring that I did not overlook activities that were not recognised or ‘branded’ as adaptation, as adaptation comprises both conscious and unconscious responses to climate stimuli or forecasts (IPCC, 2014). Furthermore, EbA and citizen engagement in adaptation are both relatively new constructs, and in order to shed light on them, I wanted to study them both in breadth – allowing for enumeration and systematisation – and in depth – trying to identify different perspectives, meanings and causal mechanisms. The result was a multi-method research strategy, which alternated between systematic ‘mapping’, in-depth inquiry into particularly interesting or data-rich cases, and repeated interaction with key stakeholders, as described in the next sections.

Deductive–inductive approach (theory utilisation and building)

I use a deductive–inductive approach, where deduction is a ‘top-down’, theory-driven method of reasoning that goes from general to specific, and induction a ‘bottom-up’ approach that goes from specific to general, including generating new theory from empirical material (Grix, 2010). In all my papers, I have first used theory (see Conceptual Framework) to guide the inquiry, categorise and assess the data. Through this exercise, new categories or themes have emerged, either because they added something different or because of their repeated occurrence or salience to stakeholders (Glaser and Strauss, 1967). For instance, in Articles 1 and 3, I combined existing theory to create broad operationalisations of EbA and citizen engagement and to look for their different manifestations in the scientific literature and local practice, respectively. Such mapping allowed me to get an overview, find gaps, and then zoom in on cases, phenomena or topics that I felt had been overlooked in the literature or had specific explanatory power.

Case study

The case study is an in-depth analysis of a specific unit, and it is generally helpful for understanding context, process and causality, testing the validity of concepts, and generating new research questions (Flyvbjerg, 2011). A case study approach often implies the use of a multitude of methods or even methodologies (Yin, 2008).

At the synthesis level, my thesis is a case study of EbA and citizen engagement in local adaptation governance. In particular, three of the four articles draw on case study methodology. In Article 2, I study the ECOSIMP project as a case of local-level transdisciplinarity (in relation to local EbA and citizen engagement). In Article 3, I study citizen–municipality interactions in local adaptation processes as cases of citizen engagement in adaptation. In Article 4, I investigate a community of coastal households in the municipality of Lomma (and their relation with municipal and ecosystem-based adaptation) as a most likely case for citizen engagement in adaptation.)

Multi-method(ology) research and triangulation

Mixed methods (Creswell and Clark, 2011; Johnson et al., 2007) refer to a specific kind of multi-method research that purposely combines quantitative and qualitative research perspectives. The mixed methods design used in this thesis benefited the complementarity and diversity of views in the research process (i.e., it was able to combine researchers' and participants' views: to quantitatively uncover relations between variables, while qualitatively revealing meanings held by research participants). It also supported instrument development (i.e., I used previous qualitative findings to develop the survey questions in Paper 4), utility (increased usefulness of results for practitioners) and triangulation (i.e., to investigate whether findings are supported by different methods/a larger sample) (Creswell and Clark, 2011). Triangulation (or 'mixing') was continuous and occurred at both the level of theory (using different theoretical perspectives), data (e.g., using different populations and stakeholders, global vs. regional focus), methods (e.g., structured survey with free-text answers), and analysis (e.g., comparing quantitative survey data with qualitative interview data) (Denzin, 1970; Johnson et al., 2007).

Transdisciplinary stakeholder interaction

Transdisciplinarity, i.e., research collaboration between academia and societal actors (in my case, mainly municipal civil servants) is said to be key for sustainability science and urban transformations towards sustainability (Lang et al., 2012; McCormick et al., 2013; Trencher et al., 2014; Wiek et al., 2012). It is closely related to concepts such as participatory action research (Glassman and Erdem, 2014; Streck, 2014), post-normal science (Funtowicz and Ravetz, 1993), and mode 2 knowledge production (Gibbons et al., 1994). Its effectiveness lies in uncovering underlying assumptions in research and practice, and developing methodologies for working with uncertainties and disputed values (Jahn et al., 2012; Lang et al., 2012).

The transdisciplinary collaboration in the ECOSIMP project (focus of Paper 2) provided a platform to discuss and receive input on my research process, including

research focus and design (e.g., for Papers 3 and 4) and preliminary results (e.g., Papers 2 and 3). Using this model of bringing back results to practitioners, and then refining them, also allowed my PhD work to continually feed into practice. One example was the observation and review in the context of the Coastal Citizen Council and Coastal Adaptation Strategy for Lomma municipality.

Methods

This section provides an overview of the methods used in the context of the different PhD papers (see also Figure 4). In the kappa, I present some additional data (e.g., interview quotes) and findings from the studies below, which were not included in the final papers (e.g., due to space constraints or their respective problem framing). These data were selected to illustrate and support the answers to the overarching research questions.

Systematic review of global case studies of ecosystem-based adaptation (Paper 1)

I carried out the systematic review together with Master's students and senior researchers in the context of an international research and education project, in which I had a coordinating role (see Luederitz et al., 2016 for a general description of the methodology). Systematic reviews can highlight strengths and weaknesses in research, provide information about the prevalence of, and trends in, on-the-ground implementation, and guide evidence-based strategic planning, which is of particular pertinence for adaptation (Lorenz et al., 2014). The research team was interdisciplinary, with participants from Sustainability Science (LUCSUS, Lund University, Sweden) and Institute of Ecology, Center for Methods, Sustainability Economics Group, and FuturES Research Center (Faculty of Sustainability, Leuphana University, Lüneburg, Germany).

Data collection

Articles were sampled in September 2014 through a systematic search in the Scopus and Web of Science databases. This used a search string that intended to identify EbA as both concept and phenomenon. Of 4040 initial hits, false positives were removed through the screening of abstracts (and later full-text articles) using predefined criteria, resulting in 110 articles relevant for review. These were divided among the participants and analysed using a review protocol developed based on theory from adaptation, ecosystem services and sustainability science (see Annex A2 of Paper 1).

Data analysis

Data was compiled in an Excel sheet with the 110 peer-reviewed articles (reporting on 112 cities globally) as rows and the review protocol categories as columns. Some categories that had allowed free-text input were now coded in an inductive manner and quantified. The quantitative analysis entailed visualising frequencies for, and relations between, variables of interest, using bar plots, maps and two-dimensional network plots. Meanwhile, qualitative coding (Mayring, 2000) or description were used for subgroups of articles of specific interest (e.g., for the handful of articles that mentioned citizen engagement in EbA, the types of engagement were qualitatively described). The typology described in the Introduction of this kappa – systems knowledge, normative knowledge and transformative knowledge – was used to categorise the findings and identify gaps.

Transdisciplinary ecosystem-based adaptation project with municipalities (Paper 2)

The Implementing the Ecosystem Services Approach at the Municipal level (ECOSIMP) project (2013–2017) focused on the implementation of the ecosystem services concept in Swedish municipal planning and associated ecosystem-based adaptation to climate-related hazards. It was one of seven research projects funded by the Swedish Environmental Protection Agency (SEPA) under the ‘Value of ecosystem services’ initiative.²¹ Project participants were ecologists and planners from seven Swedish coastal municipalities (Båstad, Helsingborg, Kristianstad, Lomma, Malmö, Simrishamn, and Trelleborg), and researchers from four Swedish Universities. Additional societal actors were the Scanian Association for Local Authorities (*Skånes Kommunförbund*), the Marine Centre Simrishamn and the County Council (*Region Skåne*).

Data creation and analysis

I co-created data with the ECOSIMP participants using (i) notes and written observations produced by different participants in the regular project workshops, seminars and meetings (focused on the project’s empirical content of ecosystem services and EbA), and (ii) sessions and methods specifically focused on the transdisciplinary working method. Based on this material, I used content analysis (Mayring, 2000) to extract and categorise evidence relevant to the research questions with regular input from, and checks by, the larger project group. These checks included a workshop discussion about the preliminary results and their implications for ecosystem services and adaptation planning and research–

²¹ <http://www.ecosystems-services.se/>

municipality collaboration, and several rounds of review of the resultant manuscript by project participants.

Mapping citizen-municipality adaptation interactions (Paper 3)

I analysed citizen-municipality interactions²² on adaptation in three coastal municipalities (Malmö, Helsingborg and Lomma) in southern Sweden. The municipalities were selected based on their level of climate risk (including recent hazard occurrence) and high municipal activity in environmental and climate work (their status as adaptation role models or ‘forerunners’ in Sweden). To map and examine modes of citizen engagement, I looked for adaptation-relevant interactions²³ between citizens and municipalities that had occurred during the last 10 years (since adaptation became a policy issue).

Data collection

I identified a total of 17 adaptation interactions through an iterative process of purposive and snowball sampling (Oliver, 2006a, 2006b) and data collection using local news archives, municipal documents and conversations with civil servants. The sampling aimed to identify *diverse* interactions regarding risk context (e.g., types of hazards), actor involvement (e.g., citizens in different types of housing; both individuals and groups), interaction processes (e.g., municipality-driven and citizen-driven; collaboration and conflict), and outcomes and learning (e.g., successful and ‘capsized’ processes). This included an analysis of transcripts from seven in-depth interviews with municipal civil servants, conducted by other members of my research team in 2014, which focused on the general operationalisation and organisation of adaptation in the municipalities.

Four interactions were chosen for in-depth analysis, for which I conducted nine semi-structured (Ayres, 2008) face-to-face interviews with municipal staff and citizens with key roles – typically municipal project managers, planners, and homeowners active in cooperative housing or informal neighbourhood associations. These two-hour interviews, conducted in the summer of 2015, explored the background, actors, procedure and outcomes of the interactions. Finally, I conducted non-participant observation (Williams, 2008) in meetings, and reviewed documented communication between stakeholders, where this was granted.

²² Only three of these were analysed in depth in the paper, due to space constraints.

²³ I used the term ‘interaction’, as I considered it more neutral as regards the directionality, content and purpose of these episodes than terms such as incentive, participation, collaboration or mobilisation.

Data analysis

Interview transcripts and other data (documents, newspaper articles) were analysed using a deductive–inductive coding scheme (Mayring, 2000) that entailed classifying and analysing relevant excerpts based on the analytical framework (deductive), and identifying emerging, cross-cutting themes (inductive).

Survey of at-risk citizens (Paper 4)

After the previous paper on citizens (more-or-less) active in adaptation interactions, I wanted to see whether the findings could be confirmed for a more general population (i.e., not sampled based on engagement) and go into more depth about people's motivations to take (or not take) part in adaptation. The selection of Lomma was motivated by (i) its past exposure to, and future risk of, climate-related hazards, (ii) its high level of municipal activity in adaptation (including municipal interest in our survey, which increased the chance of making a contribution to practice), and (iii) the prior confirmation of explicit and diverse citizen engagement in adaptation and ecosystem-based practices.

Data collection

The survey was distributed into the mailboxes of 600 households in January 2017. The selection targeted citizens living in urbanised areas based on municipal flood maps/scenarios. The aim was not to target a representative sample of the population, but rather to obtain enough variation between a number of features (e.g., respondent gender, households with and without hazard experience) to allow between-group comparison (see Marris et al., 1998). The response rate was 36% (n=217). Nearly half the final respondents had already experienced damage from weather-related events (mainly pluvial and coastal flooding and storms), and there was a 6:4 ratio between men and women respondents. Qualitative data from previous studies and contacts with municipal civil servants also allowed the survey results to be contrasted and complemented with observations at the community level (e.g., ongoing citizen–municipality processes).

Data analysis

Data, consisting of both categorical variables (such as yes/ no) and Likert scale data (in which respondents had rated their agreement with statements on a scale between 1 and 5), were compiled in a spreadsheet with households as rows and the survey questions as columns. For some variables, indices were created from several question items. I used the statistical software SPSS to carry out correlation analysis (Spearman's rho) to examine the relation between different variables. This was complemented with descriptive statistics, such as comparing means and illustration in graphs, and qualitative content analysis (Mayring, 2000) of free-text answers.

Results

In this section, I present the main findings of my study, structured around the three research questions. First, I explain how, and on what basis, ecosystem-based approaches have been applied in urban adaptation (mainly drawing on Papers 1 and 2). Second, I present the results in relation to how, and for what reasons, Swedish citizens have engaged in climate adaptation (mainly drawing on Papers 3 and 4). Third, I describe the implications of EbA and citizen engagement in municipal adaptation governance, including related synergies and gaps identified by my research (all four papers).

Of these four papers, the two on citizen engagement were closest to the overall framing of the thesis and contributed more data. This is reflected in the length of the sections on citizen engagement.

How is urban ecosystem-based adaptation applied?

This section answers the first research question on *how*, and *on what basis*, ecosystem-based approaches have been applied in local and urban adaptation. It reports on the review of global case studies (Paper 1, first subsection) and the analysis of Swedish municipalities (study related to Paper 2, second subsection).

Review of global case studies

The results show that while ecosystem-based approaches for urban climate adaptation is a rapidly growing research area, the EbA *concept* has only recently been applied to urban areas. The systematic international review (Paper 1) identified 110 journal articles from 1995 to September 2014 dealing with this topic. Only four articles explicitly mentioned the term “ecosystem-based adaptation”, the earliest having been published in 2012. In most studies, authors linked their work to other related concepts, including “climate change” (63% of articles), “adaptation” (45%), “ecosystem services” (24%), “resilience” (14%), “hazard” (15%) and “risk reduction” (9%). The remaining articles used more specialised terms, namely, specific ecological structures (e.g., urban forest or wetland) that addressed specific

hazards (e.g., flooding or heat). Irrespective of the terms used, most articles addressed heat or flooding, and the most studied ecological structures for reducing the risk of such hazards were greenspace, wetlands, trees and parks.

The systematic review assessed scientific evidence of EbA implementation in cities using a climate adaptation and sustainability science lens. The sustainability lens entailed categorising the scientific knowledge reviewed according to typology: *systems knowledge*, *normative knowledge*, and *transformative knowledge*.

In relation to *systems knowledge*, on which the majority of the reviewed articles focused, the paper identified an existing quantitative evidence base for EbA in urban areas. More than 30% of the articles assessed EbA performance in controlling temperature, and almost all reported a measurable temperature reduction occurring as a result of an ecological structure. Some focused on what *kind* of ecological structures produced more adaptation benefits, finding, for instance, taller trees with larger canopies and greater density better for cooling and for intercepting rainfall. Cooling also increased with a more heterogeneous vegetation structure, certain park shapes (rounder parks had a higher ‘cool island’ effect), and trees grown in certain soils. Some articles assessed the effectiveness of ecosystem-based approaches compared with other ‘hard’ measures (e.g., using materials with high albedo, i.e., reflection coefficient, to reduce heat) and ‘soft’ measures (e.g., socio-institutional measures for floods and storms), with varying results. In the first example, EbA was found to be more efficient, but in the second it was only moderately efficient in comparison. It became clear that there is a growing evidence base for urban EbA, but it is currently fragmented due to the different disciplinary approaches and concepts used.

Normative knowledge in EbA reflects the fact that adaptation requires value-laden decisions about what and who should be protected and the criteria to be used to measure success. This relates strongly to equity; both distributional equity (who gains and who loses from EbA) and procedural equity (whose voices are heard in the process, i.e., how stakeholders are engaged). Less than 15% of the articles mentioned equity or gender. As reflected above, EbA performance was usually evaluated in bio-geophysical terms, and economic and social valuations were rare – exceptions were occasional articles that focused on health benefits or the human comfort index (in relation to temperature). Less than a third of papers focused on process-related aspects (as opposed to measuring ecological outcomes) and consequently, even fewer addressed stakeholders in that process. However, a small subset of papers considered such partnerships crucial for implementation and maintenance of urban EbA, and reported on different ways that local governments had engaged citizens. Some initial success was noted regarding financial incentives for green roofs, education and awareness-raising about the importance of trees (including an educational programme that gave citizens a small tree to plant and

look after), and citizens' grass-root initiatives for managing mangrove ecosystems. An example of designing EbA projects to be inclusive and beneficial across scales was training rural communities to become 'treepreneurs' who grew and traded seedlings from locally sourced seeds for urban EbA projects (see Roberts et al., 2012).

Transformative knowledge here concerns how to ultimately create change towards the desired form of EbA. While many of the articles reviewed studied the link between ecological structures and their benefits for adaptation, few specified *who* should take action and *how* society can sustain ecosystems providing such benefits.²⁴ Of those that did mention how, the main focus was on institutional rather than material practices, such as integrating EbA into various urban plans, visions and management routines (sometimes with other primary purposes than adaptation). These articles also gave some insight into drivers and barriers for EbA implementation, shown in Table 2. A key barrier was, for instance, how difficult it was to access and secure physical space for EbA in dense urban areas, which city authorities responded to with incentives for action (including by citizens) on private land, creating multifunctional spaces, land 'recycling', and systematic land acquisition.²⁵

Notably, (a lack of) support from citizens was mentioned as both a barrier to and a driver of EbA, and citizen engagement was argued to be especially important for implementation in urban settings where open, public space tends to be limited. One major gap in terms of transformative knowledge was that, while adaptation is a future-oriented field, few studies considered the creation of new (constructed) ecological structures for EbA or used projections or scenarios of future demographic, social or climate conditions.

²⁴ Regarding *who*, 63% of the papers did not specify the adapting actor, 31% mentioned local government, 3% citizens, 2% businesses and 2% national governments. Regarding *how*, only 27% mentioned management strategies or practices.

²⁵ For instance, the city of Durban in South Africa, a pioneer in urban EbA, systematically acquires property adjacent to nature reserves (to maximise ecological integrity, enhance landscape connectivity and make management more effective) as well as isolated properties (to create an ecologically supportive matrix) (Roberts et al., 2012).

Table 2 Drivers and barriers for EbA

As described in the reviewed papers.

Aspect and examples	
Drivers	<p><i>Existing capacity</i>, such as the personnel or financial resources of the implementing organisation</p> <p><i>Supportive legal frameworks</i>, including strict environmental regulations or EU-level water directives</p> <p><i>Support from citizens</i> in the form of local participation in flood reduction, environmental grassroots movements and protests against environmental degradation</p> <p><i>Hazard events</i> that raised the profile of climate adaptation and mitigation</p>
Barriers	<p><i>Lack of space</i> in dense urban areas</p> <p><i>Ecological trade-offs</i>, such as conflicting interests with other ecosystem services (e.g. drinking water production)</p> <p><i>Lack of resources</i> in terms of funds, know-how and tools</p> <p><i>Unsupportive legal frameworks</i>, such as environmental and building permits, and lack of property rights</p> <p><i>Compartmentalisation and silo-type approaches</i>, for instance professionals with different educational background with different objectives and interests</p> <p><i>The science-policy gap</i>, including insufficient procedure to find and apply the results of scientific research</p> <p><i>Lack of local/public support</i> due to a failure to see climate change as an immediate risk; citizens' aversion to changes in the local environment (sometimes referred to as NIMBYism – from "Not In My Backyard"); lack of political support</p>

Analysis of Swedish municipalities

The Swedish cases partly confirmed, and to some extent expanded upon, the findings of the international review. None of the seven municipalities analysed in the context of the ECOSIMP research project (Paper 2) explicitly used the EbA concept (in Swedish, *ekosystembaserad klimatanpassning*). Instead, they tended to frame practices as related to *either* (i) biodiversity, ecosystem services, green structure planning or specific key ecosystems (e.g., wetlands in Helsingborg) *or* (ii) adaptation, risk management, coastal planning for a changed climate, or specific recurrent hazards (e.g., floods in Lomma). The first entry point proved more common, namely, that municipalities' engagement with the ecosystem services concept also increased their consideration of adaptation. Compared with adaptation, ecosystem services was found to be easier to link to existing work structures (e.g., for nature conservation), while adaptation was perceived either as a technical issue, or as being more of an overarching matter and less associated with a particular department. In addition, the ecosystem services approach was often endorsed from higher governance levels and/or through civil servants' interaction with the research community. Regardless of whether entry point (i) or (ii) was used, the explicit linking often resulted in synergies and/or created new opportunities. For instance, one ecologist explained about addressing a 'collapsed' landscape by combining ecosystem services and adaptation in a future-oriented way in the comprehensive plan:

When we started with the new comprehensive plan, we had a collapsed landscape. There was so much deficit on the ecosystem service ‘account’ that the landscape did not function anymore in terms of water retention, biodiversity, and so forth. [...] I made a map of the green structure I thought was missing, and connected it to the work on climate adaptation. I added the green structure as an adaptation action and in this way, I was able to get it into the comprehensive plan map, with additional green corridors, floodable surfaces... (ECOSIMP workshop in Båstad, 27-05-2015)

The results further showed that EbA is not carried out in a systematic way in the municipalities analysed, echoing their lack of explicit engagement with the EbA concept itself. In fact, despite the decision at the national level that ecosystem services should be considered in all political decisions (the ‘interim goal’, see Empirical Background), the linking of ecosystem services with climate adaptation at the municipal level often happens sporadically through the actions of dedicated civil servants and local politicians or through single projects. This means that EbA is neither implemented nor evaluated in a systematic way: it is not based on future climate projections and related assessments of (existing and future) risks and vulnerabilities in the municipalities. Against this background, the Swedish municipalities have struggled with the same lack of an evidence base for EbA as highlighted in the international review (Paper 1, see former section). As a result, the significance of ecosystem-based approaches was often downplayed, especially in the technical risk management sector. The dilemma between balancing the (insufficient) ‘hard science’ evidence base (systems knowledge) with different actors’ preferences (normative knowledge) in planning is illustrated by the following account from a municipal civil servant:

What worries me [...] is [...] the key assumption [...] that ecosystem-based adaptation is a good idea. Is ecosystem-based adaptation a *means* or an *end*? If it is a means, this suggests that alternative means are available, with which it is possible to reach the intended end. [...] If ecosystem-based adaptation is an end, well, for whom and why is that? Stressing specific approaches [...] might indeed lead to their implementation by popular demand, although not necessarily where they are most needed [...] that is, *where they can*] *minimize a specific risk by a meaningful amount*. These initiatives may instead end up being placed where they are *possible*, through significant compromising or similar. Hence the value or effectiveness or appropriateness of the measure is likely to be below its potential. (Email conversation, 11-01-2015, my emphasis)

A third finding was that while EbA seems to support – or even require – stakeholder engagement and collaboration, there were few examples of (systematic approaches to) related citizen engagement in the municipalities. On the one hand, the analysis showed that adopting an ecosystem-based approach to adaptation could lead to increased collaboration between sectors *within* municipalities (e.g., linking nature

conservation with technical risk management or stormwater management), as illustrated by the words of this civil servant:

[If] there is a problem in that particular area, how are we going to solve it, it's very costly. Do we need to put in larger pipes or switch to [different] pipes... let's try to find another solution. So... more recently you see ecosystem services or green areas being used in planning and it doesn't really have a law or basically a policy tied to it. So it's more of a... yeah, I don't know, collaborative effort. (Interview, 01-12-2015).

On the other hand, municipal civil servants working with adaptation increasingly recognised the need to engage with actors from outside their own organisation. Key concerns included accessing space for EbA (cf. the international review) and, to some extent, tapping into local knowledge and preferences to increase the effectiveness of interventions and improve public satisfaction. In particular, the high ratio of privately owned land in the Scania region makes it important to be able to influence the type of soil cover chosen by citizens and other private landowners to reduce flood risk (see Paper 2). However, national legislation to support such demands is largely lacking.

Furthermore, engagement with citizens in EbA, on the few occasions it occurred, was rarely deliberate or explicit (see also next section). An exception was Lomma municipality's Coastal Adaptation Programme (Swedish *Kustzonsprogram för Lomma*), which featured repeated consultation with coast users including the fishing community, wind surfers, kite surfers, boat owners, bird watchers and conservation groups in the area. The Programme establishes inclusive strategic adaptation planning for a coastal zone that may undergo large changes in the coming decades as a result of climate change, and identifies key threats (including coastal flooding and erosion) plus the values needing to be protected (including ecosystem services and technical/critical infrastructure) (see Paper 2).

How and why do citizens engage in adaptation?

This section answers the second research question by elucidating *how*, and *for what reasons*, Swedish citizens have engaged in adaptation. Based on my theoretical and empirical work in this thesis, I have extended the notion of citizen engagement in local adaptation from participating in adaptation activities organised by the municipality (e.g., panels, reference groups or citizen dialogues) to also denoting any episode in which citizens take individual or community action for adaptation, including interaction with the municipality (see the first subsection below). By analysing what people do at their own discretion and how this links in with municipal work, I redraw the 'map' of citizen engagement in adaptation – often

portrayed as collaborative, democratic and voluntary – to also encompass contestation, exclusion and responsabilisation (i.e., acting from increased necessity). In this context, I examine the values and motivations that underlie adaptation in different citizen groups (second subsection).

How: alone, together, and with the municipality

Household and community actions for adaptation

The results show that people's own adaptation measures are mainly short-term and reactive (i.e., taken in response to local hazard occurrence); nonetheless, they can entail considerable resource mobilisation at both the household and community level and are a critical component of local adaptation governance.

The quantitative survey of coastal residents in Lomma (Paper 4) showed that while the majority had engaged in 'everyday' actions, such as bringing in loose possessions before a storm (91% of respondents) and preparing for power cuts (61%), few had taken more anticipatory or far-reaching measures. About half of the 217 respondents had previously experienced personal damage or injury from local storms and flooding, something that proved to be a key factor in the number of actions taken. Less common but still popular measures were flood-proof storage on shelves in basements (25%), adapting the property for strong winds/heavy rain (23%), using plants to create a pleasant summer climate (21%), acquiring pumps and sandbags (18%), removing trees that might fall on the house during storms (17%) and revising home insurance with regard to climate hazards (17%). Less than a fifth had engaged in social measures such as warning neighbours before a storm (17%) or looking after elderly relatives/neighbours during a heatwave (12%). Finally, very few had taken more far-reaching measures such as building flood barriers (5%), applying for a building permit for adaptation (2%), or moving to a less risk-exposed area (2%) (see Table 3).

The interview study (Paper 3), focusing on hazard-affected citizens, gave a qualitative outlook on the kind of resource mobilisation that adaptation engagement entails at both the household and community level. Citizens' measures, while mainly ad hoc, covered the development, response and recovery phases of adaptation (see Table 3) and required considerable investments in the form of time, economic resources and skills (e.g., technical or administrative). This quote shows the far-reaching measures taken by one interviewee in peri-urban Malmö.

I have my own excavator, [so] it's quite practical. I have made a wall around the house. You can solve these water problems in two ways: keeping the water out, or through drainage. So what I've done is... I have also built drainage. Between 2004 and 2006 I did a comprehensive rebuilding of the house, I built a basement, [...] I built a whole new foundation while the house was still standing and installed

drainage. It was a very far-reaching intervention, [...] draining everything and connecting it to pumps from different pump groups. I have 5 pumps, 3 standing and 2 as a back-up. (Interview, 18-06-2015)ⁱ

The interviews revealed the importance of inter-household social networks and groupings like family, neighbourhood associations or other civil society organisations. These served to spread knowledge, mobilise in relation to other actors (e.g., municipalities or insurance companies), and compensate for the lack of resources or capacities that individual people had at their disposal for adaptation (see Paper 3). An example of where such mobilisation occurred was in housing cooperatives (Swedish, *bostadsrättförening*), which is a common form of housing in Sweden where members own the housing unit (typically an apartment building) and pool resources for maintenance and services.²⁶ This quote from a resident in Helsingborg illustrates how being unemployed or retired (categories which would sometimes be considered to increase vulnerability) in this case enabled people to contribute to the cooperative's response efforts:

We have 89 sandbags in the basement. It's not pretty, looks like we've bomb-proofed the property, but [when a storm is coming] we drag them up and place them around the façade, especially to cover the air vents. [...] I have been unemployed for some time so I have had the opportunity to help, so to speak. And then there are some retired residents here as well who take part, because since we are home anyway, we will help. (Interview, 24-06-2015)ⁱⁱ

Another case, of a flood-stricken housing cooperative in Söderkulla, Malmö, showed the large burden on citizens for recovery, including long-term evacuation, rebuilding, and related administration. One woman, who took on greater formal responsibilities as a member of the cooperative's board after the flood, spent all her free time over the course of a year on paperwork resulting from the flood (e.g., contacts with insurance and building companies). Many elderly residents did not have the energy or capacity to engage in the process on their own.

The cases analysed reveal citizen action to be a critical component in the development, response and recovery phases of risk reduction and adaptation. Critical, here, means that it was found (i) to support (e.g., take the pressure off) and, at times, compensate for a lack of institutional action (e.g., residents helping evacuate elderly neighbours), but also (ii) to hinder the efforts of other people or the municipality (e.g., paving over gardens and increasing runoff; curious 'storm tourists' hindering responses to flooding). In addition, there was often a high reliance on municipal support (and sometimes false expectations of what it could

²⁶ In 2014, 16% of Swedes lived in apartments run by housing cooperatives (Malmö: 31%, Helsingborg: 18% and Lomma: 15%); 50% lived in owner-occupied single-family homes (Malmö: 22%, Helsingborg: 37% and Lomma: 75%); and 25% in rented apartments (Malmö: 38%, Helsingborg: 34% Lomma: 3%) (SCB, 2015).

achieve), and on some occasions, citizens' adaptation actions were impeded by institutional frameworks and laws (see Paper 3). This shows the importance of analysing *interactions* between citizens and municipalities (see next section).

Table 3 Citizens' actions for adaptation

This table shows adaptation actions taken by citizens in Scania, Sweden, and indicates the level (household or inter-household/community) where I observed them. Notably, there were few examples of ecosystem-based action to reduce risk at the household/property level. Housing cooperatives were a typical arena for inter-household engagement.

Type of measure	Hazard reduction and avoidance	Vulnerability reduction	(Preparedness for) response	(Preparedness for) recovery
Physical/ Technical	Build flood barriers around the house (Household)	Adapt the property to better withstand heavy rain/ strong winds (Household, Inter-household)	Store sandbags and pumps (Household, Inter-household)	Use flood-proof materials in ground floor/ basement that are easy to clean/ dry (Household)
Ecosystem-based	Use plants or trees to create a more pleasant summer climate (Household)	–	–	–
Social/ Economic	Move to an area less affected by hazards (Household)	Store important papers on a high shelf (to avoid damage by flood water), or keep copies at another location (Household)	Preparation for power outages (candles, radio with battery) (Household) Warn neighbours before a storm (Inter-household) Help evacuate elderly neighbours during flood (Inter-household)	Revise one's home insurance; keep receipts of all possessions for insurance purposes (Household) Take time off work to contribute to recovery efforts in the housing cooperative (Inter-household)
Institutional (see also next section on citizen–municipality interaction)	Lobby against urban developments that will increase runoff onto one's property (Household, Inter-household)	Apply for a building permit to adapt the house (Household)	Seek guarantees that one's area will get special attention from rescue authorities in case of a new emergency (Inter-household)	Mobilisation in housing cooperative board for insurance claims (Inter-household)

Citizen–municipality 'adaptation interactions': collaboration, contestation and the space in between

The results showed that the diverse ways in which citizens engage in municipal adaptation (contributing to, and also challenging or hampering municipal efforts) are not easy to slot into existing concepts (e.g., collaboration or participation). Through repeated iteration between theory and practice, I coined the neutral term 'adaptation interaction' and identified 17 such citizen–municipality interactions across the three municipalities of Malmö, Helsingborg and Lomma (see Paper 3). Notably, in these interactions, the term climate adaptation (Swedish, *klimatanpassning*) was rarely used and citizens were rarely engaged in a planned, deliberate way. Rather, these interactions arose from other local processes, like stormwater management, property management, coastal planning, and the aftermath of actual flood and storm events – showing some of the more subtle ways that

adaptation issues and related citizen engagement can be integrated into local governance.

On this basis, I identified four main ways in which citizens are engaged in adaptation together with municipalities. These were: collaboration, contestation, compliance and choice (Paper 3). Collaborative interactions are characterised by ‘co-labouring’ and two-way dialogue. They can be initiated either by citizens or by the municipality, but resources (e.g., time, staff, flexible legal frameworks) at the municipal level are key if an interaction is to turn into a collaboration (see the coming section on Implications at the municipal level). Contestation, on the other hand, implies challenge or confrontation; it is typically a reaction either to the occurrence of a hazard or to municipal adaptation action that creates physical changes in people’s surroundings. Contestation is often a last resort for citizens who have tried to have their voices heard or their adaptation needs met in other ways and have failed. Compliance and choice represent less intense interactions, where citizens are obliged (e.g., by laws or sanctions) and freely choose (e.g., based on financial incentives or campaigns) to follow the municipality’s instructions.

Of the 17 interactions, four were classified as collaboration. They included the construction of an open stormwater drain solution in dialogue with residents in Malmö; consultation with coastal user groups in Lomma on the new Coastal Adaptation Programme; and a storm-hit housing cooperative in Helsingborg whose demand for clarification of adaptation responsibilities eventually led to dialogue and responsibility-sharing. Another four interactions were classified as contestation. One involved 500 residents of peri-urban Malmö, who appealed against a densification that would increase their flood risk (and won); and another involved residents in Lomma who opposed plans for a protective seawall next to their properties. Contesting citizens seemed to have more influence if their claims were linked to a new plan or decision, as seen for a repeatedly flooded housing cooperative in Söderkulla, Malmö, whose demands for municipal action and guidance could not be met. Compliance (3 interactions) related to regulations for stormwater management or ecological compensation on one’s own land. Interactions with respect to choice (5 interactions) included checklists for heatwaves in Malmö and a campaign for climate-friendly stormwater management in Lomma.²⁷

Focusing in on Lomma municipality and the survey results (Paper 4), one in every four of the 217 households surveyed had interacted with the municipality on adaptation-related issues. Most had personal experience of hazards. The nature of the interactions emerged in free-text answers (given by 40 respondents). Nine

²⁷ About half of interactions involved citizens as individuals, and the other half as groups or through some system of representation (see Paper 3).

mentioned engagement that sought to influence general municipal action in favour of adaptation. Examples are: reporting maintenance issues in the stormwater system, lobbying for action against erosion, and influencing long-term urban planning. Thirteen respondents had contacted the municipality after flood impacts to their property. In addition, quite a large number of interactions (15) were related to the ongoing controversy about the municipality's construction of a protective sea-wall. In this context, four respondents were explicitly against it and reported negative effects on the location (*"They are building a wall, outside the plot towards the water, which doesn't need to be so high and we don't want it."* *"We have protested against the 'security barrier' along the beach – design, location, etc."* *"Destroyed living environment due to climate [adaptation] action (floodwall)."* *"Elevation of the ground outside our house."*) (see Paper 4).

All in all, the analysis of adaptation interactions, and especially the more intensive ones, showed how citizens dealt with climate risk and non-responsive authorities by (i) increasing networking and mutual collaboration, and (ii) formally contesting municipal actions that they deemed detrimental to adaptation (and nature protection). In response, municipal officials, often constrained by legal and sectoral differences, tried to (i) tap into citizens' engagement through dialogue and minor concessions; and (ii) include adaptation elements in existing collaborations with citizens (see Paper 3).

Why: drivers, motivation and values

Values, worldviews and gender as factors to adaptation engagement

While personal experience of hazards stood out as a strong driver of citizen engagement in both the qualitative interactions study (Paper 3) and the quantitative survey study (Paper 4), the latter revealed a more nuanced image of people's motivation.

First, the survey study showed that people's beliefs and feelings about climate change play a role in their self-rated motivation to act on local hazards. Respondents who believed that the climate change issue was *exaggerated* or *only relevant to other continents/generations* reported lower motivation to engage in local adaptation (such views were more common among elderly respondents). In contrast, feeling 'climate angst' (Swedish, *klimatångest*) was correlated to higher motivation (but, interestingly, to lower self-rated adaptive capacity).

Second, and related to this, the survey showed that people's motivation to adapt goes beyond rational self-interest. When compared to economic incentives (low cost and receipt of financial compensation), the potential of an adaptation action to contribute to green, thriving surroundings and mitigate global climate change was

found nearly as (and among female respondents, more) motivational. Social motivation, such as being encouraged to adapt by family and friends, or reducing others' risk, was on average not far behind.

Third, the survey results showed adaptation engagement to be a gendered process. Male respondents were generally more motivated by economic incentives, and saw technical know-how as important for the capacity to adapt. Meanwhile, women regarded their social network as a more important resource and felt more motivation for adaptation actions that could improve ecological values at both local and global level or support other community members at risk. This shows that adaptation is embedded in culture, and that even in a gender-progressive country like Sweden, gender-based expectations of interests and responsibilities show up clearly in adaptation and risk reduction.

Meanwhile, and importantly, people's reported motivation did not correlate with their reported level of adaptation *activity*. In fact, the latter was found to be *negatively* correlated with communitarian and ecological values or motivations; in other words, respondents who expressed motivation for adaptation measures that could enhance local ecology, and who supported stricter environmental legislation, reported less adaptation action. On the one hand, this confirms that motivation does not automatically translate into action. On the other, it may be a sign of what I call a 'mitigation–adaptation gap' in people's climate awareness, whereby citizens adopt *either* mitigation (environmental) *or* adaptation (risk reduction) thinking and values.

Unplanned responsabilisation as a driver of citizen engagement

An important finding in the study of adaptation interactions (Paper 3) was how increasing climate extremes lead to an unplanned shift in responsibility from governments to citizens in terms of both preventive action and response and recovery. The increasing frequency and intensity of extreme events in the case-study municipalities in recent years have forced emergency authorities to prioritise critical societal infrastructure and life-threatening situations, and in this scenario, a single-family house has very low priority. City officials who, in the past, may have tried to help affected citizens in a less official way described being increasingly forced by the magnitude of damage to apply existing laws more strictly. This was seen in the case of post-disaster compensation, where citizens in previous small flooding events had been given the benefit of the doubt if the investigation of liability would be as costly as the compensation itself. With extreme events becoming the 'new normal', governments' limited capacity means that responsibility for managing such events is shifting to citizens, *even though there has been no change in any law or policy*.

Implications of, and synergies between, ecosystem-based approaches and citizen engagement in local adaptation governance

This section answers the third research question by outlining the *implications* of, and *synergies* between, EbA and citizen engagement in municipal adaptation governance. The implications relate to observed outcomes and gaps at two levels: the community level, which includes adaptation ‘on the ground’ and related drivers of local risk and vulnerability (first subsection), and the municipal level, which includes associated changes in the municipal organisation (second subsection). Finally, I identify synergies between EbA and citizen engagement in the cases studied (third subsection).

Implications at the community level: addressing the drivers of risk and vulnerability

At the community level, EbA and citizen engagement have both been observed to reduce the risk from adverse climate events, and in some cases, to contribute to addressing the underlying drivers of risk and vulnerability. However, there are also some gaps and concerns, especially concerning scalar interactions and vulnerable groups.

EbA

The results emphasise that EbA has had important outcomes for on-the-ground adaptation. In the municipalities analysed, the ongoing loss of ecosystem services, due to natural areas being claimed for housing and infrastructure, translates into a loss of nature’s own capacity to buffer against climate-related risk (see Paper 2). The results show how civil servants have been able to address the loss of such natural functions, e.g., through informal regulations and balancing tools that prescribe ecological compensation for land-use change, and by using the ecosystem services concept as a pedagogical tool to reason with landowners. This is supported by the considerable natural-science base for urban EbA (e.g., in relation to heat, water retention) identified in Paper 1.

Bearing these general successes in mind, the analysis of how EbA initiatives have played out at the community level also indicated potential gaps. First, the results highlight that (social) vulnerability may be neglected or downplayed when adaptation is approached from an ecological perspective. As showed in Paper 1, natural science knowledge is essential to inform planning, but the domination of natural-science and bio-physical criteria (e.g., temperature, intercepted rainfall and evapotranspiration) in assessing the success of EbA approaches are problematic,

given that vulnerability to climate-related events is socially produced. As an example, recording (mean) temperatures does not reflect people's differential vulnerability to heat (e.g., depending on age, profession or health status) or their access to a cool park (e.g., conditioned by physical mobility, transportation or personal security).

There were few examples of EbA being deployed as a protective measure at the property level. This may be because the material analysed mainly concerned pluvial flooding, for which citizen engagement in EbA related *either* to private measures to support larger-scale adaptation, *or* to lobbying against large-scale densifications that would affect natural areas and increase flood risk on their property (Paper 3). The complex scalar interactions inherent in flooding may thus produce a sort of 'commons' problem, where the efficiency of taking EbA measures to reduce risk at the property level depends on others' risk reduction efforts (or lack thereof). A case in point concerned the residents of Söderkulla, who ended up with stormwater from half of Malmö on their property during the flood in 2014:

We don't have influence over this. I mean, we have our little row of townhouses... Normally, property owners are obliged to handle stormwater on their property, but these huge amounts of water [laughter] we can't begin to solve, it comes from the outside. (Interview, 19-09-2015)ⁱⁱⁱ

This shows the need for a diverse and holistic framework to guide adaptation across scales and sectors (see e.g., Table 3), with important household-level adaptation measures also including mechanisms for early warning, evacuation, etc. which can be deployed when physical (and ecological) protection fails.

Citizen engagement

When it comes to citizens' own adaptation action, the results show that whether increased citizen engagement addresses drivers of risk and vulnerability is a question of scale. Using a risk lens on adaptation, my research has illustrated how the general responsabilisation of citizens has the danger that population groups who are already most exposed and vulnerable will be the hardest hit. On the one hand, *hazard exposure* is not evenly distributed geographically; in particular, my research emphasised how some areas, such as low-lying areas within a city that receive stormwater from other neighbourhoods, have been repeatedly flooded in recent years. On the other hand, *vulnerability* is also not equally distributed, which means that responsabilisation may disproportionately affect those who already have fewer means of protecting themselves.

On this basis, the results suggest that a better-prepared and more active general public could free up institutional capacity to assist those most at risk. For instance, on 31 August 2014, after 100 ml of rain fell within a few hours, the city of Malmö

experienced widespread flooding that cost the city 100 million SEK (€10 million) and resulted in more than 4,400 individual damage claims from citizens. The low-lying area of Söderkulla was among the worst affected. Because the emergency phone lines were blocked by people calling from across Malmö to report flooded cellars, the emergency services were unable to rescue or properly assist the residents of Söderkulla who were told to call the stormwater management agency for help (see Paper 3). If the general public were better prepared to handle non-life-threatening situations (such as cellar floods), this could free up the capacity on the side of the emergency services to assist those most in need. In addition, during ‘normal’ times, property owners (public, commercial, or other citizens) in the neighbourhoods where stormwater originates need to take action to delay stormwater during downpours (e.g., through EbA measures).

Regarding citizen engagement at the municipal level, about half of the 17 adaptation interactions analysed resulted in on-the-ground measures to reduce the risk of adverse climate events, for instance, reduced pressure on underground stormwater systems (Paper 3). The civil servants interviewed further stated that interactions had increased citizens’ trust in authorities, their feeling of ownership of adaptation infrastructure, and the understanding that private land is part of a larger risk-reduction system.

However, the analysis suggests that such interactions have been less successful in meeting household-level adaptation needs. To date, municipalities’ deliberate engagement with citizens has been more focused on making them comply with larger-scale adaptation than helping them anticipate and/or solve problems experienced at the household or community level (where increased action was more the result of hazard impacts) (see Paper 3). In addition, the analysis of adaptation interactions indicates a mismatch regarding the institutional support offered: the municipal actors involved were mostly environmental or technical departments, while the citizens interviewed strongly emphasised the social and psychological impacts of hazard events. Examples include people’s distress about losing their homes, and the functioning of social safety nets during an emergency, as the following quote from an affected resident illustrates:

There was an elderly woman... I had to make sure she got a legal guardian who represented her because there was no such action from the municipality [even though] she relied on home care. She had to be carried out of her house during the flood [...]. She ended up in an emergency residency somewhere, and during this time... they let her meet with her insurance company, even though she was a bit ‘dodderly’, [I don’t agree with] how this was handled [...]. No one came to make sure her home and her things were saved, it was all ruined by mould... After a while the Social Services realised she needed a legal guardian, but there is a whole process around this, and [...] once we got it resolved, it was too late regarding her home. Home care or Social

Services did not help her, maybe this is not part of their responsibility, but no one else's either, it seems. (Interview, 19-09-2015)^{iv}

In fact, in a rainier climate, the indirect flood impacts might produce serious public health problems, for example, stress and mould. My findings indicate that if floods are to be expected at even shorter intervals, people living in flood-prone areas will be faced with mounting stress related to e.g., tedious liability processes and trauma from past events, insecurity about the future, increasingly costly (or unavailable) insurance and plummeting property values. This points to the fact that meaningful citizen engagement in adaptation will require stronger involvement of, and coordination with, the social and health sectors of municipalities.

My research further identified a lack of systematic analysis of household and community-level risk, including vulnerability and capacity. For instance, mandatory municipal Risk and Vulnerability Assessments tend to focus on technical and organisational aspects of risk management. The results (e.g., of Paper 3) showed that the risks and engagement opportunities for different citizen groups is highly dependent on the type of housing they live in. For example, in the flood-stricken housing cooperative in Söderkulla, the single-floor housing (i.e., no second floor to evacuate to) was a key vulnerability factor. However, the democratic organisation of this housing type proved to be a strength. As illustrated by the following quote, residents were able to elect a new management that gave more priority to the flood issue:

(Researcher: How have you organized yourselves in the housing cooperative?)

It took 1.5 months. We had a previous chairman who, 'diplomatically expressed', did not do much. [...] We tried in vain to make her understand that we need help in this, we need to have consultants representing the cooperative... And during these 1.5 month, she kept saying that '[... the cooperative board] will not engage in this', so that if lawyers and consultants were to be involved, the 'wet', that is the affected side, would have to handle it on their own.

(Researcher: So she was not personally affected then?)

No, she lived on the 'dry' side [...] So a new board was [elected] at the meeting in mid-October. (Interview, 19-09-2015)^v

In contrast, tenants in apartment blocks (who often go unmentioned in the adaptation debate in Sweden) may be less exposed to flooding and do not have an important part of their savings (and hence the ability to move from a risk-prone area) bound up in their homes. To their disadvantage, they often have little influence over (the management and adaptation of) the building they live in, as seen in the case of the socially vulnerable and flood-prone area of Seved, Malmö (Paper 3).

Implications at the municipal level: adapting organisational structures

At the municipal level, the cases of EbA and citizen engagement analysed were seen to sometimes challenge existing organisational structures and routines and help change them in favour of adaptation. However, it did become clear that neither EbA nor (especially) citizen engagement were well supported at the municipal level, making it more difficult to capitalise on their benefits for adaptation. Moreover, national-level legislation was also found not to be conducive to adaptation.

EbA

The results indicate that an ecosystem-based perspective on adaptation can challenge existing organisational structures and routines with regard to (i) sectoral, (ii) spatial and (iii) temporal dimensions. One example was the way in which EbA projects questioned the routine separation within municipal organisations of responsibilities for nature conservation, planning and stormwater management. An ecosystem-based perspective was also used to establish inter-municipal coordination of adaptation efforts, for instance, between neighbouring municipalities with shared water catchment areas. However, according to planners, the largest benefit of EbA was perhaps that it helped challenge short-sighted housing development and densification and put such development into a longer-term perspective. In this context, EbA means having a ‘four-dimensional’ perspective on the land in question, where time is the fourth dimension: for instance, questioning development that cuts through retreat areas and ecological corridors – or areas that *could* have become areas for retreat, which are lost as resources (cf. Lomma kommun, 2015). EbA was considered to allow flexibility in adaptation governance, as most measures are not final or irreversible – instead, the land is retained for several alternative applications that can be adapted to how the climate, and society, develops in the future.

Citizen engagement

The results showed that although municipalities seldom plan for citizen engagement in adaptation in a strategic and deliberate way, existing citizen–municipality interactions in related local processes have had concrete effects on adaptation governance. In fact, of the 17 interactions identified across Malmö, Helsingborg and Lomma (Paper 3), 11 showed institutional learning, including being upscaled to other geographical areas and higher administrative levels. In addition, civil servants from all three municipalities described how learning from specific interactions had fed into strategic adaptation plans. For instance, after managing to turn initial complaints from residents of a storm-stricken housing cooperative into dialogue and responsibility-sharing, this planner in Helsingborg will expand the working method to other areas:

I'd say that this was our first case, like a pilot project. Now I feel we can draw lessons from that information meeting and how the dialogue happened, to see how we can work together with other areas as well. (Interview, 7-9-2015)^{vi}

However, several civil servants also noted that the equality principle (Swedish, *likabehandlingsprincipen*), which states that municipal action should be guided by the public interest and not offer unequal benefits (regulated in the Local Government Act 1991: 900 2:1–2), could impede the municipality's engagement with particular vulnerable or risk-exposed groups, even if related learning could benefit the public by feeding into adaptation plans.

While some interactions resulted in increased mutual responsibility taking, it was clear that collaboration with citizens on adaptation is generally not a priority or that it does not fit the organisational structure of municipalities. In the positive cases, relatively small concessions from the municipality (e.g., agreeing to provide sand for sandbags in the example from Helsingborg) seemed key for turning the interaction into a collaboration. Conversely, in Söderkulla, Malmö, after the 2014 floods, the housing cooperative affected tried to collaborate with the municipality by providing local knowledge (e.g., about flood levels) and hiring a private stormwater consultant. No collaborative solutions or lasting dialogue emerged because the municipality prioritised long-term, city-wide measures and did not want to give people a 'false sense of security' by implementing local token measures. This shows that even municipalities with many successful participatory environmental projects do not have the organisational structure to handle citizen input or dialogue when it is most needed. Evidence from Lomma and Malmö further suggests that there may be legal implications for municipalities that directly counsel citizens on adaptation (see Paper 3).

Another gap identified was the institutional mechanisms for inclusion and exclusion (or engagement of the 'usual suspects') in adaptation interactions. As many occurred spontaneously or involved citizens in their role as property owners, adaptation interactions in the study areas have mostly not targeted vulnerable groups. On the contrary, they were more likely to involve people with a relatively high level of education, Swedish language skills, and administrative and legal knowledge. An exception was an initiative for inclusive and responsible property management in Seved, Malmö, that added adaptation to its agenda in an ad hoc manner after the flood in 2014. The municipal programme addressed the problem of 'slum landlords' who collect rent but neglect housing maintenance in a socially vulnerable area where many tenants (with low education/knowledge of Swedish and on informal rental contracts) were afraid to protest or did not know their rights. This illustrates how engaging and supporting citizens in adaptation requires more systematic consideration of diverse housing types and associated vulnerabilities (physical and non-physical).

Taken together, the results indicate that meaningful citizen engagement in adaptation is often constrained due to laws or structures at higher governance levels. Citizen–municipality interactions thereby turn into struggles or conflict because municipalities do not want (or cannot handle) citizens’ adaptation-related input.

Synergies between ecosystem-based adaptation and citizen engagement

The results indicate that there may be untapped synergies between EbA and citizen engagement. In fact, through studying them separately, it seems that EbA may provide a better platform or ‘entry point’ for citizen engagement in adaptation than technical measures. This was mainly due to five properties of EbA, which I elaborate on below: (i) allowing coproduction of adaptation instead of transfer of risk, (ii) being less dependent on socioeconomic status, (iii) aesthetics and other ecosystem services increasing public support, (iv) tapping into people’s attachment to place, and (v) linking adaptation and mitigation (see Figure 5).

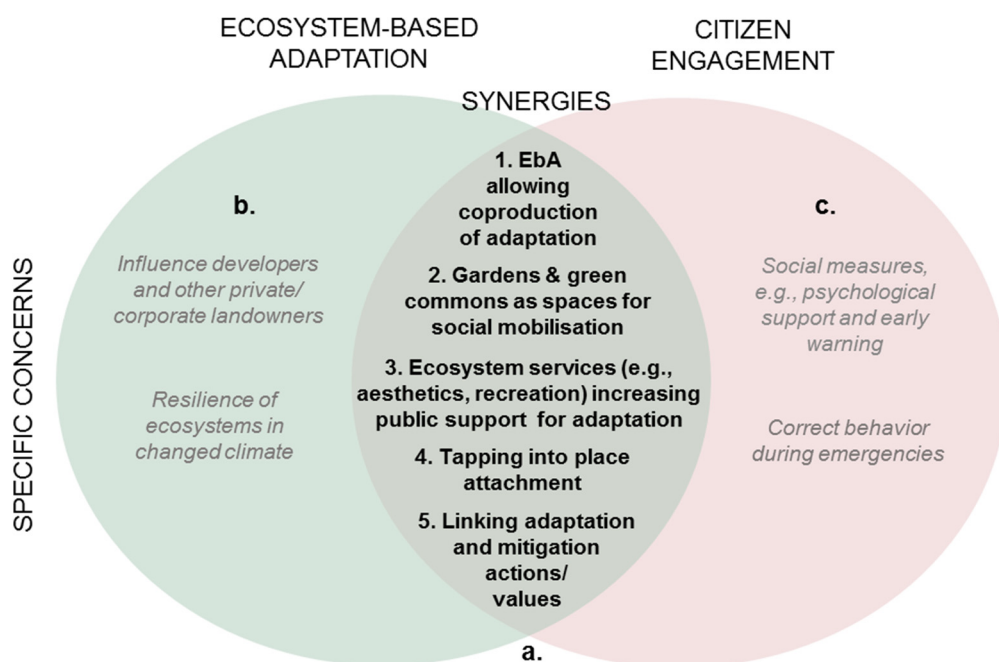


Figure 5 Synergies between EbA and citizen engagement

The figure shows synergies identified between EbA and citizen engagement through this research (part a). However, there are also important concerns that are specific to one or the other, illustrated by the examples in parts b and c.

First, EbA seems to support coproduction of adaptation instead of transfer of risk. In the study of adaptation interactions (Paper 3), EbA was found to support

collaborative effects, such as citizens helping to reduce flood risk at the municipal level through handling stormwater in their gardens. Conversely, in the same study, contestation was often linked to technical or ‘hard’ adaptation structures that only served to transfer the risk elsewhere. One example was residents’ self-built erosion protection in Helsingborg. In the Söderkulla case, the large focus on technical measures to divert stormwater led the citizen–municipality dialogue to a deadlock, as more analyses were needed to ensure that they did not risk submerging neighbouring areas in the event of a new flood.

Second, citizen engagement in EbA seems to depend less on socioeconomic status, as citizens can contribute both individually (through private gardens) and collectively (though caring or mobilising for common green spaces). As technical adaptation often requires property ownership, capital or technical expertise, there is less scope for social interaction and mobilisation. At the municipal level, the high cost and inflexibility associated with technical adaptation may contribute to the unwillingness of municipalities to be influenced by citizens.

Third, ‘spillover’ ecosystem services like a beautiful view, recreation or social meeting space have the potential to make EbA interventions more publically acceptable. Aesthetics was found to be a key factor, which made residents in Lomma oppose the seawall that the municipality planned to build to protect their properties (and public infrastructure) from coastal flooding.

We have been affected by floods ourselves this time. Surely we want preventive action [...] but it's important to do it the right way. This straight [elevated] bike path that cuts through the lawn looks dreadful, it does not contribute anything to the environment. They could build something softer, something grassier... (SVT Nyheter, 2013)^{vii}

However, recreation was also important. During the conversations with the Citizen Coastal Council, several of the coast users were concerned with how physical adaptation measures along the coast might affect their activities, including the birdwatching association and the kite surfers.

Fourth, EbA may also motivate citizens by appealing to their connection to place. Interview and survey results suggest that place attachment is a factor in both motivating and hindering adaptation. In the interview study (Paper 3), historical ties to place and local ecology was a strongly contributing factor for the homeowner who led an appeal against a flood-inducing detail plan in Klagshamn, in peri-urban Malmö:

...so you are not allowed to enter [the beach dunes during nesting seasons]. And ... it's hard already today to keep people away from there. Because some people don't understand that there are ground-nesting birds, for example, and ... imagine if there were another 500 people living in the immediate area, who don't have the history of

living close to this area, don't have ... so to say ... historical ties with the area. We who have lived here for a very long time notice how people moving here ... well, you should not polarise into 'us' and 'them', but, they do not have the same understanding [of the environmental linkages].^{viii}

Similarly, in the Lomma survey (Paper 4), respondents expressed strong support for adaptation measures that would protect the beach and allow them to remain in their community, while they were opposed to physical adaptation measures that had a negative effect on place or, to some, even contributed to a “destroyed living environment”. They stated that their motivation to act increased if an adaptation action had positive effects on their property and surroundings during normal times. This quote from a stormwater manager in Malmö suggests it may also work the other way around, i.e., that being engaged can raise citizens' awareness and help them ‘attach’ to and accept adaptation solutions as part of their environment:

I think everything you do together has a better result. Like when we constructed the stormwater trench in Vintrie, which used to be this ugly engineered trench, three metres deep and hard edges, and children would fall into it and hurt themselves. [...] We discussed closing it, but then we ended up making it an open and green stormwater solution. In the beginning, the residents were concerned that their children would drown in it, but now they [use it for recreation] and everybody loves it... just because they were included in the process. (Interview, 16-6-2015)^{ix}

Finally, EbA has the potential to link adaptation to mitigation and general sustainability discourses, which is a more familiar topic to Swedish citizens and municipalities.

Discussion

In this section, I place my findings in the larger context of urban adaptation research, in particular the growing focus on ‘transformational’ or ‘transformative’ adaptation. Based on my results, I discuss the role of EbA and citizen engagement in transformational climate adaptation, including what the latter may imply in practice. Finally, I reflect on the limitations of my research approach.

Transformational adaptation: the role of ecosystem-based adaptation and citizen engagement

In this section, I use my empirical findings on EbA and citizen engagement as a starting point and lens to discuss transformational adaptation. The topic of transformation moved into mainstream adaptation discussions with the same report as disaster risk reduction did, the SREX (IPCC, 2012), where transformation was presented as one of six components of the solution space for adaptation (Feola, 2014; Few et al., 2017; Pelling et al., 2014; Revi et al., 2014).

While both EbA and citizen engagement feature in the transformation debate (see Introduction), there is little agreement or empirical evidence on what characterises transformational adaptation in practice, and how or under what conditions EbA and citizen engagement may contribute to bringing about such change. Some scholars (e.g., Few et al., 2017; O’Brien and Barnett, 2013) differentiate between ‘*transformational*’ adaptation, mainly referring to the transformation of *adaptation practice* (as a counterpart to incremental adaptation), and ‘*transformative*’ adaptation, which has the power to bring about wider societal change (sometimes referred to as ‘societal transformation’ or ‘sustainable transformation’, e.g., (Driessen et al., 2015; McCormick et al., 2013)). However, the distinction is not always clear-cut, especially with respect to initiatives that address deeply rooted socio-political conditions and inequalities that create risk (see e.g., Few et al., 2017). In reality, it may be more fruitful to see adaptation initiatives as existing on a spectrum from ‘transformational’ to ‘transformative’ (see Figure 6).

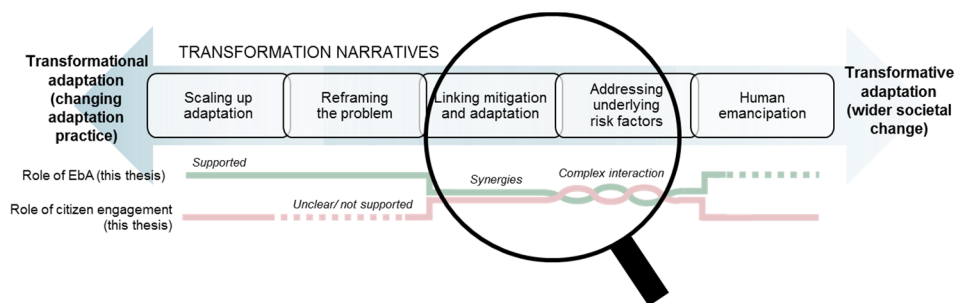


Figure 6 Role of EbA and citizen engagement in different transformation narratives

The figure shows transformation narratives identified in the adaptation literature on a spectrum from 'changing adaptation practice' to 'changing society'. The parallel/interlaced lines below illustrate the potential roles of EbA and citizen engagement in transformational/transformational adaptation, based on the results presented in this thesis. In light of the empirical cases, the two transformation narratives that appear most relevant are *linking mitigation and adaptation*, and *addressing underlying risk factors*.

My findings on EbA and citizen engagement seem to resonate with particular framings or narratives in the adaptation and transformation literature (e.g., Feola, 2014; Few et al., 2017; Kates et al., 2012; Pelling et al., 2014; Revi et al., 2014; Satterthwaite and Dodman, 2013; Tschakert et al., 2013), all which can be placed across this spectrum.

First, the analysis of Scanian municipalities shows some initial evidence (although mostly anecdotal) of how both EbA and citizen engagement have produced a broadening or scaling up of adaptation considerations to new geographical areas, sectors or administrative levels. Examples include how EbA projects can call into question organisational structures (cf. Wamsler et al., 2014) and inspire municipalities to use a landscape/catchment perspective on adaptation, thus promoting collaboration between neighbouring municipalities. Likewise, the analysis of adaptation interactions between citizens and municipalities showed how learning from interactions had fed into strategic adaptation plans and influenced higher-level decisions. The view of transformation as *scaling up adaptation* is also described by Kates et al. (2012), for instance, adaptation actions that occur at a larger scale or intensity, are new to a region or resource system, or transform places and shift locations (see also Feola, 2014).²⁸

Second, the results show how an ecosystem-based approach has been used by civil servants to *reframe* the focus of adaptation from merely protecting (new and existing) buildings from hazards, to recognising that new housing developments and urban densification also *drive* risk from climate-related hazards. This is especially

²⁸ This kind of technocratic upscaling, where one may also place the scholarship on socio-technical transition (Geels, 2010; Rotmans et al., 2001), is sometimes rather viewed as part of incremental adaptation (e.g., Pelling, 2010). However, it has been said to have 'transformative potential' or may contribute to transformation (Pelling 2014, IPCC 2014).

pertinent considering the heavy urbanisation in the region where many of the studied municipalities – despite projected increases in precipitation, sea levels and storm surges – invest in the heavy development of seafront areas. Growth and developer-oriented urban planning is a major driver of climate-related risk, due to the loss of ecosystem services, and is resistant to change (see also Hjerpe et al., 2014). In the literature on problem-driven sustainability research, critical perspectives have drawn attention to the way problems are defined (Jerneck and Olsson, 2011; Lang et al., 2012; Miller et al., 2013). Against this background, my findings would seem to resonate with the narrative of transformation as *reframing the problem* of adaptation. This can, for instance, be recognised in the IPCC’s distinction between incremental adaptation that serves to “maintain the essence and integrity” versus transformational adaptation that “change[s] fundamental attributes” of a system in response to climate effects (IPCC, 2014, p. 1758). Another example is reframing the ‘security paradigm’ in flood prevention (keeping floods out to any cost) to ‘living with floods’ or planned retreat (e.g., Newig et al., 2014).

Third, the results point to potential synergies between EbA and citizen engagement when it comes to linking efforts for adaptation and climate mitigation. In particular, Paper 3 suggests that initiatives to promote more proactive adaptation engagement can learn from related experiences in climate mitigation, which have been far more successful in raising awareness in the Swedish context, for instance, through connecting ‘why’ with ‘how’ messages, and using enabling and facilitating governance approaches that indirectly increase acceptance of less voluntary measures (cf. SEPA, 2004). In this context, contemporary mitigation research further emphasises the need to go beyond information campaigns and financial incentives that target individual citizens towards collective ways of mobilising citizens around common values, which in turn can trigger stronger environmental legislation (Hoff and Gausset, 2015). The survey analysis in Paper 4 indicated a ‘mitigation–adaptation gap’ in citizens’ climate awareness according to which general pro-environmental engagement (e.g., support for climate mitigation and local greening) coincided with having taken *fewer* adaptation actions (and vice versa). Against this background, local EbA emerges as a possible venue for engaging both groups and overcoming the gap. This resonates with the concept of transformation as the *linking of adaptation and mitigation* and general sustainable development, which is described as being the form of transformation with the most political potential (Pelling et al., 2014; see also McCormick et al., 2013). EbA is often cited as an example, through the capacity of ecosystems to act as carbon sinks.

Fourth, this thesis has shown how EbA and citizen engagement have the potential to address underlying risk factors, but there are caveats and complex interactions. EbA emphasises urbanisation and ecosystem service loss as a driver of risk but, as shown in this thesis, current implementation is often not based on comprehensive risk analysis. In addition, ecosystem-based approaches may downplay the social

production of climate vulnerability or even contribute to displacing vulnerable residents through ‘environmental gentrification’ (a concern raised in Paper 1). In contrast, citizen engagement can reduce the pressure on vulnerable or risk-exposed groups, and help make adaptation policy more relevant to them, but as this thesis shows, this does not happen automatically or with participation of any type or at any scale. In relation to this, and perhaps the most interesting transformation narrative for this thesis, many scholars see transformational adaptation as *addressing the underlying factors* of risk and vulnerability (Pelling et al., 2014; Satterthwaite and Dodman, 2013; Tschakert et al., 2013). Rooted in disaster literature, this framing of transformation acknowledges that the early work of the IPCC, with its focus on climate stimuli and technological solutions, diverted attention away from the socio-political processes that make people vulnerable in the first place (Bassett and Fogelman, 2013). Read this way, transformation extends adaptation concerns from “proximate causes of risk [...] to its structural or root causes” (Pelling et al., 2014, p. 2; see also Wisner et al., 2004 and Figure 2). It “calls for firm attention to the inequalities that undermine adaptive capacities” (Tschakert et al., 2013, p. 341) and results in adaptation policy that “really meets needs (including those of low-income groups)” (Satterthwaite and Dodman, 2013).

Lastly, I found little support in my empirical material for any ‘emancipatory’ effect of EbA or citizen engagement, such as related initiatives specifically benefiting or empowering vulnerable or disadvantaged groups, and helping them make their voices heard in larger-scale adaptation. In contrast, the analysis of ‘adaptation interactions’ (Paper 3) shows that if citizen engagement takes place haphazardly, the disadvantaged are often excluded. In addition, I found that the equality principle, which guides municipal planning, may even hinder municipalities from engaging with or providing adaptation benefits to particular (vulnerable or risk-exposed) groups. The most relevant initiative was perhaps Malmö municipality’s project in the socially vulnerable and flood-exposed Seved that used home visits and systematic inspection of housing conditions to inform people about their rights as tenants and put pressure on negligent private property managers. (However, in the scaling-up of this initiative into a neighbourhood association where flooding issues were addressed more explicitly – called “Property owners of Sofielund” – renters were not represented.) Paper 1 identified another example, albeit from South Africa, where sourcing trees for urban EbA produced livelihood opportunities in rural areas. While it is perhaps the form of transformation that is most difficult to recognise in practice, some scholars relate the term transformation to *emancipation* or *empowerment* (O’Brien, 2012; Pelling et al., 2014) (see also Feola, 2014; Few et al., 2017). I have placed this narrative to the far right on my transformation spectrum, which implies the use of adaptation as a vehicle to create wider societal change (see Figure 6). The idea of emancipatory participation is rooted in Neo-Marxism, which means that in its most radical sense, related transformation can be perceived as a

change in power structures in capitalist societies (Few et al., 2017; Renn and Schweizer, 2009). Emancipatory participation aims to ensure that the “powerless in society are heard and then empowered to represent their own interests and values” (Renn and Schweizer, 2009, p. 179). Also rooted in Paulo Freire’s work on critical consciousness (Freire, 1970), several authors emphasise that the adaptiveness of the powerless majority has generally served the interests of a powerful minority; this suggests that critical attention is required as to who decides on the scope of changes made in response to environmental change, and what the alternatives are (O’Brien, 2012; Pelling, 2010).

Limitations to this thesis

Here I discuss some limitations to this thesis, in relation to (i) the selection of Sweden for the empirical work, (ii) working with ‘forerunner’ municipalities, (iii) types of climate hazards studied, (iv) methodological limitations in terms of reaching vulnerable groups, and (v) the interdisciplinary approach taken.

The selection of Sweden has implications for my ability to generalise the results to other country contexts. Swedish society is characterised by high levels of concern for the environment, and a remarkably high degree of trust in institutions and other people (WVS, 2014) (including effective insurance and social security systems). Risk levels are comparably low, and past adverse climate events have in the main damaged property rather than people. This is likely to shape adaptation engagement by fostering public complacency and overconfidence in institutional help in extreme situations (e.g., O’Brien et al., 2006; Wolf, 2011), whereas in other cultures, citizens may be more suspicious towards authorities both in ‘normal’ times and during emergencies (see e.g., Enander, 2008). At the same time, there are striking similarities with adaptation research emerging from other Western and European countries, that share the broader governance context of privatisation, deregulation and an increasing call or need for local communities to be ‘resilient’, self-organising and directly provide a number of welfare services (e.g., Healey, 2015; Hegger et al., 2017; Keessen et al., 2013; Mees et al., 2016). I thus suggest that my findings have a bearing outside Sweden, but that further cross-country comparisons are warranted.

Moreover, the choice to work with adaptation ‘forerunners’ has implications for generalisation *within* Sweden. Malmö, Helsingborg and Lomma are renowned for their environmental work in general, and adaptation and ecosystem services efforts in particular (e.g., Thörn et al., 2017), with high incentives for adaptation in terms of past and expected future hazard exposure. This implies that the results of the study may not be directly generalisable to municipalities that are less advanced and aware. Nonetheless, the gaps and barriers found in ‘forerunner’ municipalities can

be expected to be present, or even more prevalent, elsewhere. Such ‘extreme’ or critical cases (Flyvbjerg, 2011; Onwuegbuzie and Collins, 2007) can provide important insights into mechanisms and concerns that will become more pervasive under a future climate situation with increased hazards and related adaptation actions (and reactions) by both citizens and authorities.

In this context, the methodology, which largely identified citizen engagement and governance interactions in relation to *existing* hazards, meant that most of the findings concerned flooding. This approach was necessary in order to examine how responsibilities played out in practice and to study people’s adaptation engagement as something other than an abstract construct. However, it also means that care should be taken with extrapolating the findings to other climate hazards (e.g. heat, landslides), which may have very different implications in terms of onset, type and severity of impact, regulations for accountability, and people’s associated risk perception (Enander, 2008; Jonsson and Lundgren, 2014; SOU, 2017).

Furthermore, I acknowledge that the lack of focus on vulnerable groups and social aspects in adaptation and EbA (see Papers 1 and 3) may also reflect researchers’ choices. In this context, one can argue that my research methods (survey, mapping ‘adaptation interactions’ through municipal contacts and newspaper archives) runs the same risk of overlooking marginalised groups as the municipal practice that I critique. Targeting social sectors of the municipality, and asking further questions about specific groups or conditions, would perhaps have uncovered additional municipal activity in this regard. However, my empirical findings are supported by a recent survey of 202 of Sweden’s 290 municipalities, which showed that adaptation has so far mainly targeted the spatial planning and technical sectors (Thörn et al., 2017).²⁹ To overcome such methodological challenges, more adaptation research, also in Europe, needs to be conducted from a transformative paradigm (Mertens, 2007), which uses marginalised or vulnerable groups as a *starting point*.

Finally, this thesis has attempted to cover much ground in terms of the themes addressed, and the methods and theories drawn from. Inherent in an interdisciplinary approach like this is the risk that one’s level of understanding stays at a broad and general level and that the kind of in-depth disciplinary knowledge traditionally pursued in doctorate work is not achieved. The approach taken in this thesis is certainly open to criticism from a number of disciplinary perspectives that concepts or frameworks are used only superficially or that important theoretical perspectives were neglected. This, however, is balanced by the strengths of an inter- and transdisciplinary approach, which entails accommodating a range of academic and

²⁹ While over 85% of the municipalities surveyed had integrated adaptation concerns in spatial planning, 70% in risk and vulnerability assessment and 44% in water management, less than 20% had adapted regular operational plans of municipal sector work (Thörn et al., 2017).

non-academic perspectives and constantly questioning one's own assumptions. I hope that any disciplinary *faux pas* can serve to inspire new research, in which adaptation processes and related citizen engagement are studied from a wider range of academic disciplines (cf. Thorén and Persson, 2013).

Conclusions

In this section, I outline key findings of this thesis and identify how they contribute to the existing knowledge on urban adaptation and governance. On this basis, I identify needs for further research, before presenting my final conclusion from this work.

Contribution

Key findings

The results show that although, in the main, EbA and citizen engagement have not occurred in explicit and deliberate ways, they can (be leveraged to) support municipal adaptation and address underlying risk drivers.

First, my research shows that there are growing experiences with urban EbA in both the global and Swedish contexts implemented under different terminology (e.g., ecosystem services, green infrastructure). However, these initiatives, which are largely driven by planners and ecologists rather than climate scientists or risk managers, often lack a strategic, long-term climate risk perspective, such as an assessment of current and projected risks and vulnerabilities. While participation and knowledge integration are emphasised in the original EbA literature (which has generally focused more on the rural and low-income country context, e.g., Mercer et al., 2012; Vignola et al., 2009), I found only limited examples of citizen engagement in the urban EbA cases studied. Initial attempts, such as municipalities' consultation with coastal users in coastal adaptation planning and campaigns for citizen action in private gardens, deserve further attention and evaluation against adaptation criteria.

Second, the research identifies how citizens' engagement in adaptation – alone, together, and in interaction with municipalities – has had significant outcomes for local adaptation, but their efforts are rarely supported at the municipal level. Personal experience of hazards is a strong driver for citizen action; however, factors such as ecological values and identification with place also played a role – sometimes in unexpected ways. For instance, citizens could engage *in opposition to*

municipal adaptation interventions if these had a negative impact on place, and active climate engagement seemed to relate *either* to mitigation *or* adaptation values and motivations (i.e., high engagement for one did not seem to increase the other). These challenges need further attention to support effective and coordinated climate responses. At the municipal level, the identified modes of citizen engagement were diverse, comprising collaboration (two-way dialogue), contestation (challenge and confrontation), compliance (enforcing mandatory citizen action) and choice (stimulating voluntary citizen action) – all of which were found to shape local adaptation. Few examples, however, concerned engagement with vulnerable groups.

Third, the research highlighted positive outcomes, gaps and synergies based on how the identified cases of EbA and citizen engagement played out in local adaptation governance. The results indicate that EbA, which has received little attention in Swedish adaptation policy to date (cf. Andersson et al., 2015; SCCV, 2007), is an important complement to existing, technically focused measures to address drivers of urban risk. Strategic use of EbA was found to support intra- and inter-municipal coordination of adaptation efforts and to put a longer-term perspective on short-sighted housing development and densification (cf. Hjerpe et al., 2014). However, such effects are unlikely to result from approaches that focus on single ecological measures or structures.

I also reveal how responsibility for adaptation is shifting to citizens without any change in laws or policy being instituted, which means that the burden of adaptation (including financial costs, stress and insecurity about the future) will increase disproportionately for the people most-at-risk. To prevent the detrimental impacts of such unplanned ‘responsibilisation’, adaptation policy that aims to promote citizen engagement must encourage increased activity by the general (non-affected) public while providing support and guidance to risk-exposed and vulnerable groups.

Finally, I identify synergies between EbA and citizen engagement. The analysis implied that cases of collaboration and synergetic effects (such as greening of private gardens that reduced pressure on the municipal stormwater system) were more often linked to EbA approaches, while contestation or transferred risk (such as private erosion protection increasing erosion elsewhere) were often linked to technical measures. While further follow-up research is needed to corroborate this, my findings indicate that EbA may provide a better platform or ‘entry point’ for citizen engagement than technical measures, especially when it comes to engaging people who are not (or do not perceive) themselves to be at risk. Meanwhile, the limits of EbA for households’ reduction of their own risk (due to the location, scale or timing that those measures require) shows the need for a diverse and holistic

framework to guide adaptation across scales and sectors (cf. Wamsler and Brink, 2014b, 2014c).

Responding to current debates

First and foremost, my thesis responds to the climate adaptation literature by contributing new theoretical and empirical insights on EbA and citizen engagement.

The thesis has made a contribution to the field of urban EbA by synthesising existing literature and identifying research gaps, including aspects of equity and participation. An assumption underlying the wider urban EbA literature reviewed is that if only we could produce more *systems knowledge* about socio-ecological linkages, this would lead to the right decisions being made, without considering the normative frameworks that underlie planning (e.g., urban densification as a model for ‘sustainable’ planning). On the contrary, my empirical research has illustrated how EbA is implemented against a background of *struggles* in the municipalities between different planning paradigms, civil servants from different disciplinary backgrounds, and the competing interests of different stakeholders and laws. Expansion of the scholarly debate on urban EbA is thus needed, linking research on isolated interventions, measures or ‘best practices’ (such as green walls, bioswales, etc.) with investigations into the more strategic areas of adaptation planning (see also Meerow and Mitchell, 2017; Newsham et al., 2018; Wamsler and Pauleit, 2016).

In this thesis, I have also widened the notion of citizen engagement in adaptation to include both struggles and citizens’ own measures. In fact, perhaps owing to the initial framing of adaptation in terms of impact rather than risk (Bassett and Fogelman, 2013), the dynamics between collaboration and contestation in adaptation have not been well theorised in the mainstream adaptation literature. This is, for instance, evident in this dichotomous quote from the IPCC chapter on urban areas (Revi et al., 2014, p. 580), which seems to imply that in well-governed cities, adaptation will be conflict-free:

In well-governed cities, community groups and local governments are mutually supportive, providing information, capacity and resources in maintaining local environmental health and public safety, which in turn can support adaptation. Where local government has not yet formulated an adaptation strategy, community groups can raise political visibility for climate risks and provide front-line coping.

My research complements the existing literature which uses a participation, collaboration and co-management lens on adaptation and risk governance; in other words often (i) focusing on the government perspective and situations in which governments reach out to the public (e.g., Few et al., 2007; Renn and Schweizer,

2009); (ii) conceiving one side of the participation ‘ladder’ as normatively better (either high participation or high self-organisation) (e.g., Few et al., 2007; Plummer, 2013); (iii) focusing on collaboration and ignoring scholarship on struggle and social mobilisation (e.g., Bodin, 2017); or (iv) rarely focusing on urban residents (but rather on e.g., activists or the fishing community in a socio-ecological system) (e.g., Plummer and Armitage, 2007). In this context, the thesis responds to recent calls for analysis of the ‘friction’ between emerging actors in urban climate governance, including how climate governance is being accomplished and contested (Driessen et al., 2015; van der Heijden et al., 2018). In particular, my concept and framework of ‘adaptation interactions’ responds to collaborative, or perhaps even better, to interactive governance (Ansell and Gash, 2008; Bodin, 2017; Kooiman and Bavinck, 2013). Adaptation interactions between municipalities and citizens can be seen as governance episodes (Healey, 2006b) with concrete adaptation outcomes; however, they also include less intense forms of interaction, such as campaigns and incentives. My work thereby adds to a small but growing literature focusing on the citizen–municipality interface for adaptation, using concepts such as coproduction of adaptation (Mees et al., 2017, 2016) and public/private responsibilities (Mees et al., 2014a, 2012).

As the research area of citizen engagement in adaptation is still being consolidated, the idea of EbA as an arena for such engagement (as opposed to e.g., technical measures) is, to my knowledge, quite new. However, it finds ample support in the literature on urban green infrastructure and ecological citizenship (Buijs et al., 2016; Krasny et al., 2014); moreover, the recent application of related methodologies (i.e., sociocultural ecosystem services valuation) to adaptation shows that people tend to prefer diverse, familiar and visually attractive adaptation measures (Derkzen et al., 2017).

This thesis also responds to calls for social science research on transformation in the face of climate change, including how participation and distributive effects are (or should be) addressed in both current and transformative agendas and what changes in governance modes are essential for transformative processes (Driessen et al., 2015). In this context, I discuss the potential role of EbA and citizen engagement in contributing to transformational adaptation through scaling up and reframing the problem of adaptation, linking adaptation and mitigation, addressing underlying risk drivers, and empowering vulnerable or disadvantaged groups to represent their interests in adaptation. The findings represent a ‘mixed bag’ – some emergence of, or potential for, transformation (especially in relation to underlying risk drivers and linking adaptation and mitigation); however, most changes are at best incremental, as the fundamental entry point to adaptation is based on existing societal structures, values and beliefs (cf. O’Brien and Selboe, 2015). In fact, my study demonstrates that the shortcomings identified in the 2011 systematic review of adaptation in the Global North (Ford et al., 2011), i.e., mostly short-term risk reduction and focus on

impacts rather than strategic planning, and little focus on vulnerable groups, still exist in Sweden in 2018 (see also Boyd et al., 2015).

In this context, the thesis makes a contribution to the topic of climate vulnerability in the Global North. Concurrent with the broader literature of hazards research (e.g., Adger, 1996; Cutter et al., 2003; Pelling, 2003), my research illustrated how different factors (e.g., dependence on home care, informal rental contracts, single-story housing) translated into increased vulnerability to climate impacts. With the exception of elderly people in heatwaves (e.g., Jonsson and Lundgren, 2014; Wolf et al., 2010), vulnerable groups have generally not been given enough attention in Swedish and European adaptation research and practice. With my 'risk' perspective on adaptation, I emphasise that vulnerability to climate-related hazards is highly contextual (O'Brien et al., 2007; Wisner et al., 2004). For instance, while it is important to consider the various ways in which being less privileged in society shapes climate vulnerability, one should not equate one with the other, and vulnerability may also differ considerably depending on the type of hazard. Against this background, rather than merely labelling certain groups as vulnerable, there is a need to analyse past hazard events with regard to how different factors and circumstances have translated into unsafe conditions, and subsequently, link them to future climate and social scenarios. In this context, further conceptual linking between the risk and adaptation fields is key (IPCC, 2012; Mercer, 2010). There is much to learn from related approaches in disaster risk reduction and in the Global South; in particular, my findings indicate that an increased focus on (existing) housing in adaptation (cf. Sjöstedt et al., 2016), including systematic analysis based on different housing types and climate hazards, could support the assessment of European citizens' capacities and constraints.

Finally, while not addressed in detail in the kappa, this thesis contributes to the literature on transdisciplinarity. Municipality–university interaction can be an instrument for planning, implementing, and evaluating EbA and citizen engagement in local adaptation, but there are a number of related challenges (Wamsler, 2017; Wiek et al., 2012). Emerging collaboration initiatives would benefit from the use of evidence-based methodologies for transdisciplinarity (cf. Lang et al., 2012). In this context, the paper on transdisciplinary processes (Paper 2) deserves special notice; it formulates seven additional evaluative/guiding questions, which can help inspire reflexivity and avoid foreseeable pitfalls in municipality–university collaborations. While I have chosen not to engage in depth with the concept of 'adaptive capacity' (IPCC, 2014; Smit and Wandel, 2006), this thesis thus highlights the kinds of methodological, facilitating and process-oriented capacities that are needed in municipalities and the research community alike to advance the process of adaptation.

Frameworks

The research has resulted in the development and testing of two theoretical frameworks. First, an ‘EbA cascade’ was created in Paper 1 (see Figure 7) by applying the ecosystem service cascade model (Haines-Young and Potschin, 2010) and a sustainability science lens (e.g., Abson et al., 2014; Jahn et al., 2012; ProClim, 1997) to EbA. In particular, the framework highlights the different kinds of knowledge (systems, normative and transformative) needed to support sustainable EbA throughout the cycle of planning, production, consumption and evaluation of adaptation benefits. The framework was applied to assess the wider ecosystem services and green infrastructure literature from a hazards and adaptation perspective (through their intersection in EbA).

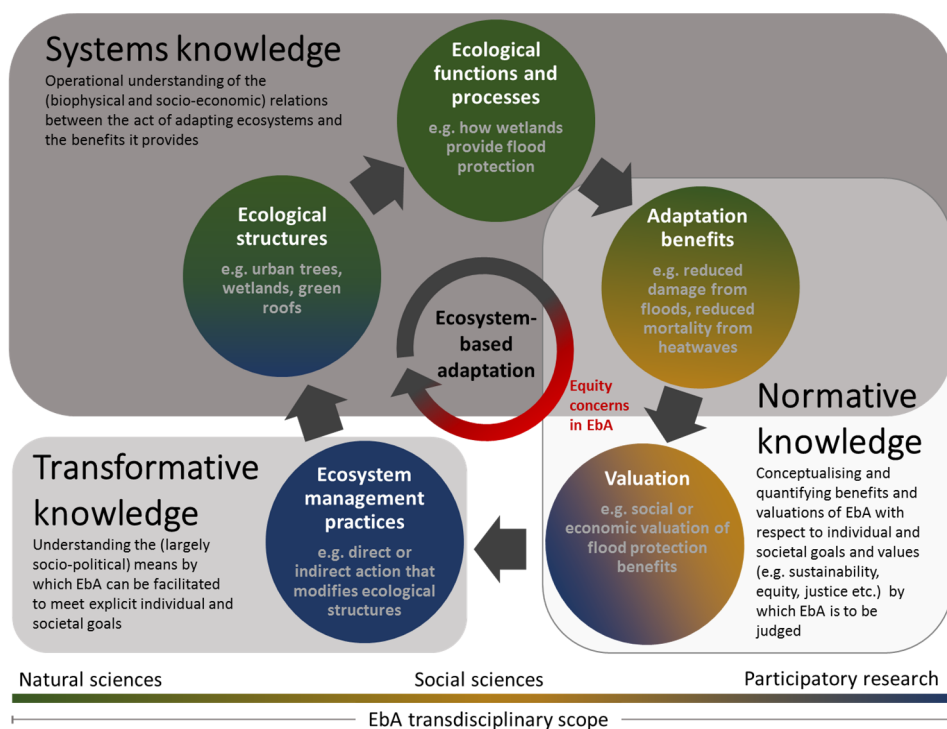


Figure 7 EbA cascade – basis for assessing EbA literature

This figure shows EbA as a linked process across natural and societal systems, and the related scope for systems, normative and transformative knowledge.

The second framework, developed in Paper 3, concerns citizen participation in climate adaptation in Western societies. It theorises the interface between citizens and municipalities in adaptation in a four-field model that locates adaptation interactions along two dimensions: top-down vs. bottom-up (vertical scale) and

contestation vs. collaboration (horizontal scale) (Figure 8). It further supports the detailed analysis of related interactions by focusing on four key dimensions: risk context, actor involvement, interaction process and adaptation outcomes (Table 4). In contrast to most studies' limited notion of participation, the framework includes struggles (not only collaboration) and takes a wider perspective of what is happening at the citizen–municipality interface (including less intensive interactions). For holistic adaptation, none of the modes of engagement should be considered a goal in itself; they are all needed and might appeal to different stakeholders depending on their capacities, needs and worldviews (Figure 8).

Municipality initiated/driven (top-down)				Collaboration (Choice)
Contestation (Compliance)	Quadrant 1: Municipality-driven, ‘hard’ governance interactions (governing by authority) Example: The municipality legally enforces citizens’ adaptive behaviour, e.g. using building permits and sanctions	Quadrant 2: Municipality-driven, ‘soft’ governance interactions (enabling, facilitating) Example: The municipality enables citizens’ adaptive behaviour, e.g. using information campaigns, household counselling, just-in-time information, financial incentives, citizen hearings and dialogs		
	Quadrant 4: Citizen-driven, contentious interactions Example: Citizens oppose the municipality’s work, e.g. based on experienced hazards, risk-inducing densification plans or unpopular municipal adaptation measures	Quadrant 3: Citizen-driven, collaborative interactions Example: Citizens support the municipality’s work, e.g. through provision of local knowledge or community-based adaptation initiatives		
Citizen initiated/driven (bottom-up)				

Figure 8 Theorisation of the citizen-municipality interface

This model theorises adaptation interactions based on two dimensions: top-down vs. bottom-up (vertical scale) and contestation vs. collaboration (horizontal scale).

Table 4 Analytical framework: key dimensions of adaptation interactions

Category	Dimension	References
Risk context	• Type of climate-related hazard	(IPCC, 2014)
	• Place-specific vulnerabilities	(Wamsler, 2014; Wisner et al., 2004)
	• Type and timing of risk-reduction measures	(Wamsler and Brink, 2014c)
Actor involvement	• (Basis for) inclusion and exclusion	(Ansell and Gash, 2008; Healey, 2006a; Hoff, 2003)
	• Individuals/Groups	(Hoff and Gausset, 2015)
	• Actor asymmetries	(Ansell and Gash, 2008; Armitage et al., 2009; Healey, 2006a; Tennekes et al., 2014; Tompkins and Eakin, 2012)
Interaction process	• History-motivation	(Ansell and Gash, 2008)
	• Top-down/Bottom-up	(Hoff and Gausset, 2015)
	• 'Hard'/'Soft' governance	(Alber and Kern, 2008)
	• Collaboration/Contestation	(Hajer, 1997; Healey, 2006a; Pelling et al., 2014; Revi et al., 2014)
Outcomes and learning	• Institutional change and learning	(Healey, 2006a; Reed et al., 2010)
	• Citizen learning	(Hoff, 2003; Newig and Fritsch, 2009)
	• Integration of expert and local knowledge	(Ansell and Gash, 2008; Armitage et al., 2009; Renn and Schweizer, 2009)

Further research needs

I started this thesis with a question about citizen engagement in adaptation. The ecosystem-based theme, in contrast, emerged from interaction with the field; this was more in line with municipalities' needs and interests, partly spurred by the popularity of the ecosystem services concept. In 2018, as I am concluding this thesis, explicit and deliberate initiatives to involve citizens in adaptation are taking form in the municipalities studied³⁰ – a process to which I have perhaps also contributed through my questions and discussions with civil servants during the course of these years. It is somewhat ironic that what I wanted to study for my PhD is only explicitly materialising at its completion; however, this provides an interesting empirical setting for future research.

Despite my own and others' contributions to the topic during the last five years (e.g., Glaas et al., 2015a; Hegger et al., 2017; Mees et al., 2017, 2016), I find that the contours of citizen engagement in adaptation – what it is (or should be), and who or what is driving it – are still much less defined than those of EbA. There is a need for further research on citizens in adaptation in their various roles, including as voters, homeowners, tenants, consumers (e.g., of utility services) and civil society members. In addition, much of the existing research on citizen engagement revolves around flooding, as this is a climate-related hazard that citizens are already experiencing, and also perhaps spurred by the European Flood Directive's call for participation (Driessen et al., 2016; Mees et al., 2014b; Newig et al., 2014). However, adaptation needs to consider the full range of climate-related hazards and unavoidably comprises forward-looking activities. Based on this, future research on this area needs to further develop methodologies to investigate citizens' roles and perspectives in less-experienced and less-tangible hazards, the most important and under-studied perhaps being heat (cf. Carlsson-Kanyama et al., 2008; SOU, 2017). Equally important would be to broaden the scope to investigate the role of the private sector in adaptation governance. While this was not a key focus of my research, I repeatedly saw how municipalities' and citizens' adaptation efforts were shaped by their interactions with insurance companies, developers and private landowners.

Regarding EbA, the review of urban EbA literature identified three important areas for future research. These can be summarised as 'integrating knowledge' – a call for more interdisciplinary approaches and knowledge brokerage; 'integrating people' –

³⁰ For instance, in 2017, as a part of its new cloudburst plan (Malmö stad, 2016), Malmö and the inter-municipal stormwater association VA SYD launched the campaign 'Tillsammans gör vi plats för vattnet' (Making space for water together), urging house owners to take measures on their properties which would reduce flood risk for themselves and others during downpours. See <https://platsforvattnet.vasyd.se/> (in Swedish).

considering stakeholder involvement and equity in both research on and management of urban EbA; and ‘integrating futures’ – increasing the use of future-oriented perspectives and scenarios. In addition, while I have only scratched the surface of themes such as growth and developer-oriented planning models and environmental gentrification, the global and local case studies alike suggest the integration of planning theory and critical urban studies into urban (ecosystem-based) adaptation research as an exciting avenue for future investigation. This gap is also pointed out by other recent studies (Chu et al., 2018; Meerow and Mitchell, 2017).

Finally, further conceptual and empirical research is needed to characterise transformational or transformative adaptation in practice, and critically examine EbA and citizen engagement, jointly and separately, as pathways to such transformations. In this context, the linking of adaptation and mitigation is an important research field to be explored.

Concluding remarks

This thesis has investigated the role and potential of ecosystem-based adaptation (EbA) and citizen engagement in urban adaptation governance and, in particular, for reducing the risk of adverse climate events. It shows that although, in the main, EbA and citizen engagement have not occurred in explicit and deliberate ways, they have had significant outcomes for municipal adaptation and have the potential to address underlying risk drivers. However, the two approaches are currently not well developed and supported at the municipal level, and changes in current governance arrangements are warranted to capitalise on their benefits for advancing – and possibly transforming – local adaptation. These changes include a more anticipatory and forward-looking adaptation process, in which ecosystem-based planning is informed by risk and vulnerability analyses and climate scenarios; more consideration of citizens’ differential vulnerability, e.g., based on housing types and other conditions; the mainstreaming of adaptation in municipal sector work (especially social sectors); and the review of (higher-level) legal barriers. In this context, combining EbA and citizen engagement may be a promising venue for mobilising collective engagement and supporting local adaptation. However, neither approach should be seen as a universal remedy. Ultimately, it is a question of how EbA and citizen engagement can complement existing approaches (e.g., technical, economic) to create urban adaptation systems that are flexible and robust. This is key if adaptation action, as stated in the Paris Agreement, should follow a “participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and [...] be based on and guided by the best available science” (UNFCCC, 2015, p. 11).

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Appendices

Appendix A: List of supporting publications

Journal articles

1. Beery, T., Stålhammar, S., Jönsson, K.I., Wamsler, C., Bramryd, T., **Brink, E.**, Ekelund, N.G.A., Johansson, M., Palo, T., and Schubert, P. (2016). Perceptions of the ecosystem services concept: Opportunities and challenges in the Swedish municipal context. *Ecosystem Services* 17, 123–130.
2. Wamsler, C., **Brink, E.** (2016) The urban domino effect: a conceptualization of cities' interconnectedness of risk. *International Journal of Disaster Resilience in the Built Environment* 7, 80–113.
3. Wamsler, C., and **Brink, E.** (2015). The role of individual adaptive practices for sustainable adaptation. *International Journal of Disaster Resilience in the Built Environment* 6(1), 6–29.
4. Wamsler, C., Luederitz, C., and **Brink, E.** (2014) Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environmental Change* 29, 189–201.
5. Luederitz, C., **Brink, E.**, Gralla, F., Hermelingmeier, V., Meyer, M., Niven, L., Panzer, L., Partelow, S., Rau, A.-L., Sasaki, R., Abson, D.J., Lang, D.J., Wamsler, C., and von Wehrden, H. (2014). A review of urban ecosystem services: Six challenges for future research. *Ecosystem Services* 14, 98–112.
6. Wamsler, C., and **Brink, E.** (2014). Planning for resilience to climatic extremes and variability: A review of Swedish municipalities' adaptation responses, *Sustainability* 6(3), 1359–1385.
7. Wamsler, C., and **Brink, E.** (2014). Interfacing citizens' and institutions' practice and responsibilities for climate change adaptation. *Urban Climate* 7, 64–91.

Policy documents, reports and popular science chapters

1. Thoni, T. (ed), Alkan Olsson, J., **Brink, E.**, Ekroos, J., Hanson, H., Hollander, J., Linder, S., Knaggård, Å., Olsson, P.A., Rummukainen, M., Sidemo Holm, W. (2017). *Ekosystembaserad klimatanpassning: konceptualisering och kunskapsöversyn*. CEC Syntes Nr 04. Centrum för miljö- och klimatforskning, Lunds universitet, Lund.
2. Jönsson, K.I., Ekelund, N.G.A., Wamsler, C., **Brink, E.**, Beery, T.H., Palo, T., Schubert, P., Stålhammar, S., Bramryd, T., Johansson, M. (2017). *Implementering av ekosystemtjänstbegreppet i kommunal verksamhet: Slutrapport*. Naturvårdsverket, Stockholm.
3. Schubert, P., Jönsson, K.I., Bramryd, T., Johansson, M., **Brink, E.**, Wamsler, C., Palo, T., Beery, T., Ekelund, N., Stålhammar, S., (2017). Ekosystemtjänstbegreppet – en historisk tillbakablick och den förväntade rollen i svensk miljöpolicy, in: *Urban Utveckling och Interaktion*, YMER. Svenska Sällskapet för Antropologi och Geografi.
4. Wamsler, C. and **Brink, E.** (2016). *Guideline for Integrating Ecosystem-Based Adaptation into Municipal Planning and Governance*. Working Paper 32. Disaster Studies and Management Working Paper Series of the University College London (UCL) Hazard Centre.
5. Hjerpe, M., Glaas, E., Storbjörk, S., Jonsson, C. A., **Brink, E.**, Wamsler, C. (2014). *Svensk forskning om klimatanpassning inom styrning och planering*. Centrum för klimatforskning, Briefing nr. 12, 2014. Linköpings universitet, Norrköping. (Appendix 6 to Andersson L., Bohman A., van Well L., Jonsson A., Persson G. och Farelus J. (2015). Underlag till kontrollstation 2015 för anpassning till ett förändrat klimat. SMHI Klimatologi Nr 12, SMHI, SE-601 76 Norrköping, Sverige.)

Appendix B: List of stakeholder meetings and interviews

2013: ‘Research circle’ (roundtables with municipal civil servants) on planning under uncertainty, 3 meetings: 2013-02-14, 2013-03-05, 2013-04-09.

2013-2017: ECOSIMP project with Scanian universities and municipalities (consisting of 1-day ‘meetings’ and 2-day ‘workshops’)

- 2014-02-17 Kick-off meeting in Kristianstad.
- 2014-05-19 – 20 Project workshop in Vitemölla.
- 2014-12-02 – 3 Project workshop in Helsingborg.
- 2015-05-27 – 28 Project workshop in Båstad. Participated in SWOT analysis of the transdisciplinary working method.
- 2015-10-29 Project meeting in Lomma. I led interactive session on Design Principles for transdisciplinary research projects.
- 2015-11-26 – 27 Project workshop in Åhus. I presented my PhD research (Paper 3) to municipal representatives.
- 2016-03-03 Project meeting in Kristianstad.
- 2016-06-16 – 17 Project workshop in Kivik. I presented research results from the ECOSIMP work packages on EbA and transdisciplinarity.
- 2016-09-26 Project meeting in Lund. I organised the meeting.
- 2017-03-21 Attended the ECOSIMP final conference in Stockholm

2015: informant interviews with citizens and municipal planners active in ‘adaptation interactions’

Malmö

- 2015-06-16 Stormwater manager and traffic planner working on Malmö’s new cloudburst plan
- 2015-09-17 Coordinator for Områdesprogrammet Seved
- 2015-09-19 Housing cooperative resident from the Söderkulla interaction
- 2015-06-18 Homeowner in the Klagshamn interaction

Helsingborg

- 2015-09-07 Head of comprehensive planning division in Helsingborg
- 2015-09-24 Operative manager in Helsingborg
- 2015-06-16 Housing cooperative resident from the Helsingborg seafront interaction
- 2015-06-24 Housing cooperative resident from the Helsingborg seafront interaction

Other relevant conferences/workshops with Scanian/Swedish municipal stakeholders

- 2013-09-19 Attended conference 'Urban Transition Forum', Malmö
- 2013-09-25 Attended conference 'Klimatanpassning Sverige' in Stockholm
- 2013-11-13 Attended conference 'Samhällssäkerhet 2013' in Stockholm
- 2014-09-19 Attended workshop on 'Att praktiskt tillämpa arbetet med ekosystemtjänster på lokal nivå i Skåne', InnoVatten/ Kommunförbundet Skåne, Malmö
- 2014-11-21 Participated in workshop on 'Flödesanalys: Översvämningarnas konsekvenser', Resilient Regions Association and Malmö Stad, Malmö
- 2014-11-27 Attended workshop on 'Water in the Sustainable City', Urban Arena, Lund
- 2017-03-22 Presented findings from the ECOSIMP project (Paper 2) at the Swedish Environmental Protection Agency's network meeting for ecosystem services

Appendix C: Original interview quotes in Swedish

ⁱ Jag har en egen grävmaskin. Det är praktiskt. Jag har gjort en vall runt huset och sen så kan man ju lösa vattenproblem på två sätt, antingen så stänger man ute det, eller så dränerar man bort det. Så jag har gjort även att jag har dränerat. ehh... 2004-2006 så gjorde jag en omfattande ombyggnad utav huset. Jag byggde en källare. Det var en krypgrund, en källare under mitt hus, men jag byggde en helt ny grund under hela huset när det fortfarande stod och dränerade under alltid. Det är alltså, det är jätteomfattande en hel grej, och sen så koppla allt... dränera allting och koppla det till pumpar ifrån pumpgrupper. Så jag har 5 pumpar. 3 som står och 2 st som reserv.

ⁱⁱ VI har 89 sandsäckar liggande i källaren. Det ser inte så vackert ut, ser ut som vi har bombskyddat fastigheten, men.. de.. dem släpar vi upp och lägger in till fasaden och framförallt över de här luft.. ventilationsinsläppen. [...] Det det... jag har ju tidigare varit arbetslös en period så jag har ju haft möjligheten att kunna (skratt) hjälpa till så att säga. Och sen så är det några som är pensionärer här också som.. liksom tar sin del för att de menar på att är vi hemma så hjälper vi till.

ⁱⁱⁱ För det är ingenting vi kan påverka. Jag menar, vi har vår lilla radhusplätt, så... För normalt sett har ju fastighetsägare skyldighet att ta hand om sitt vatten, men de här mängderna (skratt) de löser inte vi, utan de kommer ju utifrån. och där har ju VA Syd och gatukontoret, eh... Man kan säga parken ligger precis bakom, och den lägsta punkten i parken är ju högre än en del av vår gata, vilket ju gör att avrinningen... Vi blir, per automatik, plan b.

^{iv} Jag menar, en äldre kvinna, en av sakerna jag fick börja med, det var att se till så att hon fick en god man som företrädde henne, därför att där gjorde kommunen ingenting. Hon hade hemtjänst... Det var hon som blev utburen, eh, ovanpå vattenmassorna, eh... Och ingen som liksom kunde företräda henne. Så hon hamnade på nåt sånt akutboende nånstans. Och under den här tiden, jag har nån bild, sen... Hon träffade själv sitt försäkringsbolag. Hon var ju lite virrig också. Så hur det egentligen hanterades... Men det var ju innan... det var ju inte okej att man låter en gammal människa vara helt utsatt... så. Och ingen som gick in och liksom såg till att hennes hem och hennes saker räddades, utan det bara möglade upp alltihopa. Men sen så fick jag igång en... För jag sa, jag måste ju säkra upp så att... Ja, där var ju en... Så där gick ju inte.... Socialtjänsten, de var ju igång och hade insett att här behövde va en god man, men det är ju en process kring det va. Men vi fick ju snabba på det, och löst det, och fick en god man, eh, men det var ju för sent utifrån hennes hem. Men vad ska vi säga, löpande hemtjänstverksamhet och socialtjänst hjälpte henne ju inte med det. Och det ligger kanske inte i deras uppdrag, men det föll mellan stolarna.

^v (Hur har ni organiserat er i bostadsrättsföreningen?) Det tog 1,5 månad. Vi hade tidigare ordförande som inte gjorde speciellt mycket om jag uttrycker mig diplomatiskt. Det tog 1,5 månad när vi skulle ha stämman i mitten på oktober, eh och då hade vi under den här tiden förgäves att få henne till att begripa att vi måste ha hjälp i det ihär, vi måste ha in konsulter som företräder föreningen, vi måste ta tag i detta, eh... Och under den här 1,5 månaden konstaterade hon att "det här löser försäkringsbolaget, du är överambitiös, litar du inte på försäkringsbolaget, och vi ska inte göra nånting", och skulle det vara några konsulter och advokater och så vidare så fick ju den så att säga blöta, drabbade sidan, det fick de lösa själv. (Okej, så hon var inte personligen drabbad då?) Nej, hon satt på den torra sidan, eh, men vi har ju ett kollektivt ansvar för... I en bostadsrättsförening har man ju ett kollektivt ansvar för fastigheterna, så att man kan ju inte bara släppa halva föreningens fastighetsbestånd och

förlita sig på att försäkringsbolaget och byggaren gör det bästa, utan att bevaka så att detta går rätt till. Och det har vi ju med facit i hand insett att det var ju en jädra tur att vi hade koll på läget. Så att det blev ny styrelse på stämman i mitten på oktober.

^{vi} Jag skulle vilja säga att den var vårt första fall, så det är den som är vårt lilla pilotprojekt så det är väl att... Nu känner jag ju att, dra lärdomar av det informationsmötet och den, eh, hur den dialogen skedde, för hur vi kan jobba med andra områden också.

^{vii} Vi har själva drabbats av översvämning den här gången. Det är klart att vi vill ha åtgärder för att förhindra detta, det motsätter vi oss absolut inte. Men det är viktigt att man gör det på rätt sätt. Det ser ju tråkigt ut med den här spikraka gång- och cykelstigen som bara skär igenom gräsmattan. Det tycker vi inte tillför miljön någonting. Man skulle kunna göra något mjukare, något gräsbeklätt (svt.se, 2013).

^{viii} Så man får ju inte beträda detta området. Och... det är svårt redan idag att hålla folk borta därifrån. För vissa människor förstår inte det här, att det finns markhäckande fågel t.ex. och... tänk då om det skulle komma till ytterligare 500 personer som är precis i närområdet. Som inte har den historien med att leva nära det här området. Inte har... om man ska säga.. historiska banden med området. Att det märker vi väldigt som är, har, bott här väldigt lång tid, att människor som flyttar och bor.. alltså, man ska inte polarisera och säga vi och de, men, de har inte samma förståelse.

^{ix} Alltså jag kan tro att all, all... all sånt där som man gör tillsammans blir ju bättre. jag kan bara se om man pratar om... som vi byggde Vintriediket som var ett sånt här skitfult dike som var ingenjörsmässigt, 3 m djupt, skarpa kanter, alla barn ramlade ner och slog ihjäl sig och det var [oklart ord]-staketat, och så pratar man om att så kan man inte ha det, vi kulverterar det. Sen så gjorde man inte det, utan man öppnade upp det så det blev jättestort. Och det var också jättemycket.. de boende "ah, alla våra barn kommer drunkna" och sånt, och nu har de Vintriedikes-dagen som är... alla älskar det, det är nån som byggt en balkong bara för att få utsikt över det alltså... för att man gjorde det så i samråd.

Adapting Cities

The climate is changing, and cities across the globe find themselves urgently needing to adapt to climate-related hazards such as floods, storms and heatwaves. In Europe, this has traditionally occurred through top-down management structures and technical solutions. However, there is a growing consensus that 'adaptation as usual' will not be enough, which has resulted in a range of new approaches being advocated in research and practice.



In this thesis, I examine two of these: ecosystem-based adaptation (EbA) and citizen engagement in adaptation. Based on a review of global case studies and empirical work in the Scania region of Sweden, I explore how EbA and citizen engagement are pursued and have played out in practice. Specifically, I investigate how and on what basis EbA is applied in cities; how and for what reasons Swedish citizens engage in adaptation; and the implications of, and synergies between, the two approaches in local adaptation governance. Towards the end, I turn to the debate on transformational adaptation and discuss the potential roles of EbA and citizen engagement in advancing, or 'transforming', urban adaptation, for instance through linking adaptation with climate mitigation and addressing underlying drivers of risk.

LUND UNIVERSITY CENTRE OF EXCELLENCE FOR INTEGRATION OF SOCIAL AND NATURAL DIMENSIONS OF SUSTAINABILITY (LUCID).

LUCID is a Linnaeus Centre at Lund University. It is funded by the Swedish Research Council Formas, comprises six disciplines from three faculties and is coordinated by LUCSUS as a faculty independent research centre. Research aims at the integration of social and natural dimensions of sustainability in the context of grand sustainability challenges such as climate change, biodiversity loss, water scarcity and land use change. The scope is broad, the ambition is bold and the modes of operation are collaborative. Over the course of ten years we will develop sustainability as a research field from multidisciplinary to interdisciplinarity to transdisciplinarity.