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Collaborative Governance for Climate Change Adaptation: Mapping citizen–municipality interactions

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ABSTRACT

Increasing climate change impacts are a major threat to sustainable urban development, and challenge current governance structures, including actors' responsibilities for dealing with climate variability and extremes. The need for distributed risk governance and citizen engagement is increasingly recognised; however, few empirical studies systematically assess interactions between citizens and municipalities in climate risk management and adaptation. Here, we develop an explorative framework, applied to three Swedish municipalities, to map existing 'adaptation interactions' and analyse how responsibilities for climate adaptation manifest and are (re)negotiated. The results show that adaptation planners rarely consider collaborations with citizens, despite positive adaptation outcomes from related local processes. Structures and mechanisms for systematic monitoring and learning are also lacking. We argue that fostering collaborations with citizens – to support long term adaptation and reduce the adaptation burden of those most at risk – requires consideration of four strategic issues: proactive engagement; equity and 'responsibilisation'; nature based approaches; and systematic adaptation mainstreaming. Finally, we discuss how our analytical framework can contribute to further theorising municipalities' engagement with citizens on climate risk. © 2017 The Authors. Environmental Policy and Governance published by ERP Environment and John Wiley & Sons Ltd

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Introduction

THE IMPACTS OF CLIMATE CHANGE POSE SERIOUS CHALLENGES TO SUSTAINABLE URBAN DEVELOPMENT, WITH SOCIETIES EXPERIENCING climate variations and increasingly frequent extreme events such as floods, heatwaves and storms (IPCC, 2014). Most disasters worldwide are climate-related (CRED, 2015; UNISDR, 2015a); however, climate change is not an isolated cause but interacts with other drivers of urban risk, such as loss of ecosystem services

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(IPCC, 2014). This situation is challenging the division of responsibility between actors when adapting to and managing such events (O'Brien *et al.*, 2009; Adger *et al.*, 2013; Wamsler, 2016).

While municipalities are integral to climate adaptation[1] and management of extreme events (Roberts, 2008; IPCC, 2014; Rauken *et al.*, 2015), citizen[2] engagement is gaining importance in research and policy (Stern, 2006; Osberghaus *et al.*, 2010; IPCC, 2014; UNFCCC, 2015; UNISDR, 2015b). Citizens are legally responsible for protecting their own properties (SCCV, 2007; Newig *et al.*, 2014) and how they behave before, during and after extreme events affects personal safety and public adaptation (Tompkins and Eakin, 2012; Wamsler and Brink, 2014; Geaves and Penning-Rowsell, 2016). Citizen involvement can increase relevance, fairness and acceptance of public adaptation (Adger *et al.*, 2005; Burton and Mustelin, 2013; Few et al. 2007; Lemos and Agrawal, 2006; Renn and Schweizer, 2009; Tennekes *et al.*, 2014; Mees *et al.*, 2015). Municipalities – the governmental body closest to citizens – influence citizens' adaptation needs and options, including through emergency management, storm-water planning and land use (Andersson, 2009; Hjerpe *et al.*, 2014; Hoff and Gausset, 2015). Despite these interdependencies, citizen–municipality interactions regarding adaptation have received little attention, particularly in Western societies (Malik *et al.*, 2010; Wamsler, 2014).

This paper examines the role of citizen–municipality interactions in fostering climate adaptation in three Swedish municipalities. Although specific research is scarce, studies in adjacent fields indicate that interactions do occur, from top-down risk communication (Glaas *et al.*, 2015a) and financial incentives (Torgersen *et al.*, 2014) to bottom-up civic risk monitoring (Boyd *et al.*, 2015) and power struggles over risk and adaptation (Stepanova and Bruckmeier, 2013). We define 'adaptation interactions' as interactions between citizens and municipalities that further adaptation to and management of adverse climate effects. An interaction can anticipate or react to climate effects (IPCC, 2014) and it actively involves both parties. This study aims to map interactions identifiable in practice and analyse the division of responsibilities involved. 'Mapping' is used to challenge assumptions about how citizens engage in adaptation.

The next section presents key concepts and develops a framework for analysing adaptation interactions. After describing the methodology, we then map 17 adaptation interactions across the three municipalities, followed by a more detailed analysis of particularly interesting cases. Next, we discuss our results and identify four strategic areas for advancing research, policy and practice towards more collaborative adaptation. Finally, we reflect on the usefulness of the framework for analysing and supporting adaptation interactions.

Conceptual and Analytical Framework

Our understanding of adaptation interactions is constructed from the literature on climate adaptation and collaborative governance, and the review of related concepts: public vs. private adaptation (Mees *et al.*, 2012; Tompkins and Eakin, 2012), cross-sector partnerships (Forsyth, 2010), cooperative or 'hybrid' environmental governance (Glasbergen, 1998; Lemos and Agrawal, 2006), co-creation and co-production (Bason, 2010), adaptive co-management (Armitage *et al.*, 2009) and social contracts of risk (Adger *et al.*, 2013).

Climate adaptation is 'the process of adjustment to actual or expected climate and its effects' – a gradual process of long-term adaptation to irreversible climate change (IPCC, 2014: 1758) and a cyclical process requiring actions to reduce vulnerability and underlying risk factors before, during and after hazard events (development, response and recovery phase; UNISDR, 2009). Effective adaptation requires physical–technical, socio-cultural, environmental, economic and political–institutional measures to create a flexible system that functions even when individual parts fail (Wamsler, 2014).

Collaborative governance (participatory or inclusive governance; Healey, 2006a; Ansell and Gash, 2008; Newig and Fritsch, 2009; Renn and Schweizer, 2009) is tackling societal needs through social–political engagement among actors (Donahue, 2004). Here, we use it to conceptualize what happens during adaptation interactions and how shared learning can filter back into participating organisations or groups. We understand interactions as 'collaborations' (Ansell and Gash, 2008), 'collaborative arrangements' (Hoff and Gausset, 2015) or 'governance

[1]'Climate adaptation' and 'adaptation' are used interchangeably here.
[2]The term 'citizen' is used to describe people living under the jurisdiction of a local government, independent of national citizenship status.

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episodes' (Healey, 2006b). In line with Healey (2006b: 327), we see adaptation interactions as periods of concentrated attention to governance with adaptation outcomes. Healey (2006a,b) describes how learning, generated by grass roots (first 'level') episodes, feeds into mainstream urban governance (second 'level') and ultimately transforms embedded cultural values and formal and informal mechanisms for policing governance (third 'level'). Importantly, consistent with adaptation mainstreaming literature (Uittenbroek *et al.*, 2013; Wamsler *et al.*, 2014; Wamsler, 2015), pressure for transformation can emerge from any of these levels (Healey, 2006a). Here, this means that adaptation interactions may both be the cause and the result of changes in practices or ideas at higher governance levels.

The literature review helped to develop a framework to map and analyse adaptation interactions (see Wamsler, 2016). We grouped recurrent issues, crucial for characterising adaptation interactions, into four categories: (i) risk context, (ii) actor involvement, (iii) interaction processes, and (iv) outcomes and learning (Table 1).

Risk context considers what type(s) of climate hazard the interaction relates to (e.g. floods, storms or heatwaves), conditions exposing stakeholders to hazards, and risk-reduction measures (e.g. economic measures for recovery preparedness) (Wisner *et al.*, 2004; IPCC, 2014; Wamsler, 2014).

Actor involvement relates to: inclusion and exclusion (Hoff, 2003; Healey, 2006b; Ansell and Gash, 2008); whether citizens participate as individuals or groups (Hoff and Gausset, 2015); asymmetries in the participation process, due to status, available resources or skills (Healey, 2006b; Ansell and Gash, 2008; Armitage *et al.*, 2009); and responsibility for adaptation, including problem-ownership, implementation, financing and negative impacts or side effects (Tennekes *et al.*, 2014; Runhaar *et al.*, 2016).

Interaction processes may emerge from municipalities and other administrative levels (top-down), or citizens and civil society (bottom-up) (Hoff and Gausset, 2015). They may involve 'hard' forms of authority (regulations and sanctions) and 'soft' forms (adapting municipal service provision or enabling community engagement). Municipal engagement can thus be categorized as governing-by-authority, governing-by-provision or governing-by-enabling (Alber and Kern, 2008). Contestation and social mobilisation also play important roles in environmental policy and raising the political profile of risks (Hajer, 1997; Healey, 2006b; Pelling *et al.*, 2015) (see Figures 2–4).

Outcomes and learning refer to risk-reduction outcomes on the ground and changes in adaptive capacities and practices at institutional and household level. Institutional learning is understood as learning from interactions that feeds back into municipal policy or practice (see Healey, 2006b; Reed *et al.*, 2010). Citizen learning refers to learning from interactions that affect awareness and behaviour (e.g. by creating new competencies or meanings; Hoff, 2003; Newig and Fritsch, 2009). Integration of local and expert knowledge is often highlighted (Ansell and Gash, 2008; Armitage *et al.*, 2009; Renn and Schweizer, 2009).

Category	Dimension	References
Risk context	Type of climate related hazard	IPCC, 2014
	Place specific vulnerabilities	Wisner *et al.*, 2004; Wamsler, 2014
	Type and timing of risk reduction measures	Wamsler, 2014
Actor involvement	(Basis for) inclusion and exclusion	Hoff, 2003; Healey, 2006b; Ansell and Gash, 2008
	Individuals/groups	Hoff and Gausset, 2015
	Actor asymmetries	Healey, 2006b; Ansell and Gash, 2008; Armitage *et al.*, 2009; Tompkins and Eakin, 2012
	Responsibility	Tennekes *et al.*, 2014; Runhaar *et al.*, 2016
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, 2006b; Pelling *et al.*, 2015; Revi *et al.*, 2014
Outcomes and learning	Institutional change and learning	Healey, 2006b; 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

Table 1. The analytical framework: Key dimensions of adaptation interactions

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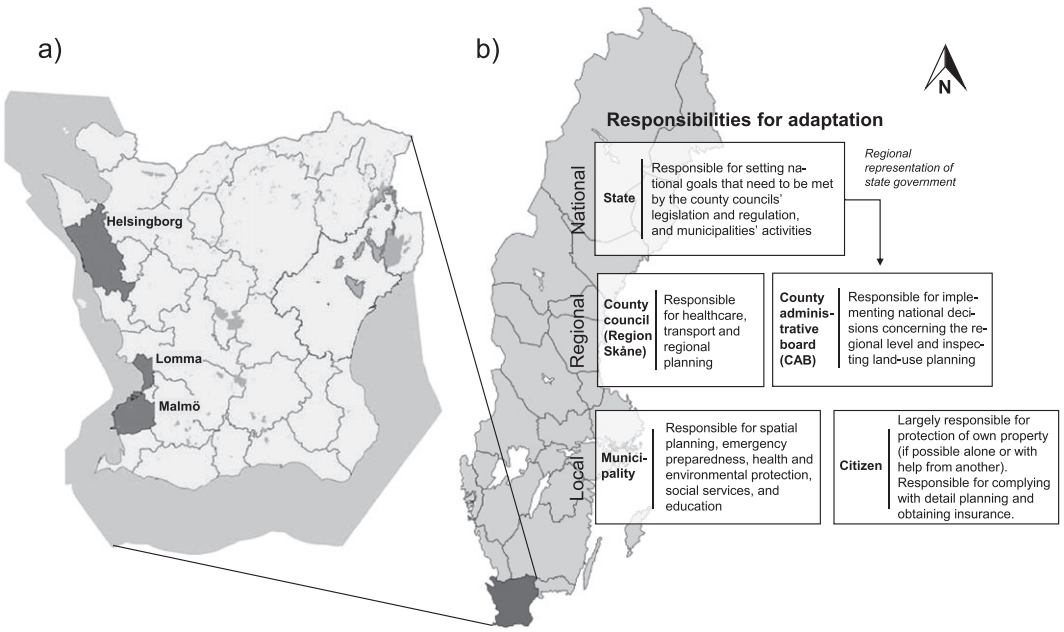
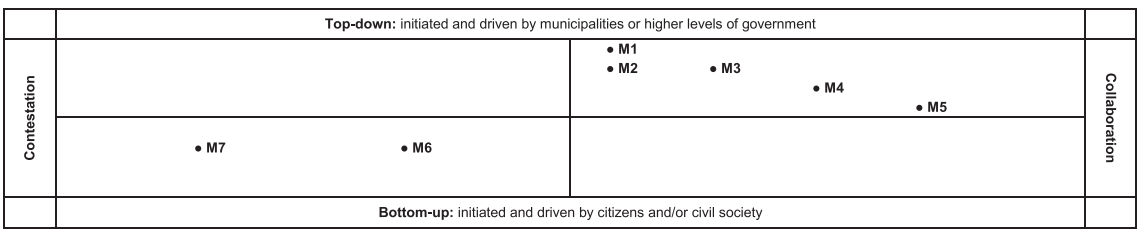


Figure 1. Municipalities and legal responsibilities for climate change adaptation. Adapted from Wamsler *et al*. (2014).



#	Description (& year of initiation/finish, if available)	Risk context (& sector/explicit purpose)	Actor involvement	Interaction processes ([…] = emerging category)	Outcomes and learning
M1	Financial incentive (reduced water service fee) offered to citizens who decouple downpipes and manage storm water on their own property (since end of 1990s).	Hazard: Pluvial flooding Explicit purpose: Storm-water management Target measure: Physical Instrumental measure: Econ.	Individual property owners Storm-water agency Asymmetries: Private action affects public risk reduction	Top-down (incentive) Municipal engagement: governing-by-enabling Citizen engagement: [choice]	No systematic evaluation of outcomes by the municipality, but believed to relieve pressure on the storm-water system, as roof surfaces account for a lot of water during heavy rains. A related initiative will target change in citizens' attitudes in 2016.
M2	Pilot project in Rosengård using checklists for risk-reducing actions in municipal home care and assisted living (2013), also targeting the general public, such as family members of elderly.	Hazard: Heatwave Explicit purpose: Heatwave preparedness in healthcare Target measure: Social Instrumental measure: Social	At-risk citizens (elderly) & General public Municipal care staff, *Region Skåne* (county council)	Top-down (instruction) Municipal engagement: governing-by-provision Citizen engagement: [compliance/choice]	Change in working routines: the contingency plans now apply to ordinary operations in *Region Skåne*. Citizen learning has not been evaluated by the project, but increased citizen action can be assumed.
M3	Web campaign to encourage people to plant trees in their gardens (emphasising improved microclimate and carbon storage), including advice on suitable tree species in a climate change context.	(Hazard: Flood/wind/heat) Explicit purpose: Climate change mitigation Target measure: Environmental Instrumental measure: Social	Individual property owners Street and Parks Dept. Asymmetries: Private action affects public and private risk reduction	Top-down (information) Municipal engagement: governing-by-enabling Citizen engagement: [choice]	The campaign page had few visitors. The issue is taken forward by a new group in the Street and Parks Dept. whose purpose is to raise the status of trees as building blocks in the city environment, e.g.,through information and dialog.
M4	Construction of an open storm-water solution in Vintrie in dialog between residents and the storm-water agency.	Hazard: Pluvial flooding Explicit purpose: Storm-water management Target measure: Physical and environmental Instrumental measure: Social	Neighbours to the planned channel Storm-water agency	Top-down (dialogue) Municipal engagement: governing-by-provision and -enabling Citizen engagement: collaboration	Reduced flood risk by relieving Malmö's storm-water system. People were initially afraid children would drown in the open storm-water channel. Dialog led to a safe design: a wide and shallow channel with gentle, grassy slopes, which is now a space for nature-oriented recreation and social interaction.
M5	Municipal neighbourhood programme in Seved (2010-2015), promoting responsible and inclusive property management, which became a venue for discussing flood management measures after the 2014 flood.	Hazard: Pluvial flooding Explicit purpose: Property management Target measure: Sociophysical Instrumental measure: Socio-political	At-risk citizens (via private landlords) Decentralised area programme, Environment Dept., Technical Dept.	Top-down (dialogue) Municipal engagement: governing-by-enabling Citizen engagement: collaboration	Upscaling into a public-private collaboration (*BID Sofielund*) where flood risk reduction is a recurrent theme, and discussions with the Streets and Parks unit about potential nature-based solutions. Increased risk awareness.
M6	21 displaced residents in Söderkulla are demanding an action plan from the municipality before moving back to the area worst affected by the 2014 flood. In 2010, they had petitioned against a densification of the nearby park (after lighter floods in 2007 and 2010).	Hazard: Pluvial flooding (reactionary) Explicit purpose: Flood protection Target measure: Mostly physical Instrumental measure: Political	At-risk citizens (via housing cooperative) Street and parks, Technical committee. Storm-water agency. Asymmetries: Potential risk transfer to neighbouring areas delayed public action	Bottom-up (lobbying) Municipal engagement: governing-by-authority Citizen engagement: contestation	No concrete risk-reducing measures in place. Learning from case influences city-wide Cloudburst Plan. Change in citizen behaviour concerns mostly preparedness for recovery.
M7	500 residents appealed a detailed plan development containing a densification, based on increased flood risk and threat to the species-rich shore meadows (2014).	Hazard: Pluvial flooding, storm Explicit purpose: Flood & nature protection Target measure: Environmental Instrumental measure: Political	At-risk citizens/neighbours Planning department Asymmetries: Private trade-offs of public adaptation regulations	Bottom-up (lobbying) Municipal engagement: governing-by-authority Citizen engagement: contestation	Rejection of the detailed plan by the County Administrative Board. Improved cohesion between 'old' and 'new' residents and increased awareness of flood risk and nature protection among new residents. Municipality plans to appeal the decision.

Figure 2. **Adaptation interactions in Malmö.**
Interactions are mapped on two axes: contestation/collaboration (horizontal axis) and top-down/bottom-up (vertical axis). Below, details are given for each interaction.

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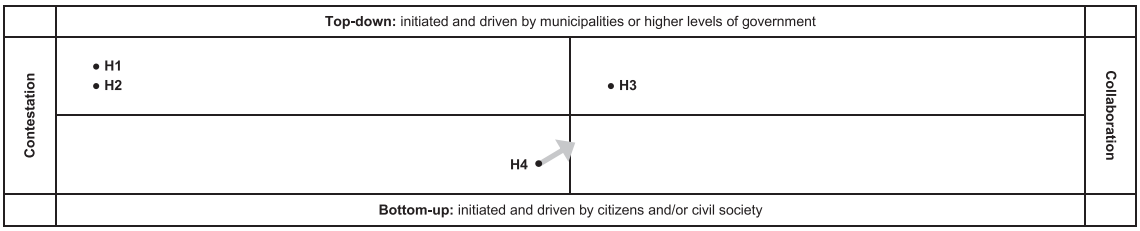

#	Description (& year of initiation/finish, if available)	Risk context (& sector/explicit purpose)	Actor involvement	Interaction processes ([…] = emerging category)	Outcomes and learning
H1	Mariastaden, a reference area for local storm-water management where the detailed plan explicitly requires water to be handled on each property to reduce risk (1995).	Hazard: Pluvial flooding Explicit purpose: Storm-water management Target measure: Physical and environmental Instrumental measure: Political-institutional	Property owners (mostly housing cooperatives and single-family houses) Planning Dept., Storm-water agency Asymmetries: private action affects public risk reduction	Top-down (regulation) Municipal engagement: governing-by-authority Citizen engagement: [compliance]	Storm water is handled locally. An evaluation is planned to identify how to feed outcomes into planning; however, upscaling would mean increased maintenance costs for public green areas. Property owners' increased understanding that private land is part of a functioning risk-reduction system.
H2	Development and use of a planning instrument to influence how private actors (including citizens) have to compensate for environmental impacts caused by land development.	Hazard: Pluvial flooding Explicit purpose: Biodiversity Target measure: Environmental Instrumental measure: Political-institutional	Individual property owners Planning Dept. Asymmetries: private action affects public risk reduction	Top-down (regulation) Municipal engagement: governing-by-authority Citizen engagement: [compliance]	Protective ecosystems are spared. Accepted change in municipal working methods and procedures (use of new instrument). Property owners' increased awareness of the relevance of nature for climate adaptation.
H3	In coastal Rydebäck, the municipality wanted to change residents' self-built hard erosion protection (which was worsening erosion in other places) and replace it with nature-based solutions.	Hazard: Coastal erosion Explicit purpose: Erosion protection Target measure: Environmental Instrumental measure: Social	Individual at-risk citizens/ property owners Planning Dept., County Administrative Board Asymmetries: public disadvantages from private risk reduction	Top-down (shared learning) Municipal engagement: governing-by-enabling Citizen engagement: N/A	After the County Administrative Board denied the municipality the right to implement soft/nature-based solutions for erosion protection (beach nourishment), the example became a site for multi-level institutional learning through a county-level advisory council on adaptation.
H4	At-risk citizens living in seafront housing cooperatives in the city centre addressed the municipality, demanding action and clarification of responsibilities after the 2013 storm.	Hazard: Coastal flooding, storm (reactionary) Explicit purpose: Storm protection Target measure: Mostly physical, some social/organisational Instrumental measure: Political	At-risk citizens (mostly via housing cooperatives) Planning Dept., Street and Parks Dept., City Office Asymmetries: limited scope of public action for private risk reduction	Bottom-up (dialog) Municipal engagement: governing-by-enabling Citizen engagement: contestation → collaboration	The buildings were improved. Municipality made small concessions to support effective response measures. Establishment of a reference group of residents to work with municipality. Learning from interaction will influence a) ongoing work with an adaptation action plan and b) detail planning. Citizens' increased awareness of their responsibility as property owners.

Figure 3. **Adaptation interactions in Helsingborg.**
Interactions are mapped on two axes: contestation/collaboration (horizontal axis) and top-down/bottom-up (vertical axis). Below, details are given for each interaction.

Methodology

The following case study (Yin, 2008), combining document analysis and interviews, examines adaptation interactions in southern Sweden.

The Study Sites

Three coastal municipalities in Scania, Sweden, were chosen as study sites (Figure 1). Climate adaptation is an emerging priority area at all governance levels in Sweden (SCCV, 2007; Andersson *et al.*, 2015; Miljö- och energidepartementet, 2015). Scania is predicted to be one of the regions hardest hit by climate change, including floods, erosion and sea-level rise (SCCV, 2007; Hall *et al.*, 2015).

Selecting information-rich municipalities was crucial for testing our analytical framework. The coastal municipalities of Malmö (328 494 inhabitants), Helsingborg (140 547) and Lomma (23 887) (SCB, 2017), although of different size and population structure (SCB, 2017, 2015; see footnote 4), are all highly engaged in climate adaptation (e.g. Wamsler *et al.*, 2014; Brink *et al.*, 2017) and have been affected by high-profile weather events – in 2011, 2013, 2014 and 2016.

Data Collection and Analysis

We identified adaptation interactions by triangulating documents with accounts from citizens and municipal staff. We used purposive sampling to identify diverse interactions regarding risk context, actor involvement, interaction processes, and outcomes and learning (see previous section). As climate adaptation is a relatively recent priority in Swedish municipalities, most interactions were ongoing at the time of the study. Of the 17 interactions identified,

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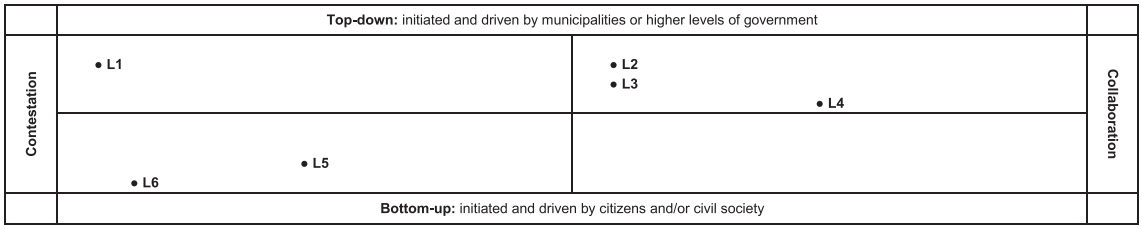

#	Description (& year of initiation/finish, if available)	Risk context (& sector/explicit purpose)	Actor involvement	Interaction processes ([…] = emerging category)	Outcomes and learning
L1	Development of an informal planning instrument to oblige/persuade private actors (including citizens) to compensate for environmental impacts caused by land development.	Hazard: Pluvial flooding Explicit purpose: Biodiversity Target measure: Environmental Instrumental measure: Political-institutional	Individual property owners Planning section of Municipal board Asymmetries: private action affects public risk reduction	Top-down (regulation) Municipal engagement: governing-by-authority Citizen engagement: [compliance]	Protective ecosystems are spared. While not legally binding, it is seen as a relevant regulation to support environmental planning.
L2	Financial incentive (reduced water service fee) offered to citizens who decouple downpipes and manage storm water on own property.	Hazard: Pluvial flooding Explicit purpose: Storm-water management Target measure: Physical Instrumental measure: Economic	Individual property owners Storm-water agency Asymmetries: private action affects public risk reduction	Top-down (incentive) Municipal engagement: governing-by-enabling Citizen engagement: [choice]	Increased use of decoupled downpipes. No formal evaluation of results by the municipality.
L3	Municipal campaign promoting climate-smart storm-water management on private gardens (2015).	Hazard: Pluvial flooding Explicit purpose: Environmental goals (biodiversity/clean water bodies) Target measure: Environmental Instrumental measure: Social	Individual property owners Planning section of Municipal Board Asymmetries: private action affects public (and private) risk reduction	Top-down (information) Municipal engagement: governing-by-enabling Citizen engagement: [choice]	Assumed increase in citizen awareness and action, but too early to evaluate impact.
L4	Municipal dialogue with coastal stakeholder groups on coastal issues (2007), including flood risk and erosion and, most recently, some involvement in the development of a new coastal adaptation plan (2016).[a]	Hazard: Coastal flooding, erosion, sea-level rise Explicit purpose: Coastal planning Target measure: Physical, environmental Instrumental measure: Social	Groups: Nature conservation orgs., fishermen, kite surfers, sailing community (individuals can also participate) Planning section of Municipal Board Asymmetries: public risk reduction affects users of the coast	Top-down (dialog) Municipal engagement: governing-by-enabling Citizen engagement: collaboration	More inclusive development of coastal adaptation plan. Establishment of trust ("*We have worked with them for 8 years, so they know what it's about when we want to talk to them*"). The learning and experiences are being up-scaled into a municipal adaptation strategy.
L5	Plans for raising a bicycle path for coastal flood protection was opposed by the south-side (lower-risk) residents for reasons of privacy and aesthetics (2013)	Hazard: Coastal flooding, storm Explicit purpose: Flood protection Target measure: Physical Instrumental measure: Political-institutional	At-risk citizens/neighbours (opposing side in a 'South Beach Interest Org.') Technical Dept,, County Administrative Board, Land and Environmental Court Asymmetries: limited scope of public action for private risk reduction; perceived private disadvantages from public action	Bottom-up (lobbying) Municipal engagement: governing-by-authority Citizen engagement: contestation	South Beach residents argued for only raising the north-side embankment, but the municipality wanted to act now rather than wait for climate risk to increase. The national court approved; the embankment will be raised, but with the bicycle path on the outside to protect resident privacy.
L6	Citizens (illegally) built houses on a coastal stretch without detailed planning; when it was finally enforced (delayed by citizen protests) houses below 3 metres above sea level could not be included (and thus 'fell out' of municipal responsibility for anticipatory adaptation).	Hazard: Coastal flooding, sea-level rise Explicit purpose: Detailed planning Target measure: Physical/ planning Instrumental measure: Political-institutional	At-risk citizens Planning section of Municipal Board Asymmetries: 'privatisation' of risk due to citizens' rejection of public responsibility	Bottom-up (defying) Municipal engagement: governing-by-authority Citizen engagement: contestation	Responsibility/liability for protection of the 'unofficial' houses is still to a certain degree unclear.

Notes: [a] Malmö has a similar council, by the time of the study it had not been used to address adaptation

Figure 4. **Adaptation interactions in Lomma.**
Interactions are mapped on two axes: contestation/collaboration (horizontal axis) and top-down/bottom-up (vertical axis). Below, details are given for each interaction.

two from Malmö and one from Helsingborg were chosen for a more in-depth analysis based on their information-richness, diversity and novelty, and timing.

Data were collected through 16 semi-structured interviews, discussions with municipal staff, document analysis and non-participant observation in selected interactions. In 2014, a first round of seven in-depth interviews was conducted with 11 key informants working in municipal climate adaptation to discover how municipalities internally conceptualize, operationalize and organize adaptation. Interviewees were selected based on their position and activities in the municipalities and regional adaptation networks (Oliver, 2006a; Flyvbjerg, 2011). In 2015, through purposive and chain-referral sampling (Oliver, 2006a,b), a second round of nine interviewees (municipal staff and citizens) were selected with key roles in the interactions chosen for in-depth analysis – typically, municipal project managers, planners and homeowners active in cooperative housing or informal neighbourhood associations. Two-hour interviews explored the background, actors, procedure and outcomes of the interaction(s), identifying additional interactions until new interactions ran out. Interview data were complemented by a review of municipality and county administrative board documents, local newspaper articles and documented communications between stakeholders. Non-participant observation took place, where this was granted (M6 and L4, Figures 2 and 4).

The data were analysed using a deductive–inductive coding scheme (Mayring, 2000) based on the conceptual framework already described. MAXQDA12 software was used to organize the researchers' classification and analysis of relevant excerpts, detect associated patterns (see Results), and identify emerging, cross-cutting themes (see Discussion). A roundtable with selected municipal informants discussed and validated the outcomes.

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Results

Mapping Adaptation Interactions

This study identified 17 adaptation interactions, nine of which started in or after 2013. A key finding is that none of these initiatives was explicitly described as 'climate adaptation' (*klimatanpassning* in Swedish).

The interactions are shown in Figures 2–4. The vertical dimension describes whether an interaction was predominantly top-down or bottom-up; the horizontal dimension describes whether the initiative was based on contestation (often due to 'hard' governance mechanisms) or collaboration (often linked to 'soft' mechanisms). The codes in Figures 2–4 (M1, L2, etc., where 'M' denotes Malmö, 'H' Helsingborg and 'L' Lomma) are also used to refer to specific interactions in the text.[3]

Risk Context

Flooding was the most frequent hazard; associated risk reduction mainly involved physical–technical or environmental measures to reduce vulnerabilities caused by local physical conditions.

Hazards. Most interactions addressed pluvial flooding (M1, M4–7, H1–2, L1–3), followed by storms, coastal flooding and sea-level rise (H4, L4–6), coastal erosion (H3) and heatwaves (M2). Three interactions were reactions to specific hazard events (M5–6, H4). For six, the primary goal was not hazard reduction, but climate change mitigation (M3), biodiversity and nature protection (M7, H2, L1, L3), and inclusive property management (M5).

Vulnerability. While hazardous location of settlements (M6–7, H4, L5) was the most cited risk factor in interactions, several factors were found to shape people's vulnerability to such hazards, including combined sewer systems (which increase flood risk) (M5), single-storey houses (preventing evacuation to a higher storey) (M6), exploitative landlords who neglect building maintenance (M5), and old age and failing health (M2, M6).

Risk-reduction measures. Most on-the-ground measures promoted or implemented through the interactions were environmental (M3–4, M7, H1–3, L1, L3, L4) or physical–technical (M1, M4–6, H1, H4, L2, L4–6) and related to development (rather than response or recovery), such as greening private properties and building drainage and floodwalls. Only three interactions involved social risk-reduction (M2, M5, H4).

Actor Involvement

Different laws guided division of responsibilities in interactions between citizens (typically homeowners) and municipal actors (typically planning departments and technical units). Citizens were often unaware of their obligations, and sometimes adaptation measures increased others' risk.

Inclusion/exclusion. Seven interactions involved citizens as a result of being at high risk (M2, M5, M7, H3–4, L5–6). The remainder typically targeted citizens in their role as property owners. Only Lomma Coastal Council (L4) involved a wide range of stakeholders – fishermen, kite surfers and nature conservation organisations. The most active municipal actors were planning (M7, H1–4, L6) and technical departments (M3, M6, H4, L5), with environmental and civil protection departments less involved. Five interactions involved storm-water agencies (M1, M4, M6, H1, L2), which are inter-municipal agencies (except in Lomma). Over-involvement of technical professionals, when citizens emphasised the social and psychological impacts of events (e.g. M6, M7), created a mismatch between citizens' needs and municipal support.

Individuals/groups. About half of the interactions involved citizens as individuals, and half as groups, for example housing cooperatives (e.g. M6, H4), a common form of Swedish housing.[4]

[3]These mappings are not a static or exhaustive list of initiatives in the municipalities, but a snapshot of a dynamic exercise that looks at how municipalities 'do' climate adaptation with citizens in practice.

[4]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% lived in rented apartments (Malmö: 38%, Helsingborg: 34% Lomma: 3%)(SCB, 2015).

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Actor asymmetries. Mismatches (i.e. gaps and overlaps) between citizens' and municipalities' perceived and actual legal responsibilities were identified in all phases. According to one planner:

> [Our responsibility] is not really clear. We have a lot of grey zones when it comes to risk in residential areas; it's kind of new. ... We haven't had that many cases as a guide, so we don't really know.

A central issue was the need for municipal action to uphold public interest and be equitable, as per the Local Government Act (1991: 900 2: 1–2) (e.g. H4, L5, L6), which places the onus on the owner, not the municipality, for property protection (Andersson, 2009; Rydell *et al.*, 2012). Even so, municipalities commonly identified synergies between protecting private and public infrastructure, such as pipes and roads (e.g. H4, L5). Interviews also revealed that citizens wrongly believed they were entitled to recovery assistance. Under the Civil Protection Act (2003: 778 3: 7) municipalities must provide emergency services to 'maintain an organisation that can intervene when the individual alone or with the assistance of another is unable to control an [emergency]' (SCCV, 2007: 623). This misconception became evident during the 2014 Malmö flood, when emergency services were so overwhelmed by calls about flooded cellars that they referred citizens from the hard-hit Söderkulla area, who were in urgent need of evacuation, to the storm-water management agency (M6). Several civil servants interviewed foresaw stricter application of laws and an increasing 'responsibilisation' of citizens.

In five interactions, (individual or public) adaptation efforts disadvantaged others (M6–7, H3, L4, L5). In Rydebäck, attempts to reduce erosion using physical measures increased erosion elsewhere (H3). Lomma citizens complained that the public seawall reduced property values (L5). In Söderkulla, public action to reduce local risk through physical measures to redirect storm water could not be implemented in case risk was transferred to neighbouring areas (M6).

Synergies were also noted, particularly regarding environmental (or ecosystem-based) adaptation measures. In seven interactions, private measures produced public adaptation benefits (M1, M3, H1–2, L1–3) (e.g. modifying private gardens to reduce pressure on the municipal storm-water system).

Interaction Processes

Most interactions were initiated by municipalities, which used different 'hard' and 'soft' instruments to get citizens to support larger-scale adaptation. Some citizens, however, resorted to contestation, claiming public adaptation efforts were substandard or did not meet their needs.

Top-down/bottom-up. Twelve interactions were municipality-driven (top-down), while five were initiated and/or driven by citizens (bottom-up) (M6, M7, H4, L5, L6).

'Hard'/'soft' governance. In nearly half of the interactions, municipalities used traditional 'hard' forms of governance (governing-by-authority) (M6–7, H1–2, L1, L5–6), and softer instruments [i.e. governing-by-provision (M2, M4) and/or enabling (M1, M3–5, H3–4, L2–4)] in the rest. 'Hard' instruments included banning construction in high-risk areas or making permission conditional upon preventive measures (e.g. building at least 3 m above sea level) (M7, H1, L6). Municipalities often had difficulty convincing property owners of the long-term adaptation benefits of these restrictions (e.g. H1–3, L1, L6). Furthermore, 'hard' instruments, such as traditional planning regulations, can counteract adaptation, as one homeowner (M7) related:

> I wanted to build in a certain way [to prevent storm damage], and the municipality deemed it was not appropriate because ... it did not look good ... to stop the roof from flying off I had to do it [my] way.

Collaboration/contestation. Often, citizen engagement could not be classified as either collaboration (co-labouring) or contestation (challenge/confrontation). Most interactions resulted in citizens complying with laws (H1–2, L1) or following (M1–3, L2–3) top-down incentives. Only in four interactions was there clear collaboration, such as continuous two-way dialogue (M4–5, H4, L4). Four interactions, all initiated by citizens, were classified as contestation (M6–7, L5–6). H4 started as a conflict but ended in collaboration (see Helsingborg Seafront below). Contestation is typically a reaction to either lack of assistance in relation to serious hazard impacts (M6, H4) or physical changes

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made by municipalities in people's direct surroundings [e.g. adaptation infrastructure (L5) or flood-enhancing densification in neighbouring areas (M6–7)].

Outcomes and Learning

Several interactions generated improved knowledge about risks and division of responsibilities for climate adaptation, leading mainly to collective solutions. However, municipalities struggled to capitalise on citizens' capacities and citizens seemed to learn quickest from exposure to hazards.

Institutional vs. citizen learning. Eleven interactions showed institutional learning, including upscaling to other geographical areas (M2, M5, H2) and higher administrative levels (M7, L5). Civil servants from all three municipalities described how learning from specific interactions (M6, H4, L4) had fed into strategic adaptation plans (detailed in Figures 2–4). At least nine interactions resulted in on-the-ground measures and reduced the risk of climate-related events (M1–2, M4, H1–2, H4, L1–2, L5).

The interviews indicate citizen learning was due more to hazard impacts than municipal interactions (e.g. M5–7). Anecdotal evidence suggests that interactions have increased citizens' trust in authorities (M5, L4), the feeling of ownership of adaptation infrastructure (M4), and the understanding of private land as an important part of a functioning risk-reduction system (H1). However, there is no systematic monitoring and evaluation of institutional and citizen learning.

Integration of local and expert knowledge. Several interactions resulted in increased mutual responsibility-taking and new collaborative solutions among municipal departments and between citizens and municipalities. One planner (H4) said:

> We were a bit worried that they [citizens] would be like 'no, it's not our responsibility', but [...] they really want to see how we can make a solution together, which is smart and efficient and economically efficient, as well.

Conversely, in Söderkulla, after the 2014 floods, residents tried to collaborate with the municipality by providing local knowledge (e.g. flood levels) and hiring a private storm-water 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 measures (M6).

In Depth Analysis of Adaptation Interactions

An in-depth analysis of three interactions (M7, M5, H4) follows, with outcomes and learning presented first. The analysis shows how citizens deal with climate risk and non-responsive authorities by (i) increasing networking and mutual collaboration, and (ii) formally contesting municipal actions they deem detrimental to adaptation (and nature protection). It shows how municipal officials, constrained by legal and sectoral differences, try to (i) tap into citizens' engagement through dialogue and small concessions; and (ii) include adaptation elements in related collaborations.

Malmö Klagshamn – Bottom Up Contestation (M7)

Outcomes/learning. In 2014, 500 residents of the coastal community of Klagshamn successfully appealed against a municipal plan to build a new residential area that would have increased their flood risk and threatened species-rich shore meadows. They argued that the legal requirement for building new developments 3 m above sea level would increase storm-water runoff to their properties. The plan was rejected by the County Administrative Board, and the appeal process brought the 'old' and 'new' residents of the rapidly urbanising Klagshamn area closer and raised the newcomers' awareness of flood risk and nature protection.

Risk context. As Klagshamn regularly suffers storms and pluvial flooding, property owners' awareness of their responsibilities and the need for individual and community-based adaptation measures has increased. As one resident stated:

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> We have always helped each other here, because everyone knows each other [...] so that day when I was worst affected, all my neighbours were here to help me.

Actor involvement. The main actors were home owners, the Planning Department and the County Administrative Board. During development of the municipal plan, residents were consulted, which is mandatory in formal planning. However, they perceived that vested commercial interests prevented any revisions to the plan. They also noted that interactions with municipalities required administrative and language skills that many citizens lacked. One resident said:

> I have stayed up many nights, to read about the planning process, how to write an appeal, what language to use ... reading other people's appeals and ... you almost have to be a lawyer to learn how to ... articulate everything right.

This was confirmed by municipal staff: 'it's almost always the case that ... residents from more "literate" areas, so to speak, are more prone to contact us'.

Interaction process. The process is a bottom-up contestation in reaction to governing-by-authority, motivated by residents' hazard experience, frustration with municipal planning and positive relationships with the environment. While citizens welcomed adaptation information from the municipality, they doubted the municipality's competence regarding adaptation for private houses.

Malmö Seved – Top Down Collaboration (M5)

Outcomes/learning. After years in a downward spiral, the low-income area of Seved became part of the 'Municipal Neighbourhood Programme for a Socially Sustainable Malmö' (*Områdesprogrammet* 2010–2015), which promoted inclusive property management based on active citizen participation and counselling. After the 2014 flood, the programme mobilised interest and know-how in flood risk reduction among institutions, businesses and civil society. The Seved Neighbourhood Programme was later upscaled into a public–private collaboration called 'BID Sofielund',[5] covering a larger geographical area, where flood risk reduction is a recurrent theme.

Risk context. Housing conditions make Seved vulnerable to floods, in particular where 'slum landlords' collect rent but neglect housing maintenance. Inspection in the Neighbourhood Programme revealed broken windows, black mould, insect infestations and rats (Sydsvenskan, 2014). Many tenants, lacking education and on informal rental contracts, were afraid to protest and did not know their rights. Paradoxically, Seved is located next to Malmö's adaptation flagship 'Augustenborg Eco-City', where nature-based solutions and open storm-water structures were implemented through close citizen–municipality interaction in the 1990s. Despite the challenges, municipal staff highlighted Seved's adaptive capacity, seen in the 2014 floods:

> There was an incredible commitment in the community where people helped and supported each other ... lifting and moving things for one another, providing evacuation facilities ... I think the residents learnt more from this than the rest of us.

Actor involvement. The actors included citizens, the municipal Environment Department and other stakeholders (e.g. commercial property owners and local businesses).

Interaction process. The interaction is characterised by top-down collaboration through governing-by-enabling. Citizen involvement was primarily through the 'Meeting Place Seved', which offered social counselling and information (Malmö Stad, 2015; Palm and Mohamud, 2014). The development of BID Sofielund increased citizen involvement, with an explicit focus on resident participation and knowledge sharing, including suggestions for educating tenants in flood response preparedness.

[5]The Business Improvement District (BID) model provides a mechanism for cooperation with commercial property owners to improve an area and make it more (socially, economically and environmentally) sustainable. BID Sofielund focuses on housing, integration and participation.

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Helsingborg Seafront – Bottom Up Contestation–Collaboration (H4)

Outcomes/learning/risk context. Following the 2013 storm and coastal flooding, inhabitants of seafront cooperatives in Helsingborg demanded greater municipal action, plus clarification of responsibilities for risk-reduction measures. The outcome was an ongoing citizen–municipality dialogue, increased citizen action (e.g. an informal early warning system, strengthening building facades, and storing sandbags and pumps), and the integration of expert and local knowledge into a municipal adaptation action plan.

Actor involvement. Actors were the Strategic Planning Department, Street and Parks Department, members of a municipal working group for climate adaptation, and representatives of at-risk citizens. Previous research on local individual and public adaptation (Lindblad, 2012), and the development of a municipal adaptation action plan may have helped to increase knowledge and mutual cooperation.

Interaction process. Here, an initial contestation led to collaboration and increased mutual understanding through governing-by-enabling. As one citizen stated:

> When we first met with the municipality ... everybody yelled at them, everything was wrong and nothing was good. But by the next meeting it had calmed down, [with people now thinking] may be we cannot do it that way, one cannot burden a municipality with everything, we have to take some action ourselves. If we choose to live this close to the ocean, it is nothing strange really. And so a kind of consensus evolved.

While (cooperative) property owners realised they were responsible for reducing their own storm risk, the municipality made concessions, such as agreeing to provide sand for sandbags and tractors to clean drainage infrastructure. However, further action was limited, according to citizens: 'The civil servants that represent the municipality, it felt like they are pretty restrained by political decisions and budgets...'.

Discussion

This section highlights key patterns identified across interactions and summarises their implications for future research, policy and practice.

Proactive Citizen Engagement and Ownership

Although individual and community-based action were important, we found that municipalities rarely promote *proactive* (i.e. anticipatory) citizen engagement or ownership of adaptation. Citizen engagement is driven mainly by past hazard events. Attempts to align citizen behaviour with municipal-scale adaptation (e.g. building permits) are generally not communicated as linked to risk or adaptation, but enforced through governing-by-authority (Glaas *et al.*, 2015a) which does not always resonate well with citizens.

In contrast, climate mitigation has successfully created and sustained citizen engagement and ownership (WWF, 2015). The link between 'why' and 'how' messages is here made more explicit: 'soft' initiatives can indirectly increase acceptability of 'hard' measures affecting financial sacrifices and personal freedoms (SEPA, 2004). Collaborative approaches in adaptation can learn much from related research and practice (SEPA, 2004; Hoff and Gausset, 2015).

There are, however, key differences. The goals and outcomes of adaptation are more complex and context-specific than reducing greenhouse gas emissions (Klein *et al.*, 2007). Differences in hazard exposure and vulnerability require tailored adaptation information. Monitoring the success of adaptation (interaction) is more challenging as, like risk, adaptation outcomes are uncertain and intangible, and may only become evident at aggregated temporal and spatial scales (Tompkins and Eakin, 2012). Citizen involvement, however, can help to address these issues.

Equity

We found that citizen–municipality interactions often exclude or disadvantage certain groups and thus fail to address equity in adaptation. Interactions tended to involve people with a relatively high level of education, Swedish

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language skills, and administrative and legal knowledge. Socio-economically disadvantaged groups, who are generally more vulnerable to hazards (Cutter *et al.*, 2003; Wisner *et al.*, 2004), can be excluded. We found little evidence of systematic risk and vulnerability analyses of different population groups in the municipalities.

To provide equitable and effective adaptation incentives, a broad perspective is needed. Equity in adaptation means considering different population groups, their likelihood of influencing the adaptation process, and the distribution of adaptation outcomes (beneficial and detrimental) among them (Adger *et al.*, 2005; Brink *et al.*, 2016).

This study highlights the need to consider residents of diverse housing types and associated vulnerabilities (physical and non-physical). The few existing studies on citizen engagement in adaptation in Sweden focus mainly on home- or landowners (e.g. Blennow and Persson, 2009; Glaas *et al.*, 2015a,b). Our analysis, however, indicates that tenants are less likely to influence climate adaptation than homeowners. They may, as seen in Seved, become more vulnerable to greedy landlords (see Cutter *et al.*, 2003, the link between renting and vulnerability to environmental hazards). Affected groups may have inadequate shelter from heat, rain, floods and high winds and also risk health effects from damp and mould (Rocklöv *et al.*, 2008; Hermansson and Hansson, 2012). Municipal adaptation planning must therefore support and engage disadvantaged people, especially in urban regions such as Malmö, where increased overcrowding, rogue property managers and more substandard homes (e.g. basements) are expected from the current housing crisis (Sydsvenskan, 2016).

Equity in adaptation also relates to the normative dimension of responsibility (i.e. who *should* do what). Scholars have discussed whether citizen engagement is a process of 'responsibilisation' (i.e. transferring the burden of risk and responsibility to citizens) or 'empowerment' (e.g. Kuhlicke *et al.*, 2011). Our study indicates that climate change will produce responsibilisation, even without legislative changes. However, it also suggests that increased action by the public can benefit those most at risk. We thus argue that responsibilisation must go hand in hand with empowerment to support equitable adaptation. Citizens' efforts must be supported by useful and timely information, incentives and an equitable legal process.

Nature Based Approaches

Our results indicate that nature-based approaches may offer a better platform for citizen engagement than physical adaptation. In fact, we identified several barriers for citizen involvement in the latter. Scope for social interaction and mobilisation is limited, often depending on property ownership, capital and/or specific technical expertise. As in Söderkulla, municipalities may be unwilling to engage with citizens because of the high costs and inflexibility of physical adaptation.

Recent studies support this. First, nature-based approaches to adaptation provide added value in terms of aesthetics, recreation and social spaces, and are thus more publicly acceptable (Jones *et al.*, 2012; Brink *et al.*, 2016). Second, being less contingent on socioeconomic status, they can allow citizens to contribute both individually (e.g. private gardens) and collectively (urban farming groups; Krasny *et al.*, 2014; Schicklinski, 2015). Nature-based approaches can address *combinations* of more-or-less prioritized hazards (such as flooding and heatwaves) and link climate adaptation to mitigation and sustainability, topics more familiar to many municipalities and citizens (Jones *et al.*, 2012; Pelling *et al.*, 2015; European Commission, 2015).

Systematic Adaptation Mainstreaming

Our study found surprisingly few examples of planned collaboration for climate adaptation. Most were a by-product of other collaborations (e.g. climate mitigation, biodiversity) or involved contestation. Municipalities still struggle internally with adaptation, including departmental coordination, institutional learning and upscaling from individual (pilot) projects (Baird *et al.*, 2014; Hjerpe *et al.*, 2014; Boyd *et al.*, 2015; Wamsler, 2015).

This situation is related to the lack of institutional mainstreaming capacities. Adaptation mainstreaming refers to the consideration of adaptation in all sector policy and practice (so that it becomes routine or 'mainstream') to reduce climate risk and vulnerabilities (Wamsler, 2014; Wamsler and Pauleit, 2016). We show opportunities for including adaptation considerations in existing (participative) projects with other main purposes (e.g. property or coastal management); however, a lack of legal and institutional support may be turning most citizen-driven interactions into contestation. Generally, the officials interviewed saw citizen engagement as less cost-effective than city-

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level actions. Municipal capacity for capitalising on citizen input is often low, and providing tailored adaptation counselling to households may have unknown legal implications. Further research is needed on how adaptation mainstreaming can help municipalities derive greater benefit from citizen interactions.

Conclusions

Active involvement of citizens in local adaptation planning is promoted by research and policy, including the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Paris Agreement of 2014. However, few studies have assessed empirical interactions between citizens and municipalities in this respect. This study addresses this gap, presenting new knowledge on how municipalities (can) engage with citizens to address climate risk.

Our results show potential for more adaptation through citizen involvement. Municipal administrations in Sweden rarely plan to explicitly involve citizens in local climate change adaptation, which is probably generalizable to municipalities less advanced in adaptation than those studied.[6] The adaptation interactions identified emerged from other local processes and involved high- and low-risk citizens. In contrast to the literature (e.g. Conde and Lonsdale, 2015), only one of the 17 interactions purposely included a wide array of citizen groups. Most had positive adaptation outcomes (e.g. local risk-reduction, citizen awareness and institutional learning), showing that improved citizen knowledge about climate risks and responsibilities often leads to a focus on collective solutions. However, with no explicit adaptation interactions planned for, there is little support for systematic engagement, monitoring and learning. Citizen engagement in adaptation seems mainly driven by hazard occurrence.

Fostering collaboration with citizens – to support long-term adaptation and reduce the adaptation burden of those most at risk – requires the active consideration of four strategic issues:

1 *Proactive engagement and ownership* – the need to raise citizen awareness of their options and (legal) responsibilities regarding all phases of adaptation, and before hazards strike.
2 *Equity* – a broader view of the target audience is needed, reflecting different housing types, articulacy and level of trust in authorities, to ensure inclusion of the most-vulnerable.
3 *Nature-based approaches and solutions* are needed as platforms to foster citizen engagement in adaptation and wider societal change.
4 *Systematic adaptation mainstreaming* – supporting, and learning from, citizen–municipality interaction requires changes in municipal organisation, such as better departmental coordination, as part of adaptation mainstreaming.

The framework developed for this study was generally useful for analysing citizen–municipality interactions. In particular, the 'mapping' of adaptation interactions helped capture the often subtle integration of climate adaptation into local governance and the diversity of interactions. Based on the empirical application, we suggest nuancing the dimension of contestation–collaboration (under Interaction process, see Table 1) with the categories 'choice' and 'compliance'. This would capture less intensive interactions in which citizens freely choose ('choice') or are obliged, such as by law ('compliance'), to follow municipal recommendations.

Given the urgency of climate change, this study highlights the need to shift from simply generating more research on sustainability problems (including risk and vulnerability) to focusing on solutions, including the actors and relations that form the solution space. In this context, our framework provides a heuristic for systematising the ways in which municipalities can engage and collaborate with citizens, on a planned and/or spontaneous basis, regarding climate adaptation.

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[6]Similar shortcomings have been observed in the related areas of climate and energy (see Fenton and Gustafsson, 2015; Fenton *et al.*, 2016).

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