Routledge
Taylor & Francis Group

Journal of Environmental Policy & Planning

ISSN: 1523-908X (Print) 1522-7200 (Online) Journal homepage: http://www.tandfonline.com/loi/cjoe20

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To cite this article: Heleen Mees (2017) Local governments in the driving seat? A comparative analysis of public and private responsibilities for adaptation to climate change in European and North-American cities, Journal of Environmental Policy & Planning, 19:4, 374-390, DOI: 10.1080/1523908X.2016.1223540

To link to this article: http://dx.doi.org/10.1080/1523908X.2016.1223540

JOURNAL OF ENVIRONMENTAL POLICY & PLANNING, 2017
VOL. 19, NO. 4, 374–390
https://doi.org/10.1080/1523908X.2016.1223540

Local governments in the driving seat? A comparative analysis of public and private responsibilities for adaptation to climate change in European and North-American cities

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ABSTRACT
The division of responsibilities between public and private actors has become a key governance issue for adaptation to climate change in urban areas. This paper offers a systematic, comparative analysis of three empirical studies which analysed how and why responsibilities were divided between public and private actors for the governance of local urban climate adaptation. For 20 governance arrangements in European and North-American cities, the divisions of responsibilities and the underlying rationales of actors for those divisions were analysed and compared. Data were gathered through content analysis of over 100 policy documents, 97 in-depth interviews and 2 multi-stakeholder workshops. The comparative analysis reveals that local public authorities are the key actors, as they bear the majority of responsibilities for climate proofing their cities. In this stage of policy emergence, local authorities are clearly in the driving seat. It is envisaged that local public authorities need to more actively engage the different private actors such as citizens, civil society and businesses through governance networks along with the maturation of the policy field and the expected acceleration of climate impacts in the coming decades.

ARTICLE HISTORY
Received 16 March 2016
Accepted 25 July 2016

KEYWORDS
Cities; climate change adaptation; comparative case studies; governance; public and private responsibilities

1. Introduction

Urban areas are relatively vulnerable to the various impacts of climate change and embody large amounts of human, financial, infrastructural and cultural capital (Hunt & Watkiss, 2011; IPCC, 2013). In order to become less vulnerable to climate change, city governments in developed countries have started to plan for and take action on adaptation to climate change (Berrang-Ford, Ford, & Paterson, 2011; IPCC, 2013; Preston, Westaway, & Yuen, 2011). Besides city governments, the involvement of private actors such as citizens, businesses, project developers and housing associations will be critical for the planning and implementation of urban climate adaptation, since adaptation is also required on and around private property. Private involvement in climate adaptation may lead to the formation of new governance arrangements between public and private actors, resulting in a mixing and blurring of responsibilities.

In the climate adaptation literature, it is often argued that vague responsibilities form a considerable barrier to the governance of climate adaptation (e.g. Amundsen, Berglund, & Westskog, 2010; Carter, 2011; Nalau, Preston, & Maloney, 2015; Storbjörk, 2007; Termeer, Dewulf, & Breeman, 2013; Wamsler & Brink, 2014), which results in a stalemate and a lack of climate adaptation action (Fünfgeld, 2010; Urwin & Jordan, 2008; Williams et al., 2013). If vague responsibilities hamper climate adaptation, conversely a more explicit allocation of

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responsibilities could drive climate adaptation. It is suggested that the formal allocation of responsibilities facilitates and structures the collaboration between actors (Bulkeley et al., 2012), and gives legitimacy to the actors (Mostert, 2015). In addition to providing clarity of responsibilities, it also matters who takes on responsibilities (Mostert, 2015): it matters how the different public and private actors divide responsibilities for climate adaptation in their cities. Public actors, such as for instance urban planners, water managers and health officers, may decide to bear responsibility for adaptation action so that present and future generations are sufficiently protected against climate impacts (e.g. Osberghaus, Dannenberg, & Mennel, 2010; Stern, 2007). At the same time, public actors may overreact and cause inefficiencies, thereby illegitimately consuming public resources. If private actors take on certain responsibilities, adaptation action may become more efficient (e.g. Mendelsohn, 2006; Stern, 2007). However, they do so for their own merit and their actions may (unintentionally) harm others, resulting in legitimacy and fairness issues (e.g. Lemos & Agrawal, 2006; Paavola, 2008). This shows that each actor (group) may have different rationales, such as for instance effectiveness, efficiency, legitimacy and fairness, for taking on responsibilities, or for delegating or assuming responsibilities with other actor (group)s.

With the emergence of the policy field of climate adaptation, the issue of the division of responsibilities and the underlying rationales for this division have been conceptually explored by several scholars (e.g. Aakre & Rübbelke, 2010; Berkhout, 2005; Mendelsohn, 2006), but it remains to be seen how feasible those divisions of responsibilities are in reality. The number of empirical studies on the governance of adaptation and the division of responsibilities is gradually increasing, but those studies are conducted on a case-by-case basis (e.g. Amundsen et al., 2010; Fünfgeld, 2010; Lundqvist & Von Borgstede, 2008; Storbjörk, 2007; Wamsler & Brink, 2014). A systematic empirical analysis of governance arrangements for climate adaptation and their underlying rationales is lacking. This paper fills this gap by analysing *how* and *why* responsibilities are divided between public and private actors for climate adaptation in urban areas: by analysing which responsibilities are taken on by which actor(group)s, and by analysing the underlying rationales of actors for assuming responsibility or delegating responsibility to other actors. This is done through a comparative case-study research, consisting of three different case studies of important urban adaptation issues (EEA, 2012): (a) storm-water retention due to extreme rainfall, (b) water safety due to increased river discharge levels and sea-level rise and (c) heat prevention due to extreme heat events. In total, 20 governance arrangements between public and private actors in 15 European and Northern American cities were analysed and compared. The selected cities are located in the temperate climate zone where the nature and scale of the adaptation issues are assumed to be quite similar. The remainder of this paper is structured as follows. Section 2 gives a brief review of the environmental governance and adaptation literature on the division of public and private responsibilities, and explicates how the concepts of responsibility and rationales are operationalized for this study. Section 3 describes the research methods. Section 4 gives a brief overview of the results of the three individual case studies. Section 5 provides the comparative analysis and reflects on the key findings of the comparative analysis vis-à-vis the literature. Section 6 presents the overall conclusion and offers some reflections.

2. Public versus private responsibilities

Until the recent past, the classical conception has been that public issues are the exclusive responsibility of the public domain, that is, governmental bodies; and that private issues are the responsibility of the private domain, such as citizens and businesses (Dubbink, 2003). Since the rise of the neo-liberal agenda in the 1980s, this conception has gradually shifted. The automatic link between public issues and the public domain has become contested, and it is increasingly accepted that the responsibility for public issues can be shared with or even transferred to the private domain (Dubbink, 2003), as witnessed by a wave of privatization. This shift from public to private responsibilities for public issues has been extensively discussed in the governance literature. It is a main feature of the 'shift from government to governance' (e.g. Jordan, Wurzel, & Zito, 2005; Rhodes, 2007; Van Kersbergen & Waarden, 2004), in which power and authority are transferred from the government downwards and upwards to other levels of government, as well as outwards to private actors. This has resulted in the formation of new governance arrangements in which governments tend to have a steering rather than rowing role, although this is argued by some to be more of an ideal or normative

prescription than that it reflects empirical reality (Arts, 2014; Capano, Howlett, & Ramesh, 2015; Jordan et al., 2005). The concept of governance is vague. Many different definitions exist, but they all somehow refer to the development of governing styles in which the boundaries between and within public and private domains have become blurred (e.g. Rhodes, 2007; Stoker, 1998). Governance scholars have developed different views on how the responsibility for public issues should be shared among public and private actors (e.g. Dubbink, 2003; Kjær, 2004; Kooiman, 2002).

In the environmental governance literature, it has often been argued that the inherent uncertainties and complexities of environmental issues, as well as the ambiguities in terms of environmental goals and the dispersion of power among a diversity of actors necessitate a governance approach in which responsibilities for environmental issues are shared among relevant public and private actors (e.g. Driessen, Dieperink, van Laerhoven, Runhaar, & Vermeulen, 2012; Lemos & Agrawal, 2006; Meadowcroft, 2007). A similar line of reasoning has been observed among governance of climate adaptation scholars, who contend that the 'wickedness' of climate adaptation induces new governance arrangements other than traditional government approaches (e.g. Lorenzoni, Jones, & Turnpenny, 2007; Termeer et al., 2013; Vink et al., 2015). Climate adaptation is a relatively new environmental policy field, which may be open to new governance arrangements instead of the more traditional government. Therefore, this emerging policy field offers an interesting object to study whether the shift from government to governance is actually happening on the ground.

For climate adaptation, the division of responsibilities between public and private actors has been conceptually explored in recent years. It is often stated that governments as public actors have an important role to play in supporting and enabling adaptation to climate change at multiple governance levels (Urwin & Jordan, 2008). A common rationale for assuming responsibility with public actors concerns market failure. Market failure may lead to a lack of adaptation, counterproductive adaptation (think of the building in flood plains as a result of insurance coverage of house owners), or insufficient adaptation so that considerable climate risks remain. Governments can, for instance, mandate insurance to cover the damages of extreme events; or they can become insurance providers (Aakre & Rübbelke, 2010; Mendelsohn, 2006; Osberghaus et al., 2010). When uncertainty regarding climate change and its impacts on society induces market failure, governments may generate and distribute knowledge on climate impacts as public goods (Aakre & Rübbelke, 2010; Berkhout, 2005; Osberghaus et al., 2010; Stern, 2007), in situations where private actors do not have access to sufficient information on climate risks, impacts and solutions. Another rationale for public responsibility is related to national security: in many countries, the construction and maintenance of dikes and levees and emergency planning are regarded as the responsibility of governments (Aakre & Rübbelke, 2010; Berkhout, 2005; Heltberg, Siegel, & Jorgensen, 2009; Osberghaus et al., 2010). Another rationale for public responsibility is fairness, by correcting for the distributional consequences of climate impacts and of adaptation action (Bulkeley, Carmin, Castán Broto, & Edwards, 2013; Marino & Ribot, 2012). Climate impacts are rather localized, leading to different impacts on different groups and localities (e.g. Hess, Malilay, & Parkinson, 2008). Governments can compensate those groups and localities most affected by and vulnerable to climate impacts or adaptation measures (Berkhout, 2005; Osberghaus et al., 2010; Stern, 2007).

A common rationale for private responsibility in climate adaptation is that private action is regarded as more efficient and innovative (Berkhout, 2005; Mendelsohn, 2006; Stern, 2007). For instance, insurance companies can stimulate the uptake of adaptive building measures to reduce the impacts of floods to private buildings through differentiation of insurance fees, or discourage building in flood plains. Another widely proclaimed rationale for private responsibility is that it raises the support for and legitimacy of a policy. Public policy is more legitimate when it benefits from a participatory and deliberative process in which public and private actors ultimately share the responsibility (e.g. Dryzek, 2000; Smith, 2003). The view that the sharing of responsibilities increases legitimacy is also shared among many adaptation scholars (e.g. Adger et al., 2009; Paavola, 2008). The sharing of responsibilities among public and private stakeholders is said to promote joint fact-finding and social learning processes, thus raising the adaptive capacity of society to cope with climate change (Gupta et al., 2010; Pahl-Wostl, 2009).

2.1. Operationalizing responsibilities

The concept of responsibility is rather elusive; it can have different meanings and can be operationalized in different ways according to different philosophical and scientific approaches. It can relate to normative conceptions that discuss moral responsibility (e.g. Miller, 2007), as is, for instance, embedded in the concept of corporate social responsibility. In a legal sense, it relates to liability. In this paper, the concept of responsibility is used straightforward. It entails the instrumental approach of 'who does what' (cf. Mostert, 2015), operationalized as the different roles that actors can take on or assign to others across the four policy process stages of planning, implementation, evaluation and maintenance (adapted from Mees, Driessen, & Runhaar, 2012; for an overview of those roles, see Table 3). These four stages enable distinguishing different roles in different stages: for instance, knowledge creation can be undertaken by other actors than those responsible for agenda setting, implementation or policy monitoring. Different roles in those stages are easily traceable and resonate with the interviewed stakeholders. They therefore offer a practical heuristic for analysing responsibilities. In the case of urban climate adaptation, these roles can be taken on by public authorities/city governments (here referred to as public responsibility); by private actors such as, for instance, citizens, housing corporations, civil society groups and developers (here referred to as private responsibility); or by arrangements in which public and private actors share responsibility, such as public–private partnerships and policy networks, a form of self-governance in which public and private actors are involved in joint problem-solving and negotiation (Adam & Kriesi, 2007) (here referred to as public–private responsibility). This operationalization was used to analyse *how* responsibilities are divided.

2.2. Operationalizing rationales for responsibility divisions

Different arrangements between public and private actors are possible and promising for climate adaptation. Arrangements may vary between different governance scales, adaptation issues and also over time, depending on which rationale (e.g. effectiveness, efficiency and legitimacy) is considered most important for the division of responsibilities between public and private actors. For the analysis of the underlying rationales of responsibilities, the *why*, six rationales were discerned (see Table 1). Those rationales are adapted from Mees et al. (2012), and reflect similar sets of criteria for environmental policy analysis as presented by, that is, Adger et al. (2003) and Crabbé and Leroy (2008).

Table 1. Overview of rationales for public, private and public–private responsibilities.

Rationales	Description
Rule of law	Conformance to the regulations to which the adaptation issue is subject (Driessen & van Rijswick, 2011). National regulations and constitutions often assign certain duties of care to local public authorities concerning the liveability of the environment.
Fairness	A reasonable distribution of costs, benefits and responsibilities. Fairness often leads to public responsibilities, to safeguard an equitable distribution of burdens and benefits (e.g. Eakin & Lemos, 2006; Osberghaus et al., 2010; Paavola, 2008).
Securing adaptation action (effectiveness)	Attainment of predefined adaptation goals to secure the supply of sufficient levels of an adaptation good (as a specification of effectiveness). Market failure may result in under-adaptation (insufficient levels) or mal-adaptation (undesired forms of adaptation). It may motivate public actors to provide the adaptation good themselves, or to stimulate private adaptation action (e.g. Aakre & Rübbelke, 2010; Berkhout, 2005; Mendelsohn, 2006).
Efficiency	Optimum allocation of scarce resources by supplying an adaptation good at the lowest cost. According to economists, the private sector is generally more efficient in allocating scarce resources and in spurring innovations (e.g. Agrawala & Fankhauser, 2008). Efficiency is an important rationale for assuming responsibilities with private actors.
Legitimacy	Acceptance by stakeholders and society of certain adaptation goals/measures, and of the way in which decisions about these goals/measures are made (Bekkers & Edwards, 2007). Legitimacy often induces public–private arrangements through deliberative processes in which a wide range of stakeholders participate, and particularly those most affected (e.g. Adger et al., 2009).
Accountability	Clarity of responsibilities and transparency of information on the content and process of policy-making, so that actors can be held accountable. As a rationale, it tends to foster the creation of networks in which responsibilities are shared between public and private actors and in which communication, information and knowledge are exchanged (e.g. Bodin & Crona, 2009; Bogason & Musso, 2006).

3. Methods

A multiple, comparative case-study design was employed, to enable the analysis of a range of different governance arrangements. It has the potential to yield emerging patterns of relationships, similarities and differences within and across cases and provides greater basis for building and refining theories (Burnham, Gilland Lutz, Grant, & Layton-Henry, 2008; Campbell, 2003; Pickvance, 2001). It is therefore well suited to inform theory building for emerging policy fields such as climate adaptation (Vogel & Henstra, 2015). The setup of the research, as illustrated in Table 2, allowed a comparison among governance arrangements in different cities/countries for one and the same adaptation measure, as well as a comparison across three adaptation measures for three important urban climate adaptation issues. The decision to focus on the level of adaptation measures was informed by the dominant framing that adaptation is most important at the local scale, since this is the scale where concrete adaptation measures are implemented (Amundsen et al., 2010; Lundqvist & Von Borgstede, 2008; Nalau et al., 2015).

The three cases represent adaptation measures (see Table 2) that are not the default adaptation option, but innovative alternatives: green roofs instead of sewerage capacity extension; adaptive building instead of flood defences; and local heat prevention measures instead of a national heat response plan (Tennekes, Driessen, van Rijswick, & van Bree, 2014). The assumption is that these innovative measures may invoke a re-orientation of the responsibilities of both public and private actors. Furthermore, the cases were selected because they represent measures which deliver different degrees of public and private benefits, thus promoting different divisions of responsibilities between the relevant public and private sectors. Over the course of three years (2011–2013), the three case studies were executed.

The 15 cities in this study (see Table 2) were selected because they are leaders in the implementation of adaptation measures in their respective countries (Carter, 2011; CIRCLE, 2013; EEA, 2012; Mees & Driessen, 2011). They offer empirical material to study, since the level of implementation of adaptation is still rather low (e.g. Berrang-Ford et al., 2011; Bulkeley, 2013; Measham et al., 2011; Preston et al., 2011). Furthermore, they are selected for their locations in the temperate zone of Europe and North America, assuming that the nature and scale of the adaptation issues is quite similar. The city of Rotterdam in The Netherlands was used as a base-case unit for each of the three case studies, to allow a cross-issue comparison of adaptation measures within a similar institutional context.

Table 2. Overview of empirical research.

	Green roofs	Adaptive building	Heat prevention
Adaptation issue	Storm-water retention: surface water flooding from excessive rainfall	Water safety: flooding from high river discharge levels, storm surges and sea-level rise	Heat prevention: morbidity and mortality of vulnerable citizens from extreme heat events
Adaptation measure	Green roofs are roofs with vegetation (sedum, grass, moss, etc.). They help to store excessive rainfall and also reduce excessive heat build-up in houses, without consuming scarce space in dense urban areas	Adaptive building measures are applied to buildings to reduce the impact of a flood, such as the waterproof finishing of floors and walls inside the house, the elevation of electricity sockets, use of the ground floor for parking/storage, etc.	Heat stress prevention measures through health care, in particular care that stimulates the adjustment of individual behaviour (e.g. drinking more water, ventilating rooms, seeking cooler places and refraining from heavy exercise)
Base-case unit	Rotterdam	Rotterdam	Rotterdam
Comparative case units	Basel, Chicago, London, Stuttgart	Hamburg, Helsinki	Arnhem (workshop) 10 foreign cities (desk research): Chicago, Kassel, London, New York, Paris, Philadelphia, Rome, Stuttgart, Tatabanya and Toronto
Data collection methods	Policy documents analysis In-depth interviews stakeholders (n = 53) experts (n = 1)	Policy documents analysis In-depth interviews stakeholders (n = 36) experts (n = 4)	Policy documents analysis Two multi-stakeholder workshops (n = 63) One focus group (n = 14) Expert interviews (n = 3)

Multiple qualitative methods were used for the analysis of governance arrangements, such as the content analysis of over 100 policy documents, 97 in-depth interviews with public and private actors, stakeholders and experts, 2 interactive multi-stakeholder workshops, and 1 focus group with an affected population group. The document analysis yielded insights into the more formal divisions of responsibilities. This top-down view of the studied governance arrangements was complemented by a bottom-up view (cf. Urwin & Jordan, 2008) based on the experiences regarding 'who actually did what' of different stakeholder groups on the ground, derived from the interviews. The interviews also provided insights into the rationales of the different actor groups. Dominant rationales were deduced from the consolidated responses of the respondents as interpreted by the researcher. Verification and validation of results were obtained through a stakeholder workshop (for the green roof case) and through case-study reports sent out to several key respondents (for the other two cases).

First, the data derived from the policy documents and from the transcriptions of the interviews and workshops were categorized and clustered according to the operationalizations of responsibilities and rationales as described in Sections 2.2 and 2.3. Next, patterns of responsibility divisions and patterns of rationales were analysed on three levels: (a) on each governance arrangement per city; (b) on the sub-aggregate level of each of the three case studies (various governance arrangements of the selected cities) and (c) on the aggregate level of the total study (multiple arrangements across the three case studies).

4. Results

In this section, a brief account is given of the three individual case studies, followed in Section 5 by a more elaborate presentation and discussion of the comparative analysis across the three cases, the objective of this paper. The latter allows the analysis of common patterns in the division of responsibilities for urban climate adaptation.

4.1. Green roofs

The results from this case study of five forerunner cities (Basel, Chicago, London, Stuttgart and Rotterdam) convey that public responsibility is quite dominant, certainly in the early stages of the policy process. Local authorities take on roles for agenda setting, knowledge creation, policy formulation and strategy making in all five cities (see also Table 3, 1st column). The interviews revealed that the key rationale for doing so is that the local authorities thus secure that sufficient adaptation action (i.e. the installation of green roofs) is taken by citizens and businesses. If private action is not stimulated by the local authorities (for instance, through subsidies, communication or even mandatory requirements), citizens and businesses refrain from taking action, mainly because of an uncertain return on investment of green roofs (Niu, Clark, Zhou, & Adriaens, 2010). Another rationale for public responsibility, according to respondents, is the rule of law: local authorities have a duty of care for storm-water management on public grounds.

In all cities, private actors, such as residents, developers and housing associations, are responsible for the financing and installation of green roofs on privately owned buildings, and for the maintenance after installation. The key rationale for this private responsibility is efficiency, as emerged from the interviews. Also other private actors play a role in the implementation and maintenance stages. In particular, the green roof industry (suppliers) and horticulturists (installers) are very active, but sometimes also green roof experts and landscape architects. In two cities, Basel and London, a green roof expert/ecologist took on the role of agenda setting and became quite influential in the planning stage. Only in one city, Basel, a form of public–private responsibility was found, created for the development of green roof quality standards.

The main differences between the cities are observed when it comes to the evaluation stage of the policy process. Here, the public authorities in Basel and Stuttgart have extended responsibilities to include monitoring and evaluation, while this is not/hardly the case in the other three cities (Chicago, London and Rotterdam). Basel and Stuttgart have introduced a mandatory requirement for the installation of green roofs on new buildings with flat roofs. In order to maintain a fair and level playing field for the private sector (fairness rationale),

Table 3. Comparison of responsibilities across the three adaptation measures for all cities.

Stages	Roles	Green roofs for storm-water retention	Adaptive building for water safety	Health-care measures for heat prevention
Planning	Agenda setting	Public (all cities) Private (consultants, ecologists) (L&B) Public–private (industry association) (B only)	Public (Ha&He) Private (He only for floating houses) Public–private (R only)	Data not available
	Risk/vulnerability assessments	Public (all cities) Private (consultants, ecologists) (L&B)	Public (all cities)	Public (all cities)
	Initiation of policy	Public (all cities)	Public (Ha&He) Public–private (R only)	Public (all cities)
Implementation	Strategy making	Public (all cities)	Public (Ha&He) Public–private (R only)	Data not available
	Planning and coordination	Public (all cities)	Public (Ha&He) Public–private (R only)	Data not available
	Financing and implementation	Public (financial incentives) (all cities except L) Private (property owners) (all cities)	Public (public infrastructure) (all cities) Private (adaptive measures) (all cities)	Public–private (HC measures) (all cities) Public (early warning system) (all cities)
Evaluation	Monitoring	Public (tracking of installations) (all cities) Public (quality control) (B only) Private (product norms/ quality label) (B&S)	Public (during planning permission) (all cities) Private (housing corporation) (R only)	
	Enforcement	Public (B&S)	Not applicable	Not applicable
Maintenance	Maintenance of measure	Public (for public buildings only) (all cities) Private (property owners) (all cities)	Public (for public infrastructure only) (all cities) Private (property owners) (all cities)	Not applicable
	Risk communication	Not applicable	Public (Ha&R, no risk communication in He)	Public (all cities)
	Flood damage control	Not applicable	Public (flood evacuation planning) (all cities) Private (residents, Flutschutzgemeinschaften) (all cities)	Not applicable
	Recovery of damage	Not applicable	Private (residents) (all cities)	Not applicable

B = Basel, Ha = Hamburg, He = Helsinki, HC = health-care, L = London, R = Rotterdam, S = Stuttgart.

the local authorities have developed an active monitoring system during the planning process as well as after the construction of new buildings.

4.2. Adaptive building

The case study of adaptive building in un-embanked former harbour areas in three forerunner cities (Hamburg, Helsinki and Rotterdam) shows that also with this type of adaptation measure local public authorities bear the majority of responsibilities. In two of the three cities, Hamburg and Helsinki, public responsibility is witnessed in the stages of policy planning, policy evaluation and policy maintenance (see also Table 3, 2nd column). Like with green roofs, a key rationale for public authorities to take on those responsibilities is that they want to secure sufficient levels of adaptation action, as was pointed out by the respondents.

In Hamburg and Helsinki, the private sector is responsible for the financing and implementation of the adaptive building measures, for reasons of efficiency similar to the green roof case. This means that the project developers are responsible for raising the ground level of their building plots, and for taking adaptive measures on the ground floor (Hamburg), and for the development of a floating district (Helsinki). Nevertheless, the

public authorities set certain standards according to which those developers may build. In all three cities, the private sector, that is, the owners/residents of private property, is responsible for flood damage control and for the recovery after a flood. In Hamburg, private building owners are also responsible for flood preparation (closing flood doors, warning the residents and timely evacuation from the building). This private responsibility is formally stipulated in a special local law by the public authorities. Accordingly, the public authorities have taken on the responsibility for a timely and regular risk communication to owners and residents, so that those owners/residents remain aware of the flood risks and of their own responsibilities to manage those flood risks.

Only in the third city, Rotterdam (see Table 3, 2nd column, rows 3, 6, 8, 10), there is question of a joint public–private responsibility for policy planning and policy implementation. Here, a policy network has been formed between the relevant public and private actors: the public authority, the project developer, the harbour authority and the residents' organization. They have sealed their cooperation in a contractual agreement in which the responsibilities are carefully described. This means that all relevant public and private actors have a shared responsibility in the stages of policy planning and policy implementation. The key rationale for this public–private responsibility has been legitimacy concerns. First of all, because the local authority believed that all stakeholders should have equal access to, and influence on the major decisions regarding the adaptive building of the residential areas, and second, because the active involvement of stakeholders was believed to enhance the acceptance of the responsibilities, of the adaptive measures taken, and of the residual flood risk (after installation of the measures).

4.3. Heat prevention healthcare measures

Also in this third case study based on 12 cities in Europe and North America, the dominance of public responsibility is quite prominent. The roles of vulnerability assessment, of policy initiation, of the implementation of an early warning system and of risk communication are taken on by the health departments/agencies of the local public authorities (see also Table 3, 3rd column). The discussions during the interactive workshops revealed that the overriding rationales for taking on those responsibilities are the rule of law and fairness. The first is because the local authorities believe that they have a duty of care for the health of their citizens according to their respective national laws. Most local authorities regard heat prevention and particularly the protection of vulnerable citizens from heat stress to fall under this duty of care. The second rationale of fairness is because local authorities think it is not more than fair to take care of the weakest interests in society, in particular, when it comes to protecting the health of deprived citizens.

Private involvement in the form of joint public–private responsibilities becomes common in most cities in the implementation stage for the execution of various healthcare measures. Here, policy networks, oftentimes consisting of public health officers, general practitioners, elderly interest groups and civic communities, are formed to actively engage with particular citizen groups who are relatively vulnerable to heat stress and who have difficulty with taking responsibility for their own health (elderly, ill, socially deprived, homeless people, etc.). For instance, in Kassel, London and Toronto, those policy networks pool resources to actively contact elderly people over the telephone during heat waves. In Rome and Philadelphia, those networks have been used for home visits during heat waves. One important rationale for the creation of policy networks is to ensure that sufficient adaptation action is taken. This is because the different actors in the network can join their different resources and skills to actively approach specific vulnerable citizen groups. A second important rationale for public–private responsibility is efficiency. In some cases, existing networks, such as social neighbourhood teams, can be used to monitor and help vulnerable groups during a heatwave, simply by integrating such activities in their regular neighbourhood surveillance and assistance work.

Nevertheless, this case also shows that different rationales may compete and contradict with each other. Here, the rationales of securing sufficient adaptation action and fairness bite with the rationale of legitimacy. In the focus group discussion with elderly citizens, it appeared that the active targeting of vulnerable citizen groups, whether by public health agencies or by policy networks, can also be viewed as impeachment of one's privacy and as paternalism, which raises legitimacy concerns. This is because the division of responsibilities in health care is first and foremost viewed as a choice between individual and collective responsibility

(rather than between public and private responsibility, a distinction which surfaces only in the case of a collective responsibility).

5. Comparison and discussion of results

5.1. Comparison of responsibilities

The comparison of responsibilities across the three case studies is presented in Table 3. It shows that public responsibility is omnipresent and dominates throughout the policy process. Public authorities carry the responsibility for many roles and in almost every stage of the policy process, and across all three adaptation measures. Table 3 shows that particularly the policy-making and policy evaluation stages are dominated by public responsibilities. In the adaptation practice of those 20 frontrunner cities, the public authorities have taken on the roles of agenda setting, policy initiation, risk/vulnerability assessment, strategy making, policy coordination, policy monitoring and risk communication. By contrast, the roles of citizens, civil society and business actors such as project developers and housing associations are still relatively moderate. The involvement of private actors tends to be more dominant in the implementation and maintenance stages of the policy process. Involvement in the planning stage is quite rare. The existence of joint public–private responsibilities is even more modest. True public–private forms of responsibility across the policy process have been witnessed in the planning and implementation stage of the adaptive building case in Rotterdam, and in the implementation of healthcare measures for heat prevention. All in all, the roles of private actors, whether exclusively private or in public–private arrangements, are currently primarily contained to the financing, implementation and maintenance of measures.

The finding that local governments play such a pivotal role is consistent with earlier empirical research on a case-by-case basis, showing that local (urban) climate adaptation is predominantly government led (IPCC, 2013; Measham et al., 2011; Mees & Driessen, 2011). The finding that arrangements with public–private responsibilities in local climate adaptation are rather scarce is confirmed by other empirical work on climate governance (Bulkeley & Schroeder, 2012; Juhola & Westerhoff, 2011). Despite the 'wickedness' of climate adaptation, the shift from government to governance, as characterized by a shift from public to more private responsibilities, has not (yet) materialized. This research thus confirms the findings of recent studies showing that governments continue to play an important role in different fields of policy-making and at different levels of government (Capano et al., 2015), hinting that governance is rather a normative, idealized view rather than empirical reality. For instance, the lack of a profound shift towards governance has also been found in empirical research in older environmental policy fields such as transport policy (Hysing, 2009), forest conservation policy (Arts, 2014; Hysing, 2009), water supply policy (Lieberherr & Truffer, 2015), climate innovation policy (Jordan & Huitema, 2014), urban environmental policy (Driessen et al., 2012) and noise policy (Weber, 2013).

Even if local governments are so dominant, the results in Table 3 show a coexistence of public and private responsibilities across and within the four policy stages and for different roles in each case. Green roofs show dominant public responsibilities in the early stages and private responsibilities in the later stages of the policy process. Public authorities initiate and develop policy, and they delegate the implementation of measures to citizens and project developers or housing associations. The same combination is witnessed in the case of adaptive building measures in Hamburg and Helsinki, although in Rotterdam, a combination of public and shared public–private responsibilities is witnessed for adaptive building. The heat prevention measures case shows the combination of a public responsibility for some of the roles (mainly initiation and development of policy, and risk communication) with a shared public–private responsibility in the implementation of healthcare measures. This coexistence of different responsibilities for different roles/policy stages does not easily fit into the idealized classifications of governance arrangements, such as hierarchical governance, market governance and interactive governance (e.g. Driessen et al., 2012; Kjær, 2004; Thompson, Frances, Levacic, & Mitchell, 1991).

5.2. Comparison of rationales

Table 4 compares the underlying rationales for responsibilities across the three cases of adaptation measures. This comparison has been contained to the city of Rotterdam, so as to allow a comparison within the same institutional context. The comparison highlights that there are two strong rationales that explain the large extent of public responsibility. First, public authorities take on responsibility in order to secure that sufficient adaptation action takes place. The authorities assume that private actors do not take responsibility due to a lack of awareness and sense of urgency for climate risks, and due to market failure such as lack of knowledge, and a lack of private benefits and therefore long returns on investment. Second, the public authorities also tend to take on responsibility in following the rule of law. They simply believe that it is their duty as prescribed by law to care for the living environment and for the health of their citizens, and they therefore also feel the threat of liability for potential damages of climate impacts. The dominant rationale for assigning responsibilities to private actors, and for private actors to take on responsibility themselves, is efficiency. Private actors are assumed to drive costs down and to stimulate innovation. Cost reductions have, for instance, actually materialized in the cities of Basel and Stuttgart, where the green roof industry has been instrumental in decreasing the costs of green roof installations.

Some notable differences in rationales are observed among the three cases of adaptation measures in Rotterdam. For instance, securing adaptation action has been a key rationale for a large extent of public responsibilities in the cases of green roofs and adaptive building (see Table 4, 1st and 2nd column), but not for the case of heat stress prevention (3rd column). A likely explanation is that the sense of urgency for heat stress is still very low among the public authorities as well as the general public. In the Netherlands, heat waves are still quite rare, and local health officers and citizens are hardly aware of the risks of mortality and morbidity from heat stress (Wardekker, De Jong, Van Bree, Turkenburg, & Van der Sluijs, 2012). It is also quite remarkable that efficiency is not the dominant rationale for a private responsibility for the implementation of health-care measures in the heat prevention case, but that legitimacy and personal empowerment tend to take the overhand (see Table 4, 2nd part, 3rd column). As mentioned before, this is because personal empowerment to decide over one's own health is a sensitive issue for this type of health-related adaptation issue, certainly in the Netherlands.

In this paper, the issue of why responsibilities are divided as they are has been addressed by analysing the underlying rationales of actors. This inherently implies an actor-centred perspective, in which it is assumed that actors take decisions and act independently from the larger social structure to which they belong. It is not the intention here to instigate the famous agency-structure debate (Giddens, 1984). Nevertheless, it seems likely that decisions on responsibility divisions by actors are, at least to some extent, influenced by structural factors at the macro level, such as the national administrative tradition in which those actors function (Knill, 1998), or the dominant political ideology in their jurisdiction (for instance, the neo-liberal ideology which tends to favour a small government; Harvey, 2005). The analysis as presented in Table 4 was contained to the city of Rotterdam to neutralize these kinds of structural factors. Nevertheless, there are some notable differences in divisions of responsibilities *between* the different cities, which could be assumed to (at least partly) stem from different state traditions and their associated steering modes and interest intermediation (cf. Knill, 1998). For instance, in Basel and Stuttgart, a regulatory approach, that is, the introduction of a mandatory requirement, was taken to promote green roofs, which resulted in an extension of public responsibilities to the evaluation stage. This regulatory approach fits well with the Germanic administrative tradition, which is characterized by a legalistic and interventionist approach and a superior role of the state in society (Knill, 1998). Such a hierarchical approach does not completely fit with, for instance, the Dutch corporatist state tradition, which is characterized by 'an institutionalised negotiation process between a limited number of organised vested interests and the state' (Vink et al., 2015, p. 73).

Actors' decisions on responsibility divisions can also be influenced by structural factors at the micro level, such as by the existing routines of related policy fields (Howlett, 2009). In the case of climate adaptation, related policy fields are urban planning and water management. In one of the studies, it was found that the allocation of responsibilities was shaped by existing policy routines. In the green roof case in Rotterdam, the division of

Table 4. Comparison of rationales for public responsibilities in the city of Rotterdam.

Responsibility	Stages/roles	Green roofs for storm-water retention	Adaptive building for water safety	Health-care measures for heat prevention
Public	Plan: knowledge creation incl. risk/ vulnerability assessments	*Securing adaptation action*: uncertainty of costs and benefits of GRs leads to inaction of private actors	*Securing adaptation action*: private actors do not have the means to perform flood risk assessments	*Efficiency and rule of law*: the local authority is considered most efficient at gathering information from public and private organizations; duty of care of local authority for the health of its citizens (Dutch Health Act 2008)
Public	Plan: agenda setting/ initiation of policy	*Rule of law*: duty of care of the local authority for the prevention of surface water flooding on public grounds (Dutch Water Act 2008)	Not applicable (see public–private responsibility)	*Fairness and rule of law*: only the local authority can guard the interest of the weakest; duty of care of the local authority for the health of its citizens (Dutch Health Act 2008)
Public	Do: strategy making	*Efficiency*: choice of GRs as water retention measure because they are less costly than infrastructural measures and costs can be shared with the private sector	Not applicable (see public–private responsibility)	Data not available
Public	Do: financing and implementation	*Securing adaptation action*: high upfront installation costs discourage private actors; local authority offers a subsidy for installation of GRs	*Securing adaptation action*: local authority increases the protection level of the neighbourhood to a minimum security level through a partial levy	Not applicable (see public–private responsibility)
Public	Check: monitoring	*Fairness and accountability*: local authority monitors GR installations in line with granted subsidies		Not applicable
Public	Maintenance: risk communication	Not applicable	*Securing adaptation action*: local authority provides advice due to a lack of awareness for and sense of urgency of citizens	*Rule of law*: duty of care of the local authority for the health of its citizens (Dutch Health Act 2008)
Private	Do: financing and implementation	*Efficiency* GRs have many co-benefits that make them attractive for private property owners, thus providing economies of scope		*Legitimacy and personal empowerment* interventions by others are impingement on one's independence and easily viewed as paternalism
Private	Plan: knowledge creation incl. risk/ vulnerability assessments	*Efficiency* GR industry develops knowledge about the benefits of GRs to make them more efficient for property owners		Not applicable
Private	Check: monitoring	*Efficiency* GR industry creates voluntary quality norms for product attributes to create market demand		Not applicable
Private	Maintenance: of measure	*Efficiency* adequate maintenance reduces costs; GR industry often integrates maintenance in their contracts		Not applicable

(*Continued*)

Table 4. Continued.

Responsibility	Stages/roles	Green roofs for storm-water retention	Adaptive building for water safety	Health-care measures for heat prevention
Public–private	Plan: agenda setting/ initiation of policy	Not applicable	*Legitimacy*: All parties that are taking on responsibility for flood risk governance should be able to influence the decision-making process (throughput legitimacy); involvement of all parties encourages a wide endorsement of the arrangement (output legitimacy)	Not applicable
Public–private	Do: strategy making	Not applicable	*Legitimacy*: All parties that are taking on responsibility for flood risk governance should be able to influence the decision-making process (throughput legitimacy); involvement of all parties encourages a wide endorsement of the arrangement (output legitimacy)	Not applicable
Public–private	Do: financing and implementation	Not applicable		Securing adaptation action and efficiency neighbourhood teams of public and private actors can pull their collective resources together; ideally heat health concerns are integrated into existing teams to be cost effective

Notes: Not applicable: the role does not exist or the role is taken on by/allocated with other actors.
GR = Green roof.

responsibilities was influenced by habitual ways of working in the urban greening and urban water management departments. This corresponds with the well-known theory of path dependency (e.g. Howlett, 2009; Pierson, 2000), and resonates with other recent work on urban climate adaptation (Uittenbroek, Janssen-Jansen, Spit, Salet, & Runhaar, 2014). It shows that divisions of responsibilities are not always made in a deliberate and conscious way; instead, responsibilities are sometimes allocated quite routinely and automatically.

6. Conclusion

The results reveal that, in the emerging practice of local urban climate adaptation, there is an evident emphasis on public responsibilities borne by local public authorities, in any case in the early stages of the policy process. Private responsibilities borne by citizens and businesses only gain importance during the implementation and maintenance of climate adaptation measures. Local governments play a pivotal role and are clearly in the driving seat in the governance of adaptation to climate change. The research shows that there are two major rationales of public authorities for taking on various responsibilities. The first is to secure sufficient adaptation action. They do so to compensate for market failure resulting from a lack of awareness and sense of urgency of citizens and businesses, as well as a lack of information and of (perceived) private benefits available to citizens and businesses. The second rationale is that the public authorities perceive climate adaptation (in the form of rainwater retention on public ground, safety against flooding, avoidance of health problems from heat stress, etc.) to be part of their duty of care for the liveability of the city and for the health of their citizens.

Will local governments remain in the driving seat? There are at least two arguments why this may not be the case. First, to cope with the ever-rising adaptation challenge from the acceleration of climate change in the course of the twenty-first century, private responsibility will anyhow need to increase, since many adaptation measures can (only) be taken in and around private property. For instance, while sewage capacity cannot be endlessly expanded by public authorities, citizens can (re)develop more green space on their properties, disconnect their downspouts and install green roofs to increase rainwater storage capacity. Second, promising alternative divisions of responsibilities may currently be overlooked because oftentimes responsibilities are divided rather routinely and automatically. By taking conscious note of the six rationales discussed in this paper, alternative divisions of responsibility could be systematically explored, resulting in more informed decisions on public and/or private responsibilities.

One such alternative, a further increased public responsibility, however unlikely given the trend towards less government, may be provoked by a call for more fairness as a rationale for making informed decisions on responsibilities. Provided governments are democratic and well-functioning, an enhanced public responsibility is supposed to take better notice of differential vulnerabilities. Local governments would want to divide benefits and risks fairly according to the carrying capacities of different citizen groups. A potential downside is that this raises the burden of already overburdened local governments. It may also decrease efficiency since it does not involve society in crafting tailor-made solutions, and it may decrease legitimacy because private actors are not involved in the decisions that affect them.

Based on an increased weight of the efficiency rationale, a more realistic alternative could be for local authorities to delegate more responsibilities to businesses and citizens, in any case for taking climate adaptation measures on their properties and buildings. An increase in private responsibilities could entice a market for adaptation products. It could stimulate economies of scale and could evoke tailor-made solutions that are better geared towards specific local adaptation issues and specific demands of citizens, who can choose which adaptation products best suit their needs. The uncertainty on the return on investment and high upfront investments costs of some adaptation products, however, deter private actors from buying such products. Therefore, public authorities may need to encourage the private sector in adopting certain adaptation measures, for instance, by giving substantial financial incentives to producers or consumers of adaptation products, or by introducing certain performance standards for rainwater harvesting on private ground, for instance, or even by making certain measures mandatory (as the example of green roofs in Basel and Stuttgart has shown). A mandatory requirement for a specific adaptation measure may be chosen for its fairness rationale because it creates a level playing field and safeguards the interests of all citizens now and in the near future, but it may kill creativity and innovation and thus decrease efficiency.

Based on an increased importance of the rationale of legitimacy, a quite promising alternative would be to enhance public–private responsibilities, by creating collaborative arrangements in which the public authorities and relevant stakeholders co-decide and share responsibilities for adaptation planning and action. Such public–private governance networks could be endorsed by contractual agreements, in which the divisions of responsibilities, risks, costs and benefits are carefully laid down. Such networks can be developed on a case-by-case basis for specific adaptation issues in specific locations with specific relevant stakeholders. Thus, tailor-made solutions can be crafted, which also supports the efficiency rationale. For green roofs and other adaptive building measures, such networks can be built between the local authority and a project developer or housing association. For instance, the public authority and a private developer could develop a contractual agreement to implement green roofs for a specific large renovation project, and in return, the developer is allowed to build more houses. In this way, specific vulnerable areas can be targeted that are faced with storm-water flooding and a lack of (open) green space. Next to legitimacy, an advantage of such public–private arrangement is that it is likely to be quite effective in securing adaptation action for specific vulnerable neighbourhoods, and it is a fair arrangement because it puts the most vulnerable first. For the adaptation issue of heat stress, public–private networks are also very promising, because they can be fine-tuned towards different vulnerable target groups and different types of adaptation measures and different relevant partners. The governance arrangements found in the 10 foreign cities of the empirical case study provide examples of such arrangements. Think, for instance, of a contractual agreement between public health, certain healthcare professionals and

community members to proactively approach elderly people during a heat wave via home visits or telephone calls. In these examples, local governments are not in the driving seat anymore, but still have important roles in those networks such as initiating those networks, enabling dialogue among relevant stakeholders, and coordinating the planning and implementation of adaptation actions.

Other researchers are encouraged to continue with the analysis of governance arrangements along with the wider adoption and implementation of urban climate adaptation, in order to monitor whether and how a shift from public to public–private and private responsibilities occurs, and what kinds of roles are taken on by the different private actors.

Acknowledgements

I would like to thank the two anonymous reviewers for their helpful comments.

Disclosure statement

No potential conflict of interest was reported by the author.

Funding

This research was part of the Dutch Knowledge for Climate Research Programme, funded by the Dutch Ministry of Infrastructure and the Environment.

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