



FACILITATING LOCAL ADAPTIVE CAPACITY FOR URBAN HEAT

An exploratory study on municipal support for the development of adaptive capacity in local society for heat

Hester van der Sprong
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I hope you will enjoy reading!

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Abstract

Adaptation to heat in Dutch municipalities is a relatively under-addressed issue. However, projections from the Royal National Meteorological Institute and other studies indicate that in the future the occurrence of heat and heat waves will strongly increase. Especially in urban areas, the Urban Heat Island (UHI) effect will contribute to high temperatures. An important factor in improving the vulnerability of society to climate change impacts, is to strengthen its adaptive capacity. Institutions play a key role in the development of societal adaptive capacity, since an enabling institutional environment is perceived as an important precondition for the implementation of adaptation measures. The Adaptive Capacity Wheel (ACW) as developed by Gupta et al. (2010) is a framework to assess institutional adaptive capacity. The assumption behind the ACW is that facilitating for adaptive capacity will lead to more adaptation in society. In this research project, the relevance of each of the dimensions incorporated in the framework is valued for the issue of local urban heat, with the aim to contribute to theory on how municipal governments can facilitate the development of societal adaptive capacity for heat. These dimensions are variety, learning capacity, room for autonomous change, leadership, resources and fair governance. Within a qualitative research strategy, first a preliminary literature is conducted to identify relevant international insights on local heat adaptation and governance. Second, a single in-depth case study is conducted in the frontrunner municipality of Arnhem to assess the relevance of the ACW dimensions for heat. Third, an expert study was held using interviews to gain helicopter view insights. Results indicate that criteria within the process dimensions of variety, learning capacity and autonomous change are mainly important to focus on. Leadership and resources have a less prominent role, although still relevant. Fair governance criteria should be met by the municipal government in general, so do not specifically apply for heat. Since local adaptation is very context-specific, also for heat the particular relevance of dimensions depend on the specific situation.

Key words

Urban heat, institutional adaptive capacity, ACW, municipal governance, adaptation

Table of contents

1. Introduction	6
1.1 The need for local climate change adaptation	6
1.1.1 Global climate change.....	6
1.1.2 Climate change in the Netherlands.....	6
1.2 The issue of heat	7
1.3 Adaptive capacity and the importance of institutions.....	7
1.3.1 Vulnerability and adaptive capacity	7
1.3.2 The role of institutions.....	8
1.4 Previous research on local adaptation and adaptive capacity	8
1.5 Research conceptual design.....	9
1.5.1 Research objective	9
1.5.2 Research questions	9
1.5.3 Research framework.....	10
1.6 Relevance of the project	11
1.6.1 Scientific relevance	11
1.6.2 Societal relevance	11
1.7 Outline thesis	11
2. Theory: Institutional adaptive capacity and the Adaptive Capacity Wheel.....	12
2.1 Institutional adaptive capacity.....	12
2.2 The Adaptive Capacity Wheel.....	12
2.2.1 Variety.....	13
2.2.2 Learning capacity	14
2.2.3 Room for autonomous change	15
2.2.4 Leadership.....	16
2.2.5 Resources	16
2.2.6 Fair governance.....	17
2.3 Considerations with regards to the Adaptive Capacity Wheel	17
3. Research strategy.....	19
3.1 Literature study.....	19
3.1.1 Theory	19
3.1.2 Local heat adaptation	19
3.2 Empirical research.....	19
3.2.1 Case study and expert views.....	19
3.2.2 Data collection	20
3.2.3 Data analysis	22
4. Literature study.....	24
4.1 Heat and the dimensions of the Adaptive Capacity Wheel	24
4.1.1 Variety	24



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

4.1.2 Learning capacity	28
4.1.3 Room for autonomous change	29
4.1.4 Leadership.....	31
4.1.5 Resources	31
4.1.6 Fair governance.....	32
4.2 The relevance of the ACW dimensions	33
5. Case study	35
5.1 Case description: Arnhem	35
5.1.1 Background context Arnhem	35
5.1.2 Heat theme in Arnhem	36
5.1.3 Context of heat within the municipality of Arnhem	37
5.2 Heat and the dimensions of the Adaptive Capacity Wheel	38
5.2.1 Variety	38
5.2.2 Learning capacity	41
5.2.3 Room for autonomous change	43
5.2.4 Leadership.....	46
5.2.5 Resources	47
5.2.6 Fair governance.....	49
5.3 The relevance of the ACW dimensions	50
6. Expert study	53
6.1 Context of heat within Dutch municipalities	53
6.2 Heat and the dimensions of the Adaptive Capacity Wheel	53
6.2.1 Variety	55
6.2.2 Learning capacity	55
6.2.3 Room for autonomous change	57
6.2.4 Leadership.....	58
6.2.5 Resources	58
6.2.6 Fair governance.....	59
6.3 The relevance of the ACW dimensions	60
7. Conclusion.....	62
8. Discussion.....	65
8.1 Reflection on the research project	65
8.2. Theoretical implications of the results	66
8.3. Policy implications of the results	67
References	68
Appendix 1: Topic list and interview guide.....	74
Appendix 2: Dutch Adaptive Capacity Wheel	76

1. Introduction

1.1 The need for local climate change adaptation

1.1.1 Global climate change

Climate change is a universal and challenging issue. It brings unpredictable changes (Gupta et al., 2010) with high uncertainties. A certain degree of global climate change is unavoidable. In its fifth and most recent assessment report, the International Panel on Climate Change (IPCC) states that the warming of the climate system is unequivocal and that it is very likely that the climate will increasingly change, since people are still highly contributing to the causes (IPCC, 2013). In recent years, both scientists and policy-makers have acknowledged that besides mitigation, which aims to reduce the anthropogenic forcing of the climate (IPCC, 2007a), also adaptation is critical to address in order to cope with projected changes (Betsill & Bulkeley, 2007; UNDP, 2010; EC, 2014). The IPCC (2007a) defines adaptation as *“adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.”* Ideally, adaptation is developed without compromising economic, social and environmental sustainability (Doria et al., 2009). Adaptation is important to address on all governance levels, from international to the local scale (Urwin & Jordan, 2008). The local level is especially relevant since adaptation is, due to the nature of climate change, place- and context-specific (IPCC, 2014). In addition, the scale of effect of adaptation measures is local to regional (Füssel, 2007).

1.1.2 Climate change in the Netherlands

Although climate change is a global issue, the expected effects differ per region (IPCC, 2014). Amongst the projected climate change effects for the Netherlands are an increase in temperature, more droughts, an increase in frequency of heatwaves and more intense and extreme weather (KNMI, 2014). At the same time, without new adjustments the Dutch ability to adapt to climate risks will decline due to an increase in complexity in social systems (PBL, 2015). On a national level, the government has invested in knowledge programs to identify and map climate risks and gain insights in adaptation solutions. The Delta program on flooding and water issues is recently updated and a National Adaptation Strategy is to be finished in 2016 (ibid.). On the local level, climate adaptation is mostly still in the first phases of development. Although it could be expected that municipalities give higher priority to adaptation than to mitigation, based on their relatively small contributions to overall climate forcing but high vulnerability to climate impacts, in practice this is often not yet the case (Betsill & Bulkeley, 2007). On an international scale, local governments are starting to respond by developing climate adaptation policies (Vogel & Henstra, 2015). The Netherlands has a comprehensive history of coping with water issues, so especially other non-water related impacts are less dealt with in practice. However, these impacts do become more urgent as observations of more frequent heat indicate. The summer of 2003 in Europe is listed as one of the hottest summers in over 500 years, with average temperatures peaking around 3.5 °C above normal temperatures (Patz et al., 2005), causing up to 70,000 estimated deaths (Robine et al., 2008). The heat wave in the summer of 2006 caused about a thousand heat-related deaths in the Netherlands (Kleerekoper et al., 2012). Also temperature records of the past few years in the Netherlands show that temperatures are already increasing, as is shown in Table 1.1. In the summer of 2014, many local temperature records were broken and the summer of 2015 was characterized by a strongly varying temperature course, peaking during a heat wave in July with temperatures even at night varying between 20 °C and 25 °C (KNMI, 2015). These events make clear that heat is an issue that has to be addressed.



Record	Long term records (1971-2000)	Long term records (1981-2010)	2013	2014	2015
Average temperature in summer in °C	16,6	17,0	17,5	17,4	17,5
Average temperature in June in °C	15,2	15,6	15,3	16,2	15,6
Average temperature in July in °C	17,4	17,9	19,2	19,4	16,1
Average temperature in August in °C	17,2	17,5	18,1	16,1	18,5
Heat wave on national scale*	-	-	21 July – 27 July	No	30 June – 5 July
Highest local measured temperature in °C	-	-	36,9	36,5	38,2
Number of tropical days (30,0 °C or higher)	3	4	6	2	5
Number of summer days (25,0 °C or higher)	18	21	24	20	28
Number of warm days (20,0 °C or higher)	54	60	65	64	62

* A heat wave consists of minimal five consecutive summer days of which three are tropical days.

Table 1.1. Summer temperature records of the Netherlands. Data retrieved from KNMI (2015). Registration at De Bilt.

1.2 The issue of heat

Regarding the issue of heat, a gap is evident between the high level of urgency expressed by scientists (Wardekker et al., 2012) and the lack of urgency present in Dutch society (Runhaar et al., 2008). Molenaar et al. (2015) claim that public awareness and institutional infrastructure to cope with adverse human thermal comfort are minimal in the Netherlands. However, it is necessary to adopt adequate measures to prevent adverse health effects for vulnerable groups. Studies show that heat stress is a leading cause of weather-related human mortality and morbidity (Luber & McGeehin, 2008). It can cause illnesses such as heat syncope, cardiovascular stress, thermal exhaustion and heat strokes. In addition, the World Health Organization has warned for formation of ground-level ozone in urban areas stimulated by high temperatures, which could lead to several lung diseases (Kleerekoper et al., 2012). High temperatures also contribute to a higher number of food-borne infectious diseases in Europe, such as salmonellosis (Patz et al., 2005). Due to climate change, the average temperature in the Netherlands is projected to increase, causing a worsening of human thermal comfort. Calculated for the 2006 KNMI climate scenarios, the amount of hours with heat stress in the Netherlands will substantially increase in the future, up to a doubling (Molenaar et al., 2015). In urban areas heat will form the largest problem, since many urban areas show the so-called urban heat island effect (UHI effect). It is the phenomenon that temperatures in cities are higher than that of the surrounding rural environment (Kleerekoper et al., 2015). The UHI effect results from lowered evaporative cooling, increased heat storage and sensible heat flux caused by the lowered vegetation cover, increased impervious cover and complex surfaces of the cityscape (Patz et al., 2005).

1.3 Adaptive capacity and the importance of institutions

1.3.1 Vulnerability and adaptive capacity

In order to address effects of climate change, such as increased heat, it is important to consider the vulnerability of social and environmental systems towards the impacts of such change. Vulnerability is the degree to which a system is susceptible to adverse effects of climate change and is unable to cope with them (IPCC, 2007b). Vulnerability is made out of three dimensions: exposure, sensitivity and adaptive capacity (Polsky et al., 2007). Exposure components are the characteristics of the stressor and the entities which are under stress. Components of the sensitivity dimension characterize direct effects of the stresses. A social or environmental system is vulnerable to the effects of global change, if it is exposed and sensitive to these effects and when it possesses limited ability for adaptation to them. Systems are less vulnerable to threats if they are less exposed or sensitive, or if there is stronger adaptive capacity (ibid.). Adaptive capacity can be enhanced in order to make society better able to adapt to the impacts of climate change, which is especially important



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

on the local level. Adaptive capacity is a universally positive system property, meaning that a system simply cannot have too much of it and it is never described in negative terms. It is translatable to decision makers through its emphasis on governance, institutions, and management (Engle, 2011). There is not a single definition of adaptive capacity, as it is used for varying applications in the scientific literature (Krellenberg et al., 2015). The concept is defined by the Millennium Ecosystem Assessment (2006) and the IPCC (2007) as *“the ability of a system to adjust to climate change - including climate variability and extremes - to moderate potential damages, to take advantage of opportunities, or to cope with the consequences”*. It is the ability to prepare in advance for stresses and changes and to adjust, respond and adapt to the effects caused by the stress associated with future climate change (Berman et al., 2012). Adaptive capacity is an important enabler of adaptation to future climate change. Adaptive capacity is unique in that it is a property that human beings can shape and manipulate, it affects both social and ecological systems (Engle, 2011).

1.3.2 The role of institutions

From a governance perspective, it is interesting to focus on the role of institutions within the process of society to develop more adaptive capacity. Institutions are expected to be able to incorporate new information in the future and to become proactive and progressive in the challenge of dealing with climate change impacts (Gupta et al., 2010). They are important, since an enabling institutional environment is perceived as an important precondition for the implementation of measures for adaptation (Adger et al., 2005; Finan & Nelson, 2009; Mandryk et al., 2015; Berman et al., 2012). The concept of institutions is defined by scholars in varying descriptions. The Institutional Dimension of Global Environmental Change (IDGEC) concept perceives institutions as a set of rights, rules, and decision making procedures that give rise to social practices, assign roles to the various participants within these practices and guide interactions among the occupants of these roles (Young, 2007). These rules and roles are both formal and informal, visible and latent, conscious and unconscious (Arts, 2006). An institution is no synonym for an organization. Mandryk et al. (2015) add that the functions of institutions can be listed as to provide structure, build expectations and set both incentives as well as constraints for human interactions. Institutions both restrict the possibilities of people to act and they enable them to do so (Sharpf, 1997).

1.4 Previous research on local adaptation and adaptive capacity

Adaptive capacity is strongly shaped by governance and response mechanisms of socio-economic, political and institutional backgrounds (Eakin & Lemos, 2010). However, the institutional context of adaptation is not clear with regards to responsibilities and mandates to facilitate adaptation (ibid.). Research on the impact of heat stress in the Netherlands suggests that there are extensive public responsibilities throughout the policy process, but implementation requires public-private co-operation (Mees et al., 2014). So far, research on local level governance for Dutch climate adaptation has focused on very diverse issues, e.g. the knowledge production for adaptation governance (Hegger & Dieperink, 2014; Termeer et al., 2014; Vink et al., 2013) and responsibilities of different actors and governance arrangements (Mees et al., 2012; Bergsma et al., 2012; Mees et al., 2013). In recent years, an increasing number of theoretical frameworks for adaptation research has been published, though relatively few analyses are made on the likely adaptation rates of potential adaptation measures (Mandryk et al., 2015). It is relevant to inquire how this process could be improved. In general, more insights into the adaptation process in terms of when, why and under what conditions climate adaptation occurs are necessary to further develop adaptation practices (Willems & Baumert, 2003). There have been case studies on how institutions can stimulate adaptive capacity (Gupta et al., 2010; Gupta et al., 2015), indicating general dimensions that institutions have to develop in order to do so. These studies have mainly been focused on water management. However, for the issue of heat, additional research is needed for further specification, as reflection on previous case studies has indicated that the relative importance of the dimensions vary for specific issues (Grothmann et al., 2013).



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

In this project, a preliminary review of literature on local governance and heat adaptation is combined with an empirical study to refine the theoretical understanding of relevant dimensions to enhance adaptive capacity specifically for local heat. This is based on the concept of institutional adaptive capacity - the adaptive capacity for institutions - defined by Gupta et al. (2010, p. 461) as “the inherent characteristics of institutions that empower social actors to respond to short and long-term impacts either through planned measures or through allowing and encouraging creative responses from society both *ex ante* and *ex post*”. Gupta et al. (2010) have translated these characteristics into assessment tool the Adaptive Capacity Wheel (ACW), consisting of six dimensions and twenty-two criteria which are further discussed in the next chapter. Their research is the compiled result from a comprehensive literature review, which was needed since there was no clear connection between local climate adaptation and the supporting role of institutions or sustainability governance. The assumption behind this framework is that when institutions possess more of the identified dimensions, they are better able to stimulate adaptive capacity in society (Mandryk et al., 2015).

1.5 Research conceptual design

1.5.1 Research objective

A key issue to address is how to increase the adaptive capacity of society (Termeer et al., 2011), which also applies to local heat adaptation. Since adaptive capacity for coping with heat is a relatively new topic, the objective of this research project is to contribute to the academic theory on how local governments can enhance the development of societal adaptive capacity for heat. Local governments are considered to be key actors in climate adaptation policy development (Vogel & Henstra, 2015). The capacity to adapt and the distribution of that capacity critically determine the degree of success of adaptation (Adger et al., 2005). For the purpose of this research, municipal governments are perceived as institutions since they fit the above description of institutions by being closely linked with shaping the set of rights, rules, and decision making procedures for social practices, the assigning of roles to the various participants and the guiding of interactions. Although the assessment tool by Gupta et al. (2010) is meant to assess institutions, no assessment is made in this project as the aim is to refine the ACW for local heat for future assessments on this theme.

The research project can be qualified as both theoretical-oriented and practice-oriented. The analysis is to result in a refinement of the theory on enabling institutional dimensions, specifically for local governments and for the issue of heat. A tailor made framework is created for municipal governments that can be used in practice to support the development of adaptive capacity in society.

1.5.2 Research questions

Resulting from the research objective, the main research question is formulated as follows:

Which dimensions of institutional adaptive capacity of municipal governments are most relevant for local heat adaptation in the Netherlands?

Several sub questions are formulated in order to answer the main research question. First, the general framework of the ACW as developed by Gupta et al. (2010) for institutional adaptive capacity needs to be refined for local level governments and specifically for the issue of heat, based on literature on local governance and heat adaptation.

- ❖ *Which dimensions of institutional adaptive capacity are most relevant for stimulating societal adaptive capacity for municipal governments with regards to heat stress according to literature?*

This produces a more accurate theoretical framework. Second, it can be further refined by an empirical validation through a case study in a Dutch municipality.



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

- ❖ *To what extent are the dimensions of institutional adaptive capacity for heat present in the case study municipal government of Arnhem and how are they developed?*
- ❖ *Which dimensions of institutional adaptive capacity are most relevant for stimulating societal adaptive capacity for municipal governments with regards to heat stress according social actors in practice?*

Insights can be gained on the perceived relevance of each of the dimensions in practice, along with the perceived importance in relation to each other. Third, the feedback of experts in this field on the results of the first steps can be used to strengthen the accuracy of the case study results.

- ❖ *Which dimensions of institutional adaptive capacity are most relevant for stimulating societal adaptive capacity for municipal governments with regards to heat according to Dutch experts?*

The study is directed at an urban municipality, due to the UHI effect. Furthermore, the issue of heat is mainly framed as a direct health issue, although decreased labor productivity and changing energy consumption patterns are among the expected effects as well, for example due to higher use of air-conditioning. High temperature health impacts in the Netherlands include heat-related mortality, cardiovascular problems, respiratory problems, dehydration, stress and sleep disturbance (Wardekker et al., 2012). Municipal governments are part of a larger local institutional context. In this project, the focus lies on the institutional role of a government since governments are often perceived as leading actors within relatively new policy domains. As the study of Mees et al. (2014) indicated, stakeholders vision large responsibilities for public actors on the issue of heat stress. However, it needs to be kept in mind that the study has an exploratory nature.

1.5.3 Research framework

The steps that are taken to provide an answer to the central research question as discussed above are translated into the research framework as presented in Figure 1.1.

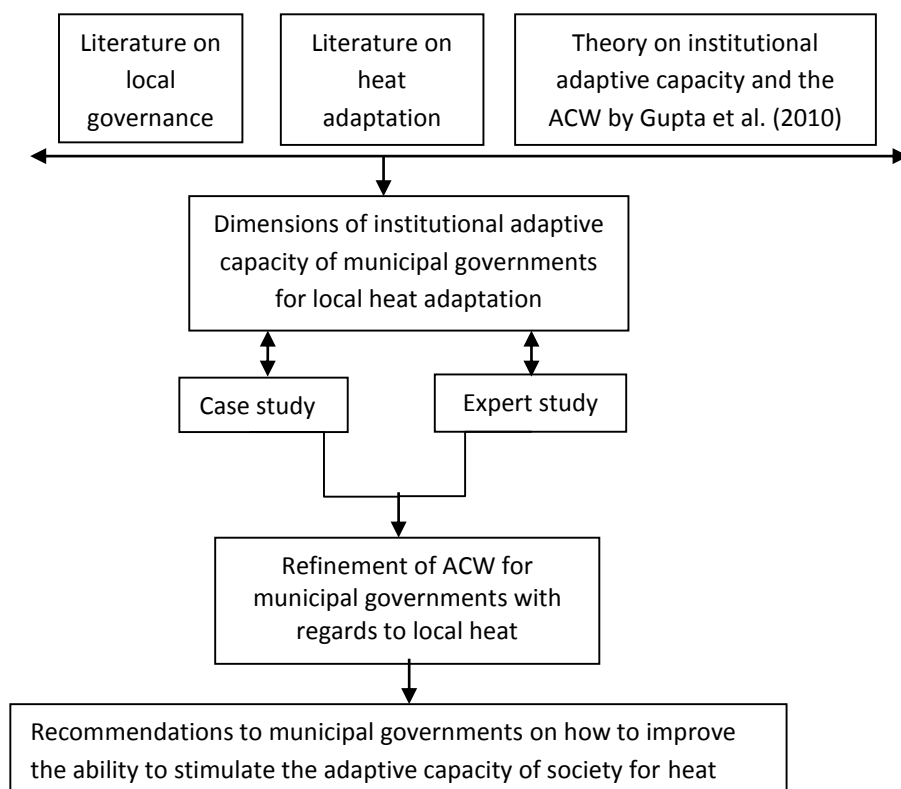


Figure 1.1. The research framework.



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

The insights generated from this research can be used to make advising recommendations to municipalities that are in the first phases of planning for local heat adaptation, which is considered to be a shared task between public and private actors.

1.6 Relevance of the project

1.6.1 Scientific relevance

Adaptive capacity is a relatively under-researched topic within the sustainability science (Engle, 2011). However, building adaptive capacity for climate change at the local level has been subject of some recent international research (Glaas et al., 2010). The theoretical background of this research project is built on the concept of institutional adaptive capacity as introduced by Gupta et al. (2010). Although this concept and the accompanying ACW is based on a broad theoretical background, more empirical research strengthens its value. In more recent years some studies have been conducted with the ACW, yet literature remains limited especially regarding the specific issue of heat. The insights will contribute to the academic field of local climate adaptation on what the role of municipal governments in particular could be in developing the capacity of society to deal with the relatively new (at least for the Netherlands) climate challenge of heat.

1.6.2 Societal relevance

As mentioned in the opening paragraph, climate change is complex and uncertain, and it will pose new challenges to the institutions of society (Gupta et al., 2015). Although institutions are in general more associated with long term developments, it is necessary to respond more quickly to these challenges. Dutch national adaptation policies have framed climate adaptation as a local problem that should be addressed as such (ibid.). Therefore, it is important for municipal governments to be able to encourage society to have strong adaptive capacity. Important to note is that it is not claimed that when institutions facilitate adaptive capacity, it is in all cases used by society to develop more local climate adaptation (Gupta et al., 2010). However, strong adaptive capacity is presumed to lead to a reduction of vulnerability of the social system (Polsky et al., 2007), which means that people are less affected by the impacts of climate change in a negative manner. In case of doing nothing, a lack of adaptation will occur (PBL, 2015). The societal relevance of this research project lies in its attempt to contribute to the process of change towards more local climate adaptation. All people that are negatively affected by the climate impact of increased heat could potentially profit from better facilitation for adaptive capacity. In case of heat stress, these are mainly people that are extra vulnerable to heat such as elderly and sick people (Koppe et al., 2004).

1.7 Outline thesis

In the following chapter, the concept of institutional adaptive capacity is further discussed and the dimensions of the ACW are explained. The third chapter elaborates on the qualitative research strategy and the method of data collection. Subsequently in chapter four, the results of the literature study are presented including a first refinement of the ACW. In the fifth chapter, a case description is presented and the results of the case study of Arnhem are discussed, including a second refinement of the ACW. Thereafter, chapter six contains the results of expert study and a third refinement of the ACW. Subsequently, in the conclusion chapter gained insights are presented. In the final chapter, a reflection on the study results is given and the limitations with regards to this project are discussed.

2. Theory: Institutional adaptive capacity and the Adaptive Capacity Wheel

In this chapter, the concept of institutional adaptive capacity is further explained and the Adaptive Capacity Wheel (ACW) and its six dimensions are discussed. Critical notes on the framework from both Gupta et al. (2010) and other scholars are addressed.

2.1 Institutional adaptive capacity

Institutions reflect both formal governmental processes as well as formal and informal social engagement patterns. Governance bridges the gap between state and civil society and uses interdependencies in society in decision making procedures (Gupta et al. 2008). Governance institutions are those institutions concerned with policy making and policy implementation (Termeer et al., 2012). According to Gupta et al. (2010), the response to climate change calls for institutions that promote the adaptive capacity of society. As mentioned in the introduction, they define the adaptive capacity of institutions as the characteristics of institutions that empower social actors to respond to impacts of climate change through planned measures or through allowing and encouraging creative responses from society. These combined characteristics is further referred as institutional adaptive capacity. Gupta et al. (2010) have adopted the definition of institutions as provided by the Institutional Dimension of Global Environmental Change (IDGEC) concept and explain that institutional adaptive capacity encompasses two elements. First, it includes the characteristics of institutions that enable society to cope with climate change. The characteristics referred to are both formal and informal and could be rules, norms and beliefs. Society exist of individuals, organizations and networks. Second, the concept includes the degree to which such institutions allow and encourage actors to change these institutions to cope with climate change if necessary. Institutions should allow actors to learn from new insights and experiences in order to flexibly and creatively manage the expected and unexpected, while maintaining a degree of their institutional identity (ibid.). Institutions are developed by humans and they can be changed by humans, although in general they embed a degree of resistance to change (Gupta et al. 2008).

2.2 The Adaptive Capacity Wheel

Gupta et al. (2010) have created the ACW as assessment framework for analyzing the adaptive capacity fostered by institutions. It focuses on institutional change, which is considered crucial for climate change adaptation, with a specific focus on qualitative aspects of adaptive capacity (Gupta et al., 2015). The ACW contains six dimensions and twenty-two indicators, which aim to help academics and social actors to assess institutions on their ability to stimulate society's adaptive capacity and to determine whether and how those institutions have to be changed (Gupta et al., 2010). These dimensions are: variety, learning capacity, room for autonomous change, leadership, resources and fair governance (ibid.). A distinction can be made between variety, learning capacity and room for autonomous as core qualities, whereas leadership, resources and fair governance are supporting qualities (Termeer et al., 2012). The ACW is presented in Figure 2.1.

The dimensions of variety, learning capacity and room for autonomous change can be seen as integral to adaptive capacity and are therefore considered to be the basic qualities (Gupta et al., 2008). They refer to the potential inherent flexibility of institutions (Munaretto & Klostermann, 2011).

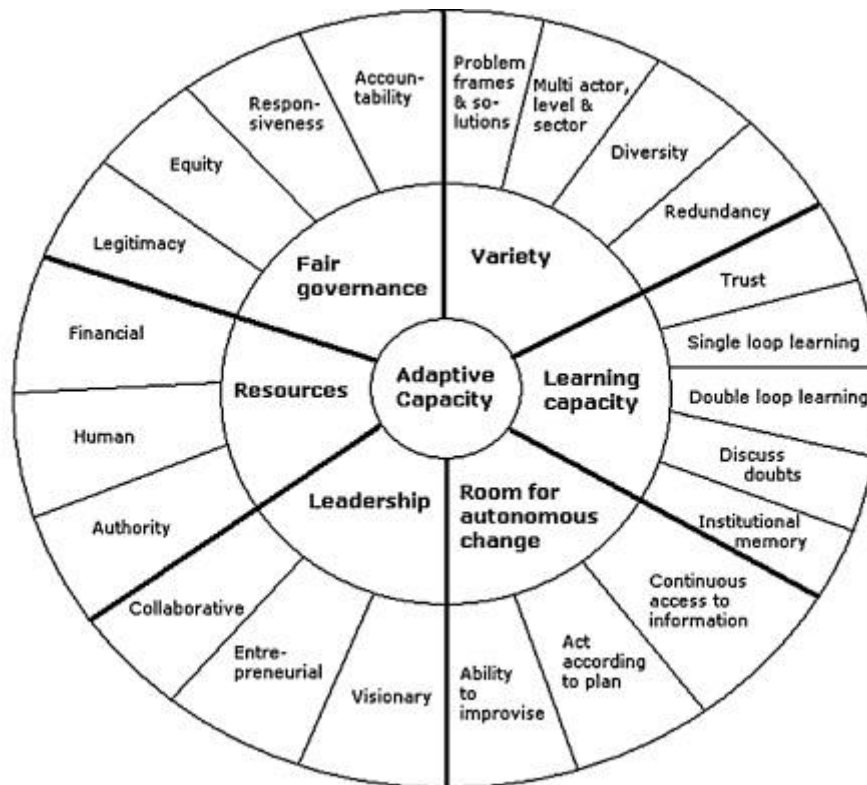


Figure 2.1. The Adaptive Capacity Wheel by Gupta et al. (2010).

2.2.1 Variety

Climate change can be categorized as an unstructured problem, which embeds diverse interests and perspectives (Gupta et al., 2008). Not enough is known to develop an optimal and fixed climate adaptation strategy in advance, suggesting it would be a better strategy to deal with the manifold uncertainties and ambiguities by allowing and encouraging variety (Termeer et al., 2012). The dimension of variety entails that there is no single ideal approach, policy strategy or set of solutions for climate change issues and problems are therefore best be dealt with within a framework of multiple discourses and solutions, where multiple actors intervene at multiple levels of governance (Gupta et al., 2010). Adaptation is made up of actions throughout society, including individuals, groups and governments, operating at different spatial and societal scales (Adger et al., 2005). By encouraging social ingenuity from many people, the opportunity is created to continuously generate tailor-made solutions for complex problems in different economic, cultural and political settings (Gupta et al., 2008). More complex and diverse governance regimes have a higher adaptive capacity (Pahl-Wostl, 2009). By applying variety, a system becomes more capable to envisage future expected and unexpected climate impacts by having a range of adaptive or proactive strategies, measures and instruments at its disposition (Gupta et al., 2008). Variety in solutions and opinions is important for being able to react to different kinds of impact of climate change, many of which are unpredictable. Variety can be improved, for example, by involving different kinds of social actors in decision-making processes (Munaretto & Klostermann, 2011). Variety calls for fostering diversity, understanding complication, creating redundancy and resisting the tendency towards simplification and reductionism. Redundancy implies that 'more of the same' should be created, for example multiple emergency exits in a building, which is not cost-effective due to overlap but provides more certainty (Gupta et al., 2008; Gupta et al., 2010). Gupta et al. (2008) refer to the 'law' of requisite variety by Conant and Ashby (1970), that states that the variety within a system at least as great must be as the environmental variety against which it attempts to adjust itself. The overall of discourses will lead to a variety of ideas that match the variety of environmental changes (Nooteboom, 2006, p. 236). In order to develop adaptive capacity, a diversity of responses must be created and the solution that



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

fits the reality best will become dominant (ibid.). However, the suggested optimum level of variety is very difficult to operationalize in practice (Gupta et al., 2008). Also, one has to be careful not to let variety either paralyze action, imply suffocating consensus or lead to negotiated nonsense (Termeer, 2007).

According to Gupta et al. (2010), institutions possess the dimension of variety, in case it allows for a variety of problem frames and solutions, allows and facilitates a multi-actor, multi-level and multi-sector involvement, promotes diversity to create tailor-made policies and allows redundancy in the short-term to promote the best long-term solutions. A definition for each of the criteria of variety is presented in Table 2.1.

Dimension of variety	
Criteria	Definition
Variety of problem frames	Room for multiple frames of references, opinions and problem definitions
Multi-actor, multi-level and multi-sector	Involvement of different actors, levels and sectors in the governance process
Diversity of solutions	Availability of a wide range of different policy options to tackle a problem
Redundancy or duplication	Presence of overlapping measures and back-up systems; not cost-effective

Table 2.1. Criteria and their definitions of the dimension of variety by Gupta et al. (2010).

2.2.2 Learning capacity

Due to the uncertainties about how to anticipate climate effects, it is often argued that adaptation should be considered a learning process (Termeer et al., 2012). Learning means that based on experiences, a greater understanding of a situation can be achieved (Gupta et al., 2008). Change is conceptualized as social and societal learning that proceeds in a stepwise fashion moving from single to double loop learning, in which informal networks are considered to play a key role (Pahl-Wostl, 2009). Learning capacity is needed for developing new responses to climate change impacts in which single loop learning means learning how to do things better, while double-loop learning means learning how to do better things (Munaretto & Klostermann, 2011). Adaptive institutions encourage actors to learn and provide the possibility and willingness to learn from each other across boundaries (Termeer et al., 2012). Adaptive capacity can be enhanced if society is permitted to improve routines based on past experiences and also to critically question socially embedded ideologies, frames, assumptions, knowledge claims, roles, rules and procedures that dominate problem solving (Gupta et al., 2008; Gupta et al., 2010). Since climate change adaptation is a relatively upcoming phenomenon, it is to be expected that strategies will conflict with dominant values, routines and problem perceptions and solutions (Termeer et al., 2012). Important is a focus on listening and discussing doubts rather than defending views (ibid.). The challenging of basic assumptions could lead to new patterns of problem solving that become institutionalized (Gupta et al., 2008). Mechanisms that inhibit genuine learning include defensive routines in organizations. These are for instance actions, policies and practices, that prevent participants from experiencing embarrassment or threat, which overprotect current frames. However, redesigning the institution context often requires ‘unlearning’ of past insights, routines, fears and reflexes (ibid.).

According to Gupta et al. (2010), an institution demonstrates learning capacity if it encourages actors to build mutual respect and trust among each other, adopt both single and double loop learning to improve routines and challenge norms and basic assumptions, discusses doubts by being open towards uncertainties and stimulates institutional memory by monitoring and evaluation processes. A definition for each of the criteria of learning capacity is presented in Table 2.2.

Dimension of learning capacity

Criteria	Definition
Trust	Presence of institutional patterns that promote mutual respect and trust
Single loop learning	Ability of institutional patterns to learn from past experiences and improve their routines
Double loop learning	Evidence of changes in assumptions underlying institutional patterns
Discuss doubts	Institutional openness towards uncertainties
Institutional memory	Institutional provision of monitoring and evaluation processes of policy experiences

Table 2.2. Criteria and their definitions of the dimension of learning capacity by Gupta et al. (2010).

2.2.3 Room for autonomous change

This dimension focuses on whether institutions allow social actors to seize opportunities when they present themselves and autonomously adjust their behavior in response to environmental change (Gupta et al., 2010). It includes the capacity of self-organization by actors involved and a governmental system in which authorities are not solely responsible for climate adaptation (Termeer et al., 2012). Room for autonomous change is needed because top-down responses can be slow and generally lack detailed local knowledge (Munaretto & Klostermann, 2011). Institutions can enable social actors by providing them with the necessary means and information (Gupta et al., 2010). Actions associated with building adaptive capacity could include communicating climate change information, building awareness of potential impacts, maintaining well-being of people, protecting property or land, maintaining economic growth and exploiting new opportunities (Adger et al., 2005). Room for autonomous change entails the ability of an institution to permit social actors to either explicitly or implicitly adjust their behavior in response to an existing or potential threat (Gupta et al., 2008). Learning does not include actual behavioral changes, therefore this dimension focuses on the ability of institutions to enable social actors to adjust to changing circumstances (ibid.). Room for autonomous change is particularly important on lower levels of governance, and especially during a crisis or disaster. Gupta et al. (2010) refer to a study by Tierney et al. (2006) that shows that immediate relief efforts are undertaken by ‘victims’ and not by the government or aid organizations. Termeer et al. (2012) point out that planned governmental intervention to deal with potential future threats could damage structures and practices of autonomous change in society.

According to Gupta et al. (2010), institutions have to ensure that actors have access to information, provide plans and scripts for action and have the capacity to improvise. Adaptive institutions enhance the self-help function of society by encouraging experimentation with, and responding to everyday contingencies, breakdowns and opportunities (Gupta et al., 2008). A definition for each of the criteria of room for autonomous change is presented in Table 2.3.

Dimension of room for autonomous change

Criteria	Definition
Continuous access to information	Accessibility of data within institutional memory and early warning systems to individuals
Act according to plan	Increasing the ability of individuals to act by providing plans and scripts for action, especially in case of disasters
Capacity to improvise	Increasing the capacity of individuals to self-organize and innovate; foster social capital

Table 2.3. Criteria and their definitions of the dimension of room for autonomous change by Gupta et al. (2010).



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

The dimensions of leadership, resources and fair governance are contextual variables which contribute to adaptive capacity indirectly. They are considered to be key features of institutions in general (Gupta et al., 2008). Leadership and resources are needed in every change process, for climate change this is not different (Munaretto & Klostermann, 2011).

2.2.4 Leadership

Leadership is a driver for change, by showing a direction and inspiring other actors to follow or even use coercive measures to promote conformity to a particular development path (Gupta et al., 2008). Within this dimension, the focus is on how institutions encourage leaders to emerge and reshape the institutions themselves. Leadership thus does not refer to actors in society in this case (ibid.). Literature refers to varying sorts of entrepreneurs and leaders (Gupta et al., 2010). In the ACW, three types of leadership are distinguished that are crucial for promoting and realizing adaptation strategies (Termeer et al., 2012). Visionary or directional leaders are able to convince others of the necessity to anticipate for potential future threats. Entrepreneurial leaders are good at gaining access to the necessary resources for realizing desired projects. Collaborative leaders bridge different interests and build coalitions (ibid.). In democratic countries, leadership needs to be legitimate and inspirational which rules out coercive types of leadership (Gupta et al., 2010). In the case of an unstructured problem such as climate change, leadership is needed that promotes variety and creativity; dialogue and understanding, regardless of the uncertainties (Gupta et al., 2008). In practice, leadership may possibly conflict with ‘variety’, but real good leaders should be able to provide room for variety (Gupta et al., 2010).

According to Gupta et al. (2010), institutions should encourage the rise of visionary leadership, entrepreneurial leadership or leadership by example and collaborative leadership. All three types of leadership are required to adapt to the potential effects of climate change with success (Termeer et al., 2012). A definition for each of the criteria of leadership is presented in Table 2.4.

Dimension of leadership	
Criteria	Definition
Visionary	Room for long-term visions and reformist leaders
Entrepreneurial	Room for leaders that stimulate actions and undertakings; leadership by example
Collaborative	Room for leaders who encourage collaboration between different actors; adaptive co-management

Table 2.4. Criteria and their definitions of the dimension of leadership by Gupta et al. (2010).

2.2.5 Resources

As acknowledged in a wide range of literature, the ability to generate resources is a large influence on how effective an organization or institution can be (Gupta et al., 2010). Institutional norms and rules should enable the generation of sufficient resources providing that social actors implementing these rules are able to do so (Gupta et al., 2008). The ability to generate resources determines to a certain extent how effective an institution is. Such resources can include financial, social, human, legal, and technological resources (ibid.). Financial resources are necessary to develop, experiment with and realize adaptation strategies. Educated and qualified people referred to as human resources, and authority are required to take and implement decisions (Termeer et al., 2012).

According to Gupta et al. (2010), institutions should possess mandate or involve actors with decision power, have human resources and have economic resources. A definition for each of the criteria of resources is presented in Table 2.5.

Dimension of resources

Criteria	Definition
Authority	Provision of accepted or legitimate forms of power; whether or not institutional rules are embedded in constitutional laws
Human resources	Availability of expertise, knowledge and human labor
Financial resources	Availability of financial resources to support policy measures and financial incentives

Table 2.5. Criteria and their definitions of the dimension of resources by Gupta et al. (2010).

2.2.6 Fair governance

The dimension of fair governance entails a characteristic institutions must possess themselves (Gupta et al., 2010). The nature of governance determines what room is given to social actors to participate creatively in the problem solving process (Gupta et al., 2008). Such governance may have differing levels of legality, legitimacy, equity and accountability which are considered to be important preconditions for many of the other discussed criteria (ibid.). The term ‘fair governance’ instead of good governance implies the preference of redundancy over cost-effectiveness (Termeer et al., 2012). However, fairness also implies that resources should not be squandered indiscriminately. A balance needs to be found between effectiveness and efficiency, as innovation processes are often inefficient but should be allowed to be in order to take place at all, since a maximum efficiency is only possible in a stable environment (Gupta et al., 2010). Institutions should allow for and encourage legitimate policy processes, protect basic rights and equity, and be responsive, transparent and accountable (Termeer et al., 2012). Legitimacy is likely to be triggered through extreme events that raise the consciousness of climate change within policy-making and hence giving legitimacy for governmental action (Adger et al., 2005). Equity is partly important for instrumental reasons since developments which are inequitable undermine the potential for welfare gains in the future and if legitimacy is lacking, there is less chance of full implementation (ibid.).

According to Gupta et al. (2010), institutions establish fair governance when they allow and encourage legitimate policy-making, equitable policy processes and outcomes, responsiveness and accountability. A definition for each of the criteria of fair governance is presented in Table 2.6.

Dimension of fair governance

Criteria	Definition
Legitimacy	Whether there is public support for a specific institution
Equity	Whether or not institutional rules are fair
Responsiveness	Whether or not institutional patterns show response to society
Accountability	Whether or not institutional patterns provide accountability procedures

Table 2.6. Criteria and their definitions of the dimension of fair governance by Gupta et al. (2010).

2.3 Considerations with regards to the Adaptive Capacity Wheel

The ACW reflects on the quality of institutions and is designed to assess whether specific parts of institutions such as laws and policy plans can promote the adaptive capacity of society (Klostermann et al., 2010; Krellenberg et al., 2014). It is of a generic nature, clarifying whether an institution enables or inhibits adaptation to change and serves as a tool meant for a first diagnosis that could lead to the creation of a discussion about the adaptive capacity of institutions (Klostermann et al., 2010). The incorporated dimensions and criteria of the ACW are rooted in a detailed literature review of various authors who have worked on differing approaches to the issue of institutional adaptive capacity, resulting in a meta-analysis of various approaches and combining it into a single

analytical tool capable of determining several dimensions (Krellenberg et al., 2014).

Gupta et al. (2010) discuss some notes that have to be considered for the ACW. They stress that there “can be tensions between the criteria; for example, between diversity of solutions and act according to plan”, or between “strong diversity of solutions and entrepreneurial leadership” (p.465). They add that the fulfilment of some criteria may make others less relevant, for example “if there is sufficient entrepreneurial leadership, this may displace the need for visionary leadership” (p.465). If applied to a specific sector, some dimensions and criteria may be more important than others so that they “are not additive in the sense that values given to each criterion can be simply added” (p.465). An analysis by Grothmann et al. (2013) confirms that equal weighting of criteria can be very misleading, since some criteria might require a high value in certain cases as a prerequisite for adaptation. This makes it interesting to consider the relative importance of each of the dimensions for specific problems.

Biesbroek et al. (2013) state that the list of possible barriers emerge in developing and implementing climate change adaptation strategies is seemingly endless. While most barriers are not specific to climate change adaptation, the most frequently reported barriers relate to the institutional and social dimensions of adaptation (ibid.). Grothmann et al. (2013) argue that there are six main challenges for adaptation to climate change: (1) uncertainties, (2) lack of knowledge (3) adaptation mainstreaming (4) policy integration (5) equity and (6) adaptation barriers. They conclude that all of these challenges are explicitly or implicitly addressed in the ACW Gupta et al. (2010). Grothmann et al (2013) have extended the ACW by two dimensions due to a lack of an important social factor. Adaptation motivation as a dimension refers to actors' motivation to realize, support and promote adaptation to climate, while the dimension of adaptation belief refers to actors' perceptions of realizability and effectiveness of adaptation measures. However, Gupta et al. (2010) clearly explain that the ACW is created as an institutional assessment tool with the inclusion of some social factors, in order to discuss strengths and weaknesses of governance institutions (Termeer et al., 2012). A growing body of international research on enhancing local adaptive capacity and facilitating local adaptation considers political support or political will to be vital in starting to facilitate local climate adaptation (Hjerpe et al., 2015). The ACW by Gupta et al. (2010) also does not address technology and infrastructure, and thus cannot be mistaken for an analytic tool to assess the adaptive capacities of social systems comprehensively (Grothmann et al., 2013)

An assessment using the ACW shows only the inherent capacity of an institution to respond to change, not the degree of effectiveness of the regime (Klostermann et al., 2010). The ACW is used for analysis in a hand full of studies so far in its original form or with some alterations to fit the research (Munaretto & Klostermann, 2011; León-Camacho et al., 2014). The ACW dimensions provide room for many aspects to take into account, since giving a limitative list would be against the very idea of adaptive capacity. When using it for assessment, scoring institutions must also remain flexible and open-ended (Klostermann et al., 2010). Munaretto & Klostermann (2011) state they found the ACW method useful as a tool to create a balanced overview of relevant aspects and provides a clear indication where one could start with improving the institutional system. It proves to be especially a strong communication tool. However, they also conclude that due to the set of twenty-two criteria applying the ACW is time-consuming to process. Also, interpretation of the criteria was not always straightforward since the method is not always too explicit on how to interpret the different criteria. Application to a single formal institution such as a statutory scheme is relatively easy, but when used in a broader case study, the richness of the data can lead to confusion about which of the data should be used (ibid.).

3. Research strategy

In order to achieve the research objective, a literature study and empirical research have been conducted. In this chapter, the research strategy including the methods of data collection and data analysis are discussed. Within the research project, a triangulation of methods (Verschuren & Doorewaard, 2010) has been employed by analyzing literature, conducting interviews and analyze observations to strengthen the accuracy of results. Limitations with regards to the chosen research strategy are discussed in the separate discussion chapter of this thesis.

3.1 Literature study

3.1.1 Theory

The article of Gupta et al. (2010) is the theoretical basis of this thesis, as discussed in chapter two. The literature on which the criteria of the ACW are based has been scanned to construct a more specific explanation of the definitions. Gupta et al. (2010) has been cited in GoogleScholar 268 times. These titles have been scanned in order to identify possible relevant articles to complement insights on institutional adaptive capacity and the Adaptive Capacity Wheel. In addition, within the citations is searched on the term 'ACW' to find articles that specifically refer to the ACW in their abstracts, which indicate the relevance of the framework in those studies. This has led to the identification of ten articles, that all have been analyzed for on relevant insights with regards to the ACW.

3.1.2 Local heat adaptation

Subsequently, a literature study was conducted in order to identify which dimensions of institutional adaptive capacity are most important to focus on for municipal governments. This study is conducted with the use of data sources Google Scholar and Scopus, accessible through the library of Utrecht University. The main search terms that were used are linked to heat adaptation literature and local climate governance literature. Table 3.1 provides a short overview of used terms.

Search term	AND	AND
Heat	adaptation	Climate, health, events, spatial, governance, risk
Urban	adaptation	Climate, heat, local

Table 3.1. Overview of main search terms in data sources.

However, a snowball method was mainly employed to include the most relevant literature in the study, as the search terms also resulted in articles that were less relevant for this research. Therefore, references in articles that proved to be relevant to other literature have been searched specifically. The insights of a total of thirty-eight articles have been incorporated in the literature study. International research provides an indication of relevant elements of the governance approach for the heat issue and these have been categorized within the dimensions of the ACW.

3.2 Empirical research

3.2.1 Case study and expert views

Subsequently, a single in-depth case study is conducted with the aim to provide specified insights in the heat adaptation issue with regards to facilitating local adaptive capacity. The case study is complemented with expert views. A case study design is chosen, since it enables the researcher to go in-depth and gain profound and full insights into a process, confined in time and space (Verschuren & Doorewaard, 2010). The main characteristic of a case study is that it attempts to examine a contemporary phenomenon in its real-life context, while the boundaries are not clearly evident (Yin, 1981). In this project, the case study is used to gather experiences from practice to validate which dimensions of institutional adaptive capacity are important, so the ACW can be specified for local heat adaptation. Furthermore, experts in the field of local climate adaptation are

**Facilitating local adaptive capacity for urban heat**

Master thesis Hester van der Sprong

asked for their professional opinion on the issue to make the results of the research more generalizable. In the empirical part, qualitative methods will be used. Qualitative data contains rich, 'real' and holistic information and is considered to reduce the researchers' narrowness and bias (Miles, 1979).

The case selection has been done by strategic sampling. Three main criteria were listed. First, heat must be a risk, for example identified by heat islands with the expectation of an increase in the future. Second, heat must be acknowledged by the municipal board as a problem. Third, efforts are being made to plan and encourage heat adaptation in the city. It is important to keep in mind that the focus of the study is on the municipal ability to facilitate and stimulate adaptive capacity of society, not whether municipalities adopt measures themselves. Since heat is a more urgent issue in urban areas, these were the focus of the sampling. The selection group of urban municipalities in the Netherlands was limited due to the limited level of policy maturing of the study topic. The municipality of Arnhem was selected, based on identification of heat as a risk by maps of the Klimaateffectatlas (KRA, 2016) and recent research by Klimaatverbond Nederland (2015) in which the municipality has indicated heat is amongst the highly expected climate change effects in the city. The municipality has been involved in multiple studies on the topic of urban heat over the past years, making her a front runner on the issue and the theme has been included in a visionary policy document named 'Structuurvisie 2020-2040' (Gemeente Arnhem, 2012).

3.2.2 Data collection

Prior to the case study, a desk top research was used to gain further insights in the local context of Arnhem and relevant social actors for heat. Due to the available time for this project (30 EC), eleven qualitative interviews are held with social actors in Arnhem and four qualitative interviews with experts/professionals on this specific topic. The selection of interviewees was based on the identification of relevant actors, such as the municipal government, housing corporations, care facilities working with vulnerable people, urban inhabitants, spatial professionals and green platforms. Interviews are the main source of information. In this study, the social actors are considered to be informants, while the experts are considered to be both informants and suppliers of knowledge (Verschuren & Doorewaard, 2010). These interviewees of the case study are presented in Table 3.2. The interviews are held in February and March 2016.

Social actor	Description	Interview date	Access source
Municipal government	Policy adviser public space, water and ecology. Municipal contact person urban heat research in Arnhem.	February 17, 2016 Office in Arnhem	Interview in person
Housing corporation 1	Sustainability project manager at a housing corporation active in Arnhem, with more than 23.000 rental units spread in several municipalities.	February 19, 2016 Office in Arnhem	Interview in person
Governmental organization	Adviser human habitat at governmental organization in close collaboration with the municipal government. Focus on health and safety of people, specific theme of heat.	February 19, 2016 Office in Arnhem	Interview in person
Care facility 1	Board member of care facility for elderly people in Arnhem, which is also active in professional home care.	February 22, 2016 Office in Arnhem	Interview in person
Education center 1	Coordinator education at center for development of a sustainable society in Arnhem, with a main focus on green.	February 23, 2016 Office in Arnhem	Interview in person

**Facilitating local adaptive capacity for urban heat**

Master thesis Hester van der Sprong

Education center 2	Manager urban information center and platform for green initiatives in Arnhem. Provides support with knowledge, experience and human labor.	February 25, 2016 Office in Arnhem	Interview in person
Housing corporation 2	Manager property at a housing corporation mainly active in Arnhem, with more than 13.000 rental houses in the municipality.	February 26, 2016 Office in Arnhem	Interview in person
Neighborhood association	Member of active neighborhood association both on green and health themes, in a neighborhood in an identified hot spot area.	March 19, 2016 Coffee place in Arnhem	Interview in person
Landscape architect 1	Landscape architect at small firm involved with the exploration of possible solutions for heat in Arnhem, and a project on the return of a historical stream to the center.	March 23, 2016 Office in Arnhem	Interview in person
Landscape architect 2	Landscape architect in Arnhem and self-employed entrepreneur, active in new societal initiatives for more urban green and collaboration among social actors.	March 23, 2006 Office in Arnhem	Interview in person (unstructured)
Care facility 2	Recently retired manager at home care facility active in the region of Arnhem, with professional experience with governance for the issue of heat.	March 23, 2016 Residential place in Dieren	Interview in person

Table 3.2. Overview interviewees case study Arnhem.

In the case study, two participatory observations at scheduled meetings planned by the actors themselves are included, in order to complement the data gathered through the interviews. A short description of these meetings are presented in Table 3.3.

Meeting	Description	Date
Observation 1 (meeting on green)	Meeting between representatives of the municipal government of Arnhem and inhabitants of the city center. Purpose is to discuss where and how in the center of Arnhem green can be realized by collaboration and shared investment. N = 12.	February 17, 2016 Private location, Arnhem
Observation 2 (meeting on heat)	Heat meeting organized by the municipal government of Arnhem and an external organization for local governments, health organizations and other interested professionals. Purpose is to inform participants on the increasing urgency of the heat issue in the Netherlands and to discuss possible local approaches to address heat. Focus on Arnhem. N = 34.	March 31, 2016 City hall, Arnhem

Table 3.3. Overview of participatory observations.

In Table 3.4, an overview is presented of the experts included in the expert study. They have been selected based on their professional experience with the heat theme. A mix is made between researchers and policy involved experts. The expert interviews are held to improve the validity and generalization of the case study results, by providing a helicopter view on urban heat adaptation.

Expert	Description	Interview date	Access source
Expert 1	Project manager at Dutch NGO, active on local climate adaptation issues. Involved in projects to raise (governmental) awareness and stimulate action with regards to the heat issue.	March 9, 2016 -	Interview by telephone
Expert 2	Researcher at Wageningen University and Research center. Expertise on urban climate planning, landscape architecture and climate responsive design. Several publications on urban heat issue.	March 11, 2016 Office in Wageningen	Interview in person
Expert 3	Researcher at the Hogeschool van Amsterdam with expertise on climate resilient cities. Several studies on heat stress and the urban heat island effect in Dutch municipalities.	March 18, 2016 Office in Amsterdam	Interview in person
Expert 4	Researcher and policy analyst at the Dutch Environmental Assessment Agency (PBL) and Utrecht University. Expertise on environmental health governance, health and spatial planning and climate proof cities.	March 21, 2016 Office in Utrecht	Interview in person

Table 3.4. Overview interviewees expert study.

In order to gain full and overall insights related to adaptive capacity for heat, interviews have an open nature and are semi-structured. It is the intention that all dimensions are discussed, however, it is desired that interviewees are able to discuss the most relevant issues in their opinions without strong steering directions by the researcher. All interviewees were initially contacted by email, which included a short outline of the research project and the interview request, and in most cases subsequently by phone. Participants are interviewed in their natural context. On average, an interview lasted between sixty and ninety minutes. Not all interviewees have been identified prior to the interview phase, since some actors were recommended by other actors during interviews, leading to a snowball effect. Snowball sampling can be used when the researcher knows little about what comes across in a certain case or when the population of interest is not clearly known (Verschuren & Doorewaard, 2010). On request of some interviewees, the interviewees were anonymized and categorized. This does not pose a problem for the research project because of the exploratory nature of the research, the background information of the interviewees provides enough information about the context in which pronouncements are made. The interviews were held in Dutch and all participants have been asked for permission to record the interview.

The interview guide has been included in the Appendix of this thesis. Due to the rather broad scope of the ACW and limited interview time, the focus of the interviews has been adjusted to the elements the participant brought up, since the aim of the research is partly to identify which elements are most important according to social actors. Also, in general the main focus of the questions is within the categories the literature study shows to be most relevant.

3.2.3 Data analysis

The recorded interviews have been fully transcribed and relevant data as identified by the analysis have been translated to English by the researcher. It is important to use a systematic manner to analyze data in order to create reliability and validity (Miles, 1979). Color-coding by labeling into groups that correspond with specific themes (Creswell, 2007) has been used, which in this case are the dimensions of the ACW. Qualitative data should reflect ‘meaningful events’ in a case study, which means not too many categories should be enlisted (Yin, 1981). Therefore, labeling has not been done on the level of the criteria, since this would become confusing and also, since not every

interviewee has addressed each criteria. Additionally, during the interviews participants also mentioned elements that did not belong to the dimension discussed in the particular question, for which the researcher has restructured the transcript back to the original dimensions.

Assessment	Criteria
Less relevant	The majority of interviewees agrees on the relevance No clear explanation can be given why it would be relevant
Medium relevant	There is no agreement among the interviewees on the relevance It only seems relevant to a certain extent
Highly relevant	The majority of interviewees agrees on the relevance A clear explanation can be given why it is relevant

Table 3.5. Assessment criteria dimensions of the ACW with regards to heat.

In Table 3.5, the scoring categories on the relevance of the ACW criteria are explained. Three different categories are included to be able to make a nuance distinction between the criteria. This manner is chosen, since two categories would have forced a too strict categorization. On the other hand, more than three categories would have given platform for too much subjectivity as no stricter justification than included in Table 3.5 is desirable in this exploratory study.

4. Literature study

In this chapter, the extent to which the dimensions of the Adaptive Capacity Wheel apply for the issue of heat is discussed based on a preliminary literature study. After each dimension, a short sub conclusion is given. Subsequently, an indication of the relevance of each criteria belonging to a dimension is presented. In this study, international literature on heat adaptation and local governance is included.

4.1 Heat and the dimensions of the Adaptive Capacity Wheel

4.1.1 Variety

Variety of problem frames

The issue of urban heat in literature is approached from two main frames. First, heat is defined as a spatial planning and development issue. Vulnerability to heat is partly caused by the spatial design of cities, primarily due to the high thermal absorbance of engineered urban surfaces and the lack of vegetation (Watkins et al., 2007; Luber & McGeehin, 2008). Place-specific physical and environmental characteristics such as the type of materials covering urban space, and the size and shape of open spaces affect the degree of vulnerability to extreme heat events (Kim & Ryu, 2015). Second, heat is approached from a health perspective within which it is defined as a human behavioral and health issue. Physiological and behavioral adaptations can reduce heatwave morbidity and mortality, as can changes in public health preparedness (McMichael et al., 2006). Hajat et al. (2010) explain that human adaptation to heat depends on the body's ability to act as a natural cooling system. Specific behavior can aid that ability. A study from Keatinge (2003) indicates that heat-related illness is largely avoidable. However, unprepared behavior for heat waves and weak health infrastructure in society cause health-related morbidity and mortality. Within these perspectives, diverse solutions are provided on how to address heat. Different opinions exist on which aspects are most important to focus on and what acceptable costs are (Lowe et al., 2011; Kleerekoper et al., 2012; Jonsson & Lundgren, 2015).

Kovats and Hajat (2008) have created a causal chain from heat exposure to heat death, as presented in Figure 4.1. The framing of heat as a problem from a spatial perspective focuses in general on factors affecting exposure, such as the presence of shade in a municipality. From a health perspective, the issue is mainly defined by factors affecting sensitivity to a given heat exposure and factors affecting access to treatment, such as heat aware behavior and access to a health network.

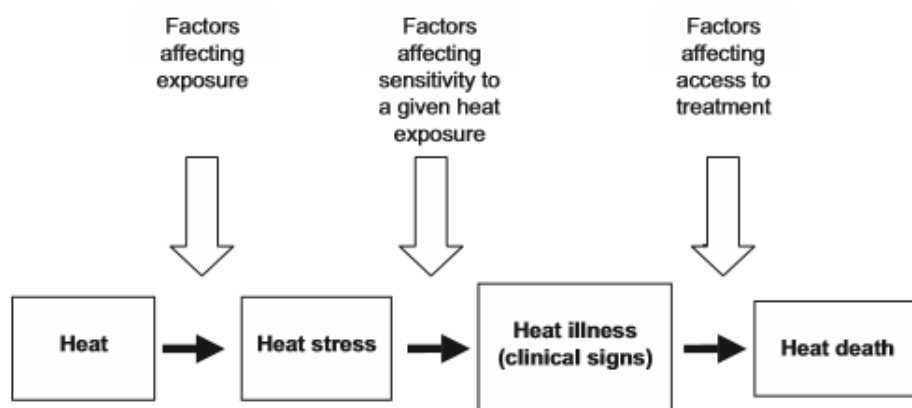


Figure 4.1. Causal chain from heat exposure to heat death. Source: Kovats & Hajat, 2008.

Diversity of solutions

Solutions for heat as adaptation possibilities can be ordered according to the problem frames of spatial planning and health and behavior.



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

The first cluster of solutions is based on spatial urban planning. Measures aim to reduce heat in the city and to mitigate the urban heat island effect, which is a form of adaptation to heat. City cooling initiatives gain in importance, because they could reduce heat-related illness and mortality and have the additional potential to reduce energy demand, greenhouse gas emissions, air-conditioning costs, and air pollution (Luber & McGeehin, 2008; Kirshen et al., 2008; Martinez et al., 2011). Kleerekoper et al. (2012) describe four categories of design principles for Dutch cities to diminish the accumulation of heat and to apply cooling techniques, being: vegetation, water, built form and material. The various options differ in effectiveness and costs. First, vegetation cools the environment actively due to evaporation and transpiration processes, and passively by providing shade to surfaces. Vegetation strategies include the planting of street trees and urban parks, and increasing private green in gardens and green roofs (Luber & McGeehin, 2008; O'Neill et al., 2009; Lowe et al., 2011; Kleerekoper et al., 2012). A case study by Kirshen et al. (2008) shows that cities could increase the use of shade trees to contribute to local cooling. Second, water has a cooling function due to evaporation, by absorbing heat or by transporting heat out of the area. In urban areas, the implementation of fountains can be a beneficial balanced cost versus effect option for spaces with a high use (Kleerekoper et al., 2012). Also, water contributes to the increase of green infrastructure (Lowe et al., 2011). Third, building design plays a role in the UHI effect (Kirshen et al., 2008). For example, cities have a larger surface area compared to rural areas and therefore more heat can be stored. With establishing more compact buildings with less external facades, there is less heat storage (Kleerekoper et al., 2012; Kim & Ryu, 2015). Other examples are to reduce the trapping radiation by multiple reflections between buildings and the street surface, the creation of high ratios of street height to street width (*ibid.*) and modifying the built environment to provide proper ventilation (O'Neill et al., 2009). Fourth, the use of specific materials and colors can reduce heat build-up and optimize thermal comfort (O'Neill et al., 2009; Kim & Ryu, 2015). For example, bricks store relatively much heat. Evaporation from urban areas can be increased by using permeable materials, changing roofs and street pavement are common seen strategies (Kleerekoper et al., 2012).

The second cluster of solutions aims at adaptation in health infrastructure and behavioral change. From this perspective, the development of a heat plan is mainly important. It should incorporate elements such as a heat health warning system (HHWS), education and awareness raising, heat event preparedness including a plan of communication, a program of evaluation and longer term strategies for reducing heat risk (Lass et al., 2011; Bernhard & McGeehin, 2004). Heat plans are generally constructed on the national level, but they are important on lower levels as well. Variability in predictability within heat warning systems between different cities suggests that systems must be location-specific (Patz et al., 2005). Heat plans must describe specific and detailed roles and responsibilities for all supporting actors (Bernhard & McGeehin, 2004). It is necessary to actively raise awareness of potential health impacts and advice on protecting against and recognizing the symptoms of heat illnesses, including dehydration, heat stress and heat strokes (Kovats & Kristie, 2006; Ebi, 2011; Adger et al., 2005). Heat preparedness can also be achieved by making cooling centers and medical care available, including access to transportation (O'Neill et al., 2009; Luber & McGeehin, 2008). So-called cooling centers can be set up in public spaces, such as libraries and community centers (Bernhard & McGeehin, 2004; Lowe et al., 2011). Longer term strategies for reducing heat risk could include improvements to housing, management of chronic diseases, and institutional care of the elderly and other vulnerable people (Kovats & Hajat, 2008; Kovats & Kristie, 2006). In Table 1, some public health measures in the United States and Europe within a HHWS are listed by Kovats & Kristie (2006).

Measure or strategy	Comments
Media announcements (radio, television)	Provide general advise on heat stress avoidance to general public
Bulletin or webpage	May be restricted access, to relevant professionals or accessed by anybody
Leaflets	General advice, and advice for nursing home managers. Often distributed at beginning of the summer via health centers, and places where vulnerable people may be
Telephone help-line	Either a dedicated telephone service is opened or people are encouraged to phone a pre-existing general health advice line
Opening of cooling centers	Some evidence exist that cooling centers are more used by low-risk individuals than high-risk individuals
Alert to hospital emergency rooms, ambulance services	Can be used to improve operational efficiency, needs to be based on local information and carefully evaluated
Home outreach visits to vulnerable persons	Important but expensive. Requires some registry of vulnerable people. Use pre-existing networks of volunteers or professionals.
Evacuation of vulnerable persons to cooling centers	Using a registry of vulnerable people, home visits needed
Outreach to homeless	High-risk group of people
Utility companies cease disconnection for non-payment	Some areas rely heavily on air conditioning
Fan distribution	Fans are effective under temperature of 37 °C.

Table 4.1. Common public health measures. Based on: Kovats & Kristie (2006).

Multi-actor, multi-level and multi-sector

Variety in problems frames and diversity in solutions links to the involvement of multi-actor, multi-level and multi-sector.

Corfee-Morlot et al. (2011) emphasize that for climate change issues, local authorities are to work with a multitude of local actors, as they combined comprise the collective response to climate change. These actors are households, community organizations and businesses as well as urban planners and resource managers investing in adaptation measures. A general trend in recent years is that urban environmental governance in the Netherlands has become more decentralized and interactive, and stakeholder involvement has become more important, as has the role of trust and knowledge (Driessen et al., 2012). Climate change adaptation requires engagement of stakeholders and communities to address the issue on a municipality level (Bulkeley et al., 2009). Municipal authorities should integrate climate change across different policy domains in order to develop effective policies and actions, and collaboration with other levels of government is needed (ibid).

Also specifically for heat, literature indicates a multi-actor setting to be important. An urban planning process requires a multi-actor environment, as collaboration between principals, urban designers, architects, residents, real estate developers, experts from various fields, institutions, municipalities and other authorities is desired (Müller et al., 2005). A study on policy process for encouraging green roofs shows that local authorities had consultations with consultants, NGOs, economists and the industry, in order to facilitate practical implementation (Mees et al., 2013). Governance arrangements can create networks between stakeholder groups (Carter et al., 2015). Since greening public spaces has a high public acceptance, it is feasible and recommendable to involve citizens in the initiative (Kleerekoper et al. 2012). This is also important since the next step in long time span initiatives is promotion of green in private spaces, which could be a considerable amount of surface in urban municipalities (ibid.). On the health side, Mees et al. (2014) state that



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

private actors in network arrangements with local authorities are important for actively reaching out to different vulnerable citizen groups for the implementation of health care measures. Bernhard and McGeehin (2004) state as well that successful response to heat emergencies requires close collaboration of many local governmental agencies and NGOs. Health departments are not necessarily the only suitable lead agencies for heat prevention at the local level, health stakeholders should always play a major role in heat preventive efforts (Martinez et al., 2011). General communication campaigns are mostly the responsibility of governmental health departments and health institutes. However, for well-functioning implementation actors such as hospitals and home care staff are important, together with general practitioners, health centers and social services (Lass et al., 2011). Heat warning systems require clear lines of responsibility for multiple agencies involved for the active identification and care of high-risk individuals. These agencies include the weather service and local health and social care agencies (Kovats & Kristie, 2006).

Literature that stresses the importance of a multitude of actors, also emphasizes the involvement of various governance levels. For example, possible relevant actors as mentioned by Müller et al. (2005) operate on different levels, with each its own benefits. Local governments are in a good position to implement several heat-health preventive strategies, other institutional levels are better suited for other necessary tasks (Martinez et al., 2011). Local governments can educate their communities and connect them to local, regional and national resources; organize local collective action and channel know-how and external support to different groups (ibid.). Local adaptation activities to lessen human vulnerability are enhanced by a supportive policy environment at national and international level (Keim, 2008), although adaptation must occur at the community level, since local public health agencies are uniquely placed to prepare society for climate-related disasters (ibid.). Coordination with higher level governments is also necessary to ensure the ability of local actors to adapt is not constrained by national or regional processes (Juhola & Westerhoff, 2011).

Effective heat adaptation also requires strong inter-sectoral coordination, which is most useful when combined with effective communication between different municipalities and with higher levels of government and institutions (Martinez et al., 2011). Unintentional adaptation has the capacity to reduce the effectiveness of purposeful adaptation, and therefore the integration of adaptation actions and policies across sectors is a key challenge to achieve effective adaptation in practice (Reilly & Schimmelpfennig, 2000). There are some adaptation measures that do not only address climate risks but also provide co-benefits in other policy fields. In case the sense of urgency is low, these so-called no or low regret measures focus on other policy goals, such as improving quality of public spaces with more green for example (Wardekker et al., 2012). Also indirect sectors could be included, such as the tourism sector. For example, with an increase of green routes through a municipality, bicycle use is stimulated, green forms a habitat for fauna and makes a city more attractive and improves its image (Kleerekoper et al., 2012).

Redundancy

In literature, several studies can be found that hint towards redundancy. For example, Martinez et al. (2011) indicate that prior to or during a heat wave, different forms of communication are needed with a similar message, such as hard copy and through the Internet. Although some people are reached double, individuals most at risk might not be frequent users of computers. In addition, Kovats & Kristie (2006) state that there is an absence of strong evidence of specific health measures in reducing heatwave mortality or morbidity in Europe. For example, passive dissemination of heat avoidance advice, which is seemingly important, is likely to be ineffective given the current knowledge of high-risk groups (ibid). It suggests that for a part of the population, heat avoidance advice is sufficient, for another group of people other solutions are needed. Bernhard & McGeehin (2004) state that although access to air conditioning is an effective intervention to reduce mortality during heat waves. Opening cool centers would be a good approach to increase access to air conditioning, however this measure has not been proven effective in reaching the most at-risk



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

seniors (ibid). It means also other solutions have to be in place, in case they work better at fulfilling their purpose at the moment of a heat wave. A study by Jonsson and Lundgren (2015) points out that individuals in society have different opinions regarding investments, such as for air-conditioning, planning for green, the creation of cool places for refuge from heat and monetary cost-free behavioral changes. It indicates that it is not known for certain which solutions will be best embraced in society.

The dimension of variety

For the issue of heat variety in problem frames can be observed, in literature broadly divided in the frame of urban planning and the frame health and behavior. A diversity of solutions and strategies can be distinguished, for avoiding buildup of heat in the city, cooling of urban areas, heat communication, and possible actions during a heat wave. A multi-actor, multi-level and multi-sector involvement seems recommended to address the complexity of the issue, and to reach an integrated approach in which each actor, level and sector has its own input. Redundancy in solutions is mentioned, since different people prefer and react differently to the variety of options. However, these are specific examples and there is a close link to diversity of solutions, questioning whether it is real redundancy that is needed.

4.1.2 Learning capacity

Trust

As discussed above, literature indicates it is preferable to have a variety of actors, levels and sectors involved in the issue of heat adaptation. This implies the need for collaboration between actors, that have diverse history with each other. Juhola & Westerhoff (2011) state that networks may prove to be useful in building social capital among actors, by means of cultivating trust and fostering commitment. Improved social capital and connectivity help advance compliance with mutually agreed-upon rules (ibid.). Diverse types of co-operation arise. For example, Kalkstein et al. (2009) explain that the development of a HHWS involves coordination between the agency issuing the warning and other stakeholders (ibid.). Mutual respect and trust are beneficial for co-operation.

Single loop learning and double loop learning

Municipalities can provide for opportunities to experiment with approaches and learn about the aspects of climate change (Corfee-Morlot et al., 2011). A study by Jonsson & Lundgren (2015) indicates that the need for routines to systematically consider heat or other climate-related risks was expressed by both municipal planners and operational staff. Bernhard & McGeekin (2004) state that from a health perspective, after a heat event meetings with all participating agencies to the heat response plan should be scheduled to review response activities, communication plans and outreach activities. It enables for learning. Kovats & Kristie (2006) emphasize that European countries need to learn from each other how to prepare for and effectively cope with future heatwaves. In agreement, Lowe et al. (2011) state that it is more efficient for lessons learnt to be communicated than to be re-learned. Although elements of single loop learning are mentioned in literature, these are very limited available for double loop learning. Carter et al. (2015) state that a precautionary approach dictates departure is necessary from current governance responses to extreme weather events in order to develop the needed adaptation responses to climate events that are difficult to forecast, such as heat waves. However, a concrete indication changes are needed in assumptions underlying institutional patterns with regards to the issue of heat have not been found.

Discuss doubts

Corfee-Morlot et al. (2011) point out, based on several studies, that scientific uncertainty is a frequent obstacle to local adaptation for decision makers. Several considerations have to be taken into account. Kim & Ryu (2015) state little is known about the general urban design characteristics of sites with significant heat vulnerability within the localized context. An example of this is the solution of designing with wind, which can lead to effective cooling of buildings and urban areas. For the



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

Netherlands however, wind could be a tricky measure for cooling since stimulating wind for ventilation in summer can lead to unpleasant situations in winter (Kleerekoper et al., 2012). Another difficulty concerning design principles is that it is difficult for policy makers to quantify heat in order to set targets and to evaluate progress. Heat accumulation of an area needs to be quantified and it needs to be defined what an acceptable level of heat accumulation is (ibid.). For approaches aimed at changing behavior, there are no studies indicating which measures work best for heat (Kovats & Kristie, 2006). Bernhard & McGeehin (2004) state that more research is needed on heat plan effectiveness. Also, there are measures that are debatable to promote, such as air conditioning use. Adger et al. (2005) point out that domestic and commercial air-conditioning in Europe following summer heat waves represents effective adaptation, but that it is not sustainable in the long term based on the energy- and emissions-intensive technologies in use.

Institutional memory

An indication of the need for development of institutional memory for heat can be found in literature. Kleerekoper et al. (2012) indicate the need for evaluation of progress of accumulating heat made by urban design measures. However, more examples can be presented for health and behavioral change. Luber & McGeehin (2008) consider heatwaves to be sporadic natural disasters, but different from other, more destructive phenomena such as hurricanes, memories of the heatwave disappear once cooler weather arrives. This makes institutional monitoring and evaluation especially important. Heat warning systems need an evaluation of effectiveness (Kalkstein et al., 2009), for example for predicting heatwaves, notifying vulnerable populations, and adoption of adaptation advice associated with communications (Lowe et al., 2011). These evaluations are urgently required to inform good practices. Specific monitoring is desirable for the need for and providing transport to people at risk, addressing the shelter and hydration needs of homeless people, maintaining a list of vulnerable individuals and using active individualized communication forms (ibid.).

The dimension of learning capacity

Literature suggest co-operation between different actors as mentioned within the dimension of variety, and the fostering of trust is important to strengthen commitment. Single loop learning for the heat issue involves experimenting with different approaches, making adjustments in routines and learn from the exchange of experiences. A concrete indication for the need of double loop learning for heat has not been found in literature. Openness regarding doubts is desired, since there are several uncertainties that have to be taken into account for both planning and health approaches, especially concerning effectiveness and possible negative effects. Institutional memory enables evaluation and reconsideration of the elements of heat plans, and progress results and possibilities for urban planning.

4.1.3 Room for autonomous change

Access to information

People can be informed on how they can contribute to making the municipality more heat adaptive by themselves. Kleerekoper et al. (2012) provide the example of promoting the use of permeable pavement, especially for spaces with a low use rate like parking spaces or private roads. Advice could be to use bricks instead of asphalt, or more preferably bricks with holes so grass can grow in between. This advice is to be promoted for private users, individuals and companies. Carter et al. (2015) also recommend to activate private land owners to participate in greening initiatives, by informing them on possibilities. As is seen in practice, both public authorities and the green roof industry have a large interest in education and information campaigns to promote green roofs (Mees et al., 2013). Also during a heat wave, providing information is key. As has been indicated within the variety dimension, amongst the most important public health measures are HHWS and health promotion (Kovats & Hajat, 2008). HHWS is one of the most prominent response to heat waves worldwide, with the overall aim to alert decision makers and the general public of impending



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

dangerous hot weather and to serve as a source of advice on how to avoid negative health outcomes associated with hot weather extremes (Lass et al., 2011). It is based on making access to information available. Heat protection advice, such as provided in Table 4.2 by Hajat et al. (2010), is frequently mentioned in literature (Luber & McGeehin, 2008; Abrahamson et al., 2009; Hajat et al., 2010). The provision of advice is closely linked to the next criteria by providing some sort of script.

Commonly provided heat-protection advice to the general public	
1	Avoid drinking alcohol
2	Wear lightweight, loose fitting clothing
3	Drink regularly without waiting for thirst
4	If you have no air conditioning at home, seek out an air-conditioned or cool environment
5	Stay indoors in an air-conditioned environment
6	Wear a hat
7	Avoid or reduce physical activities
8	Protect yourself from the sun
9	Know the symptoms of heat-associated illness, and know how to respond
10	Look in on susceptible people
11	Do not leave children in a closed, parked car
12	Avoid going out during the hottest part of the day
13	Take frequent baths or showers

Table 4.2. Heat-protection advice, derived from Hajat et al. (2010).

Act according to plan

Linked to access to information is the ability for actors to act according plan, which is especially relevant during a heat wave. Bernhard & McGeehin (2004) state heat plans are necessary to reduce heat-related morbidity and mortality and should provide for coordinated action, also from private sector participants. The aim of a HHWS is to alert not only decisions makers, but also the broader public of upcoming dangerous hot weather and serves as a source of advice on how to avoid health risks (Lass et al., 2011). Additionally, in the case of experienced negative effects of heat, Knowlton et al. (2009) point out that several studies indicate that heat stress can rapidly become life threatening, especially among those with limited access to immediate medical attention. It is known that people with severe heat stroke symptoms have little time to go to a hospital or emergency department. Therefore, it is important that people know what to do when a heat wave occurs and how to prevent heat stress.

Capacity to improvise

In literature, the importance of ability to improvise of society for spatial planning is not clearly indicated as there seem to be no studies specifically available yet. However, engagement of stakeholders and communities in the issue on a municipality level is relevant (Bulkeley et al., 2009). On the other side, Lowe et al. (2011) claim that heat impacts are not just a medical or physical problem, but also a social problem for which the solidarity and actions of neighbors, volunteers and caretakers of vulnerable people are very important. It means action is required originating from society itself. Bulkeley et al. (2009) state that in order to address the adaptation challenge, human capacity development and training within municipalities and the wider community is needed. Wolf et al. (2010) formulate the expectation that social capital could reduce vulnerability to risks from the impacts of climate change in the health sector. Social cohesion has to be developed within society. Strong social networks have been said to support individuals and collective initiatives of adaptation and enhance resilience (ibid.). Social support is referred to as important in promoting cooling behaviors, while social isolation is a risk factor for heat-related morbidity and mortality (Sampson et al., 2013). Social capital reservoirs, such as volunteer organizations, provide great opportunities to reach vulnerable people without large economic costs (Martinez et al., 2011).



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

The dimension of room for autonomous change

Informing society leads to more understanding on how people can contribute themselves to make their local environment more heat adaptive. Encouraging individuals and market parties is recommended. Provision of information is also very important during a heat wave in the form of a warning system about heat and risks. Corresponding, plans and advice are to be provided to support people in what to do when a heat wave occurs and how to prevent negative health effects. In literature, the ability to improvise can be linked to the need of social cohesion development, as people in society are highly important for supporting vulnerable people during heat events.

As represented in this literature study, more scientific information is available with regards to the key dimensions variety, learning capacity and room for autonomous change and heat, than there is with regards to the supporting governmental dimensions of leadership, resources and fair governance, specifically for heat.

4.1.4 Leadership

Visionary, entrepreneurial and collaborative leadership

Sippel & Jenssen (2009) mention lack of leadership as one of the challenges for local level climate change adaptation in general. Literature suggests a –collaborative- leadership function might be reserved for municipal authorities, as several studies show that planning of adaptation is often government-led (Mees et al., 2013). Municipalities have a central position in the interaction with stakeholders. For example, they can exchange information on specific procedures hospitals, clinics, retirement and nursing homes adopt before and during the summer period and during heat-waves (Martinez et al., 2011). Leadership, in different forms, could make a difference. For example, it was seen that in the absence of a coordinated response to ensure that elderly people are kept cool and well hydrated, even in high-income countries heat waves can cause large numbers of deaths as the heat wave in Europe of 2003 demonstrated (Haines et al., 2006). Collaborative leadership could lead to better coordination.

Leadership within society is also acknowledged in literature. Research by Sampson et al. (2013) suggests that ongoing health behaviors may more likely be maintained during a heat event than the adoption of new behaviors. In order to stimulate behavioral change, public health must support leaders at social service and community programs working with vulnerable people in their efforts to prepare for reaching out to the vulnerable, prior to and during heat events. These so-called leaders could be active at places such as senior centers, meal delivery programs, and community block groups (ibid.). Martinez et al. (2011) state that not all local governments have the resources and incentives to promote or support climate-friendly urban planning, which shows room for entrepreneurs to step up. Also visionary leadership could have a function, as a study pointed out that in several European cities, ecologists were instrumental in getting green roofs on the local political agenda. They increased awareness for, and knowledge of, green roofs in and beyond their cities (Mees et al., 2013).

The dimension of leadership

Leadership can be a driving force of development, and especially collaborative municipal leadership is important to support developments regarding heat. However, literature is not too specific on leadership within the government for heat. The role of leadership in society has been discussed as well, as also societal leaders can fulfill important functions.

4.1.5 Resources

Financial resources, human resources and authority

In order to address the adaptation challenge, financial capacity and flexibility is needed (Bulkeley et al., 2009; Sippel & Jenssen, 2009). In literature, several findings indicate what role resources have within the issue of heat. Financial means are needed for subsidy programs, for example for



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

stimulating green roofs on existing buildings (Mees et al., 2013). These subsidy programs could define the trend towards more green adaptation measures (Kleerekoper et al., 2012). However, not all resources have to be provided by the municipal government. To accomplish heat adaptation, investments are needed in all areas ranging from health care to spatial cooling to smart land use (Kirshen et al., 2008). Both Sippel and Jenssen (2009) and Corfee-Morlot et al. (2011) point out that a lack of expertise could be a challenge for climate change adaptation on the local level. Corfee et al. (2011) assume that local climate policy decisions need to build on knowledge that is co-produced through local interpretation and interactions with more formalized scientific and technical knowledge. This is the case with vulnerability mapping, which requires refined techniques so novel tools to improve planning and preparation for heatwaves can be developed (Luber & McGeehin, 2008). It allows for better resource allocation and tailoring of health communication messages to specific population groups (ibid.). Kovats & Kristie (2006) stress the necessity of long-term interventions such as training and education of staff and caretakers and improvements to health care infrastructure. Both money and human capital is needed for this. In case of a heat wave, active outreach is needed for the elderly, the homeless and the socially isolated (Martinez et al., 2011). In addition, the provision of caps, lockers for storing belongings and maps of drinking fountains might need to be handed out (Lowe et al., 2011). It requires the availability of human labor. However, this is not specifically a task for the municipal government as the health care sector must be capable to postpone non-emergency services during a heatwave, and increase hospital beds and ambulances (ibid.). Corfee-Morlot et al. (2011) point out that also a lack of mandate to address climate issues could be an obstacle to local adaptation action. However, the issue of authority for heat is not frequently mentioned in literature. Municipal governments possess authority themselves to act on the heat stress theme. For example, a study by Mees et al. (2013) indicates that local authorities have the authority to require green roofs as 'material consideration' in planning applications. As is seen in practice in several European municipalities, green roofs were made mandatory on all new builds or part of local development plans. In other areas green roofs on new buildings are stimulated via a density bonus (ibid.).

The dimension of resources

Financial resources support the trend towards more adaptation for heat, for example through subsidy programs. Investments from society are important as well. Human resources and especially expertise is required locally fitting approaches and educational support of society. Authority as defined in the ACW does not seem to be discussed in literature for heat specifically.

4.1.6 Fair governance

Legitimacy, equity, responsiveness and accountability

Very limited research is available in heat adaptation literature that considers fair governance and the criteria of legitimacy, equity, responsiveness and accountability as they are defined within the Adaptive Capacity Wheel. A few limited articles mentions why municipal governments have a certain approach in dealing with the heat. For example, Kleerekoper et al. (2012) state that green initiatives have high public acceptance, and are therefore popular measures for policy makers to include in policy. Also, research by Mees et al. (2013) shows that private actors were involved in the policy process on green roofs in several European cities, for which the consideration of legitimacy was a prime motivation of local authorities for seeking stakeholder input. However, it can be expected of a Dutch municipal government to have public support, to have fair institutional rules, to be responsive to society and to have accountability procedures. A municipal government in a democracy such as the Netherlands should possess the criteria of legitimacy, equity, responsiveness and accountability in principle, for all policy areas. The citizens of a municipality provide the municipal board with legitimacy and requires to be heard regularly in varying forms (Breeman et al., 2010, p.102). These criteria thus also apply to the heat issue.

The dimension of fair governance

In this literature study, not many direct links to fair governance as defined by Gupta et al. (2010) have been found for heat. However, for a municipal government, serving the public interest, these criteria are important for any theme.

4.2 The relevance of the ACW dimensions

Based on the results of the preliminary literature study, an assessment of the criteria of the ACW is given, indicating their relevance for the issue of heat. This first assessment is presented in Figure 4.2.



Figure 4.2. Assessment of the ACW criteria based on the literature study.

Based on the literature, first criteria of variety are qualified as highly relevant. For the issue of heat variety in problem frames is observed, as is a diversity of solutions and strategies, and the importance of multi-actor, multi-level and multi-sector involvement is stressed. Redundancy is considered medium relevant, as it is to some extent discussed although the difference between redundancy and diversity in solutions seems small. Four criteria of learning capacity are marked as highly relevant, as literature suggests establishing co-operation and trust, and learning to improve routines is important. Due to uncertainties linked to heat, doubts should be discussed. Monitoring and evaluation is needed to improve approaches. Double loop learning, however, is qualified as less relevant, since a concrete indication for the need of double loop learning for heat has not been found in literature. The criteria belonging to the dimension of room for autonomous change have been categorized as highly relevant, as literature indicates informing people is important to increase the capacity of people to adapt themselves, as is providing advice for action. The ability to improvise is linked to the need for social cohesion development, as society is highly important for supporting vulnerable people during heat events.

With regards to more limited results within the dimensions of leadership, resources and fair governance, it has to be taken into consideration that literature did not indicate certain criteria to be relevant, nor did it indicate them not to be relevant. From this point of departure, visionary and



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

entrepreneurial leadership are considered medium relevant, as leadership can be a driving force of development though also societal leaders could have this function. Collaborative leadership is qualified highly relevant, as the municipal government possesses a good position to connect people. Financial resources are medium relevant, as they can support development for more heat, although finances can also be contributed by other parties. Human resources and local knowledge can be considered more relevant. Authority is barely discussed in literature for heat specifically, and since financial and human resources are, this criteria is qualified as less relevant. The criteria of fair governance have been categorized as medium relevant, as they are not specifically discussed in literature for heat, but can be considered important for a governmental body on any topic.

5. Case study

In this chapter, the results of the case study are discussed. First, a general case description of the municipality of Arnhem is given, as well as the specific context of heat. Second, aspects of the heat issue linked to the dimensions of the Adaptive Capacity Wheel are discussed. After each dimension, a short summary is included. Third, the relevance of the ACW dimensions is discussed based on the results of the case study.

5.1 Case description: Arnhem

5.1.1 Background context of Arnhem

Arnhem is a middle size urban municipality located in the east of the Netherlands. The city is the capital of the province of Gelderland. In the north of Arnhem, the municipality borders the Veluwe, one of the largest forested region of the Netherlands (Staatsbosbeheer, 2015). The river Rhine flows through the center of the city, originally several streams flowed through Arnhem as well that have been redirected in pipes now. Figure 5.1 shows the location of Arnhem on the map of the Netherlands. Figure 5.2 shows a map of Arnhem.



Figure 5.1. Arnhem marked on the map of the Netherlands. Source: Ruimte voor klimaat (2011).

Figure 5.2. Map of Arnhem. Source: Kaarten en Atlassen (2013).

As measured in February 2016, Arnhem counts 154.082 inhabitants (CBS, 2016). The prognosis is that this amount will increase to more than 170.000 inhabitants in 2040, as can be seen in Figure 5.3. In present, almost 20% of the population in Arnhem is sixty-five years or older. For 2040, the expectation is that this percentage will be around 27% of the population being sixty-five years or older, as is presented in Table 5.1 (Gemeente Arnhem, 2016a).

Year	Inhabitants	65 +	Percentage 65 + of total population
2016	153817	30524	19,84%
2040	170700	46307	27,13 %

Table 5.1. Inhabitants of Arnhem. Source data: Gemeente Arnhem, 2016a.

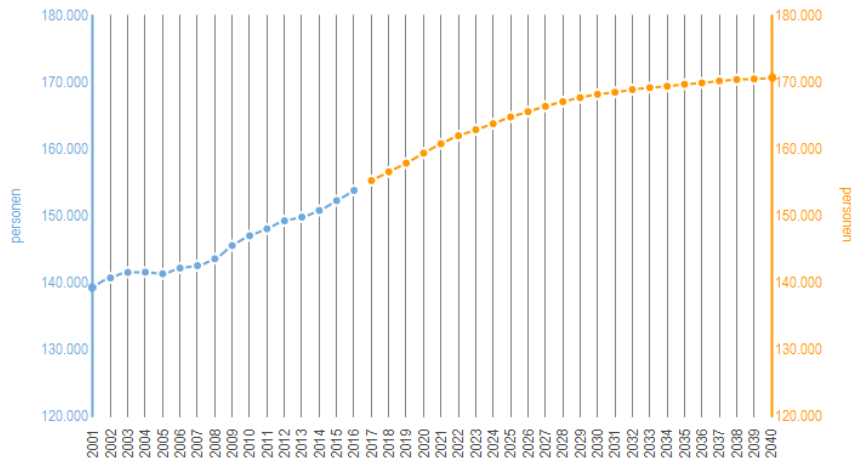


Figure 5.3. Inhabitants of Arnhem. Source: Gemeente Arnhem (2016a).

As of 2014, within the municipal board the political parties D66, SP, CDA and ChristenUnie are represented (Gemeente Arnhem, 2016a). In Arnhem, a hospital named Rijnstate is located. The city is also home to music and event hall Gelredome, as well as to Burger's Zoo. There are multiple museums and several parks in the city, such as Park Sonsbeek and Park Presikhaaf. In 2008, Arnhem won the national competition by the foundation Entente Florale for being the greenest city of the Netherlands (VGS, 2008). In 2009, Arnhem won the price for being the greenest city in Europe (VGS, 2009). Wageningen University listed Arnhem as the 7th greenest municipality of the 31 largest Dutch municipalities in 2014, based on the amount of public green for each square meter in the built environment per residence (WUR, 2014).

5.1.2 Heat theme in Arnhem

The municipality of Arnhem has been enrolled in several research projects funded by the European Union, as part of the larger European research project Future cities. During one of these studies in 2009, researchers from Wageningen University and Research center (WUR) have measured temperatures in Arnhem during hot days. Results showed temperature differences inside and outside the city at nightfall were up to 7 °C, similar to the city of Rotterdam (Ruimte voor klimaat, 2011). Due to these measurements, more support within the municipal government of Arnhem was developed for the project. The heat map of Arnhem shows the areas in the city with the most risk at heat buildup, as is presented in Figure 5.4. The heat map is translated into a heat attention map, with recommendation to limit heating, provide options for cooling winds, protect cool areas and strengthen cooling mechanisms (ibid.).

Heat has been included in the visionary policy document 'Structuurvisie Arnhem 2020-2040', in which the municipal government has expressed its ambition for the future of the city. In this document, the analysis of the heat issue for Arnhem is included, as well as three ambitions and five recommendations for heat in order to use potential cooling options, prevent further heating of the city and to decrease heat stress (Gemeente Arnhem, 2012). The municipal government acknowledges that extreme heat, such as experienced in 2003 and 2006, will become more frequent in the future, as is also expected by the Kennis voor Klimaat scenarios (KRA, 2016). On the website of the municipality, several information and complementing documents can be found with regards to the issue of heat, such as the results of the Future Cities studies and several fact sheets on realizing urban green (Gemeente Arnhem, 2016b). The connection to heat and experienced temperature, and the influence of heat on human health and the livelihood of the city is made (ibid.).



Figure 5.4. Map of heating in Arnhem. Made by the University of Kassel. Source: Ruimte voor klimaat (2011).

5.1.3 Context of heat within the municipality of Arnhem

Based on the interviews in the case study, a short context of the perception of heat in Arnhem can be presented. In Arnhem, the municipal board has the ambition to decrease heat in the city, although it is not on the top of the priority list (Municipal government). The issue of heat in Arnhem and the need for adaptation is not that well known among actors (Housing corporation 2), and also not a priority yet for actors to work on (Housing corporation 1). From a political view, it is considered an interesting topic to improve the boards image (Landscape architect 1, Neighborhood association). For greening, many developments are occurring, but very little with the perspective of heat in mind in specific (Education center 1). Awareness on the issue is low, which is very important to develop first, and that requires time (Housing corporation 1). It starts with knowledge of the issue and preparedness to give the subject priority (Care facility 2). Single success cases could serve as examples to raise awareness among society (Governmental organization). In addition to heat as an effect of climate change, social developments are in process such as the aging of the population and the sobering health care system (ibid.), which influence vulnerability. Social cohesion has to be developed in order to create a strong society during a heat wave (ibid.). Informing people about climate adaptation could already start with children, to make the future generation aware of the issue (Education center 1).

Several actors question the exact role the municipal government could have in increasing adaptive capacity in society for local heat. The municipal government itself is also searching how to approach the issue of getting people involved (Municipal government). Some actors state that there is a role for the municipal government to draw attention to the issue of heat (Housing corporation 1), while others question whether the municipal government in Arnhem is really supporting the theme (Neighborhood association) and the extent of their added value on all domains, for example with regards to professional health care (Care facility 2).



5.2 Heat and the dimensions of the Adaptive Capacity Wheel

In the case study, social actors in Arnhem have been asked for their perspective on the six dimensions of the Adaptive Capacity Wheel with regards to heat in their municipality. These insights have been complemented by several observations.

5.2.1 Variety

Variety of problem frames

Also within the case study, a variety of problem frames dealing with the issue of heat and local heat adaptation seems to be the case. When trying to build awareness about heat, all possible approaches have to be combined (Governmental organization). The ambition to address heat applies to urban planning, the design of urban private and public landscapes and the inner climate of buildings, with a special consideration of vulnerable people (Gemeente Arnhem, 2012). Further, a focus is needed on the coherence between the physical and the social aspects of the issue (Observation 1). Within the dimension of variety, it is the task of the municipal government to monitor all different developments (Municipal government) and to pay attention to the direction those developments are taking (Housing corporation 1). As was seen in the literature study, the two main problem frames are within urban planning, and health and behavior (Care facility 2). Since Dutch cities are not built heat resilient, heat is trapped in buildings (Governmental organization, Observation 2). There is a direct link between a green and blue environment and health (Governmental organization), and addressing green can also stimulate social interaction, which could support a positive behavioral change (Neighborhood association). Social change with regards to behavior during heat events has to be further facilitated by a public space that is designed with places of shade and cooling by water (Governmental organization). Measures in the spatial environment are connected with developing awareness (ibid.). Recently it is seen that urban green gets additional meaning besides being enjoyable, such as being beneficial for health, social cohesion and climate proofing of the city (Municipal government, Landscape architect 1). Different aspects of the issue of heat have to be linked to each other to create understanding of the larger picture (Housing corporation 1). With making varying approaches visible, it becomes clear for people that heat is linked on many other issues (Education center 1). The municipal government should include people already early in development stages of the policy process, focusing on civil participation (Education center 2). Also in society, people are starting to realize that more green can increase life comfort as well and enhance social cohesion (Education center 1). On local scale, people are starting to green their streets, although mainly inspired by the effect of green on the livelihood and the fact that people might feel safer, since working on green provides for social contacts and social control (Education center 2). It is relatively new to connect climate change effect to social changes with regards to developments including vulnerable populations (Governmental organization). Parties come together that have not worked together before (Observation 1), although it makes sense that for example actors occupied with health, are also interested in green (Education center 1).

As a side note to variety, some actors think it might be wise to maintain a more narrow focus in the first phases of development, since the problem of heat is not well known yet within society (Housing corporation 2). It is also acknowledged that actors that have too few intersection with the issue might not be so invested, and by including them the process might become unnecessary complex (Housing corporation 1). One has to be aware that there are many other reasons people want green the city (Municipal government, Landscape architect 1, Education center 1, Education center 2), however green and climate are very close linked (Landscape architect 1, Neighborhood association).

Diversity of solutions

Municipal governments could best apply variety in the possibilities of adaptation measures to promote (Education center 2). Individual actors are operating on specific levels, but the municipal government should approach the issue on a higher level and consider the entire environment

Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

(Housing corporation 1). Every neighborhood is different and therefore it is not possible to make a blueprint approach to facilitate adaptive capacity (Governmental organization, Observation 1).

Again, the first category of solutions is within the frame of spatial design. Commissioned by the municipal government, the exact heat problem in Arnhem is mapped, along with different solutions to be realized on urban planning level, as is shown in Figure 5.5 (Landscape architect 1).



Figure 5.5. Solutions for heat as identified for Arnhem. Based on Buro Poelmans Reesink (2013).

First of all, this includes to promote green, such as green gardens, green roofs and vertical green (Municipal government, Education center 2). Especially vertical green can be an attractive option in urban areas, since space is limited (Landscape architect 1). In Arnhem, green is an important part of the approach to reduce the amount of so-called heat hot spots in the city (Municipal government). Additionally, minimal increase in building volume and non-permeable surface is strived for (ibid.), since it affects the temperature in the environment. Second, water also supports cooling in the city. In Arnhem, the heat issue is one of the motivations for restoring the original stream Jansbeek within the city center (Landscape architect 1). Third, is the use of certain materials in buildings, for which all technical knowledge is available, although seen less in practice (Municipal government, Education center 2). Materials affect both temperatures in the environment as inside houses. A first attempt to include heat in designs of new buildings was made by including the theme in assignment descriptions from the government, and results were that the majority of architects incorporated it to a certain extent (Municipal government). Measures such as the use of specific materials, colors and designs can be considered in the future when heat becomes more urgent, as long as they are also realistic from a financial perspective (Housing corporation 1, Housing corporation 2).

The second set of solutions is within the frame of health and behavior, connected more directly to adaptation during a heat wave. An important option is the use of the national heat plan, which is mainly a warning system, on local level (Governmental organization, Observation 1). Simple communication about practical measures is important, such as advising people to drink enough, downscale activities and look for shade (Care facility 1). Communication is also important with non-health professionals. For example, housing corporations can pay extra attention to the well-being of people during heat events, since apartment stewards are familiar with the local residents (Care facility 2). Additionally, the establishment of cool spaces should take place, for example by provision of temporary shade with canvasses in the streets (Governmental organization, Landscape architect 1). Relatively simple adjustments in buildings have to be incorporated, for example how bedrooms are situated towards the side of the sun (Governmental organization). Adjustments on residential level are mentioned as well, such as lowering experienced temperatures by introducing more house



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

awnings (Housing corporation 1). In health care, a distinction can be made between a formal and informal approach (Governmental organization).

It is desirable that the municipal government has an open mind and allows local actors to find fitting solutions for the specific context of an area (Housing corporation 1). Examples can be provided, and often there is more than one solution (ibid.). Thus it is important the municipal government does not support a single solution for urban heat (Education center 2). In addition, each neighborhood requires a different approach on how to stimulate adaptation measures. An illustration is the maintenance of green at the bottom of street trees. For different neighborhoods can be observed that communication with the municipal officer is either very strict or very informal (Education center 2). Some neighborhoods like to decide on its own strategy and solutions for heat (Neighborhood association), while in others there might be less attention to the subject.

Multi-actor, multi-level, multi-sector

Variety is also important if the municipal government aims to reach and include all relevant parties (Municipal government). The municipal government needs the input of municipal inhabitants, active organizations and market parties in order to accomplish something (ibid.). The issue of heat is too complex for only private initiatives as well (Education center 2). Relevant actors addressing heat are the municipal government, the GGD (Dutch municipal health service), housing corporations, municipal hospitals, representatives of care facilities and care providers, people from knowledge institutions and health insurance companies (Care facility 2). By involving all of them, the issue can be approached from different perspectives (ibid.). Especially professionals have knowledge about the issue, making them important to include both in the healthcare sector and in urban planning (Care facility 1). Each actor has its own role in developing more adaptation in society (Care facility 2), for example municipal health services could provide guidance to people, while knowledge institutions are important for researching whether all possibilities are being utilized (ibid.). Also representatives of elderly organizations and chronic ill organizations have a role (Governmental organization). Involvement of different actors in the process can establish better co-operation among them in practice (Care facility 2). The municipal government should involve local actors in the development phase of analyzing the issue, and actively communicate what each actor can contribute (Housing corporation 1). For building design, consultation with the municipal government and their urban architects is necessary since several conditions are laid out that have to be met (Housing corporation 1). There is potential in co-operation between the municipal government and social actors for establishing green measures (Housing corporation 2). In Arnhem, it can be observed that various attempts are made by the municipal government to include actors in the heat issue, for example by including the theme in assignments for the design of public spaces (Landscape architect 1). People could be involved in the process to increase association with the issue of heat (Neighborhood association).

A sectoral approach for stimulating heat adaptation is not desired, since such an approach mainly is effective for acute problems, such as flooding (Municipal government). Chain integration needs to be built, wherein the municipal government has to explain the aim and long term vision (Housing corporation 1). Measures that are beneficial for climate proofing have to be mainstreamed in other domains (Municipal government). Different levels are involved, as adaptation is important on local level but funding can be received from the regional governments, for example for green or water projects (ibid.). Also for certain aspects in health care, the municipal government needs co-operation with regional governments (Care facility 2).

Redundancy

Since heat is a relatively new subject, no one can tell yet which direction the process is going to take. Therefore, it is important the municipal government keeps an open mind, while indicating the vision



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

for the long term without specifying how to reach it (Housing corporation 1). For example, the municipal government of Arnhem encourages all green initiatives (Municipal government). In general, variety must be pursued since by each approach different target groups are triggered. Information spread through a flyer reaches a different group of people than information provided during an educational lesson at a school, which reaches children and parents (Education center 1). It is the task of the municipal government to use all possibilities at disposal to reach all layers of the population. For example, it should be taken into consideration that elderly might only read the newspaper and do not use the Internet (Care facility 2, Governmental organization). With such an approach, there might be overlap in which people are reached by single communication measures. For each specific neighborhood, one has to make an estimation of what the best possible measures are to address heat, varying from measures inside building to measures in the surroundings (Housing corporation 1). For places in which from a technical point of view not much can be changed, behavioral and health guidance becomes more important (Care facility 2). Since it is not always straightforward to indicate what applies in a situation, several options can be developed at the same moment.

The dimension of variety

A variety of problem frames dealing with the issue of heat and local heat adaptation seems important. Different perspectives on the issue are possible and for establishing real awareness, all approaches have to be combined with a focus on the coherence between the physical and the social aspects. There are different types of actors mentioned as important to include, such as both health and spatial planning professionals, but also broader market parties and civil society. Diversity of solutions is important as there is a wide range of solutions that contribute to dealing with heat. Redundancy seems to have a place, since heat is a relatively new theme to work with and within society, people still have to discover what will fit practice the best. However, diversity might be more important than strict redundancy.

5.2.2 Learning capacity

Trust

Especially in the future, exchanging experiences with other actors on addressing heat could have a considerable role in the learning process, as is happening on other topics at the moment (Housing corporation 2). Collaborations have to develop, also with the municipal government, and every party has to find themselves in a particular role. Together, they must agree on goals to achieve (Housing corporation 1). At the moment, trust is sometimes a missing factor in the process of working with other actors (ibid.). Involving actors in development processes improves trust (Education center 2). Actors could benefit from efforts to bring them together, as people should not have to reinvent what has already been discovered (Education center 1). In Arnhem, an attempt is made to create a platform to bring people working on similar projects in contact (ibid.). Smart combinations of measures have to be found with each other. For example, by applying more shade, less cooling is needed which is also positive for use of less energy (Housing corporation 1). Meetings with different actors working within the field of health and heat support the process of developing better understanding (Governmental organization). The municipality of Arnhem is facilitating a heat meeting, from a health perspective, at which varying actors are invited (ibid.). Also on the side of urban planning, meetings to update actors at municipal level helps to further develop individual approaches and to discover possibilities what can be done (Landscape architect 1). Building trust is very important for working on new projects in which the outcomes are not known yet (Landscape architect 2). Not having trust makes communication and co-operation more difficult (Neighborhood association).

Single loop learning

In early phases of development, it is important to have room for the discovery (Housing corporation 2). People should be enabled to learn from experiences and learn from practice, which proves to be



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

more effective than learning from knowledge alone (Education center 1). At the moment, learning also implies developing awareness, which has to be one of the first steps (Housing corporation 1, Governmental organization, Education center 2). In Arnhem there are some initiatives related to heat, but these are not leading to a real shift yet, which requires more than making a website and newsletter on the issue (Municipal government). Process development is very important (Landscape architect 1). In Arnhem, first steps are being made by (landscape)architects to work together as they have concluded as the result of a field analysis co-operation is necessary (Municipal government). Multiple actors indicate that good examples lead to followers (Housing corporation 1, Municipal government, Education center 1). The municipal government has a role in setting a model example, also to increase awareness among all those parties they would like to work with and to communicate why the issue is important (Housing corporation 1). Also examples by other actors could be made available. For example to show the effects of green, both for the creation of shade and social cohesion (Education center 1). In Arnhem, a pilot project is in place in which people are encouraged to green their garden. However, the heat aspect is not mentioned yet towards people, although it is a consideration from the initiators. At the moment, learning has to contribute to establishing the best manners in which to approach people (ibid.). First attempts lead to new insights how to approach project, as the example of establishing little places with urban green illustrates (Landscape architect 2). Another initiative in Arnhem is to showcase 'climate proof' gardens, so people pass by and see these examples, without them actively looking for them (Education center 1). Relevant within the learning process is to educate actors what can be done (Housing corporation 1). Heat events might be needed in order to proceed and achieve more awareness (Municipal government), since the occurrence of an event allows for the opportunity to make progress (Education center 2). Organizing collective action is not that easy (Governmental organization, Education center 2), and an important question is spread awareness and knowledge in society (Education center 1). In health care, it must be accepted that normal routines change during a heat event, for example in home care (Care facility 2). Outcomes of meetings with other actors can be used to make recommendations for policy change within the own organization (Care facility 2). Studies to exact extent of the heat issue as have been conducted in Arnhem a few years ago, have especially a prioritizing function (Governmental organization). Learning occurs by finding out how things work in practice (ibid.). Best practices have to be developed by doing and learning (Neighborhood association).

Double loop learning

Society is changing, which is also relevant for the theme of heat adaptation. People want to become more involved in decisions regarding the own living environment (Municipal government). It still has to be figured out what people want to do themselves and what responsibility of the municipal government is (ibid.). The transition to a society in which people get more to say in the physical domain of the municipality, as is seen in multiple cities, characterizes less influence from the municipal government (ibid.). However, this process is not only a development in response of societal demand but also part of cutbacks in the governmental body (Education center 2, Neighborhood association). In general, people are very much searching how processes work these days, since there is more dynamic and complexity, and the government has a different role in the overall (Landscape architect 2). It should always be possible to be critical on the functioning of the government, since it enables improvement (Housing corporation 1). Individuals can also criticize the approach of professionals, for example in health care (Governmental organization). At the moment, developments is still very much in developing phases so deepening single loop learning or double loop learning is not really visible yet (Observation 1).

Discuss doubts

As a result of small initiatives, the heat island effect in Arnhem will not disappear, so an important goal of supporting these projects is to raise of awareness (Municipal government). It means to



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

discuss the issue and make people aware of what is going on, and it is a continuous search to find out what the best approach towards this is. Also within the municipal government in Arnhem, it cannot be stated with certainty the best approach is selected to achieve heat resilience (ibid.). A relevant question is what is the exact message that should be spread (Municipal government, Education center 1). Scientific uncertainty over green measures is less relevant. Heat is a qualitative issue, since the experienced temperature is more important than the actual temperature. Therefore it is less important to calculate the drop in temperature after a tree is planted, and more interesting to see how people experience the additional shade that is provided (Municipal government). It is questionable to which extent people are interested in the exact effect of their green (ibid.). Doubts of people with regards to how to improve green should be addressed if present, since it is not intended people drop out because they do not know how to proceed (Municipal government, Education center 2). At meetings, it is beneficial to provide room to ask questions, as it leads to joint learning. Specific questions could be whether specific measures should be promoted, such as air conditioning, or what the role of scientific data is in warning systems (Observation 1). There is little doubt about what can be done for practical health care, and in a formal facility this is very straightforward (Care facility 1). However, especially the 'how' question with regards to reaching vulnerable people at home is relevant (Governmental organization, Care facility 1).

Institutional memory

In practice, it is not plausible scientifically measurements are going to be made on how much particular green has helped for making a certain area heat proof (Municipal government). This is also not a consideration for placing green and water at the moment, as especially budgets determine the extent to which it is applied (Landscape architect 1). However, a lot can be learned from evaluation of approaches, as is shown by the example of the short but intense heatwave of 2015. Many actors requested information, which was not prepared well enough and evaluation has led to better organization for this year (Governmental organization). Evaluation should always be part of a policy process, as has also been the case with facilitating a social heat initiative by civilians, which indicates what approach and facilitation could even work better next year (ibid.). It is important to monitor whether policy approaches have had the desired outcomes, and results can be shown (Care facility 2). A monitor system aimed at the process could be useful, so it becomes clear what happened during a heat event, which approaches worked well and which did not. Evaluations should be communicated as well (ibid.). At the moment, it is not monitored what local actors do with the warning provided by the national heat plan, so no good feedback is gathered about that (Governmental organization, Observation 1).

The dimension of learning capacity

Facilitation of collaboration and for the exchange of knowledge and experiences between different actors is valued, and building of trust and good communication is acknowledged as important for working on new themes such as heat. A learning process in which developing awareness about the issue and the risks has an important place, as has the question which actors have which roles, and how projects and people can be best approached. Double loop learning might be part of the change in society towards more involvement of people within decision making, also about the own living environment. Scientific uncertainty about certain measures is not a large issue as much is known, both for health and spatial planning. However, the question how to achieve change and how to address and involve society is very open, which leads to the need to discuss doubts about chosen approaches. Monitoring and evaluation are needed to improve and learn from previous approaches.

5.2.3 Room for autonomous change

All changes that occur outside the municipal government, are more important than changes happening within the government (Municipal government). People have to be willing to contribute and take responsibility, both for green (ibid.) and for health measures (Governmental organization). It is observed that people currently are becoming more aware of climate change effects on local



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

scale (Education center 2). Subsequently, civil society should be provided the opportunity to take action, for which a municipal officer should have the role of observer, though ready to step in. The ability of civilians to adapt is needed in the future when heat becomes a more urgent issue (ibid.).

Access to information

The municipal government has a role to provide information during a heat wave, but probably also at the beginning of the summer to make sure everybody is updated again (Care facility 2). In Arnhem, a lot of information is available about heat and heat spots in the city, which is ought to be communicated to the outside world (Municipal government). However, heat is not presented as a huge problem (ibid.). On a municipal level, the heat story must be told (Education center 1). How it further applies to each city area vary, but when heat becomes really visible the message will come across (Education center 1). On the website of the municipal government information is available about heat (Municipal government), it is also communicated during events such as 'plant a tree in the city' (Education center 1). Illumination is important, so actors are aware why the topic is important and know what they can do themselves (Housing corporation 1). Provided information can be linked to the heat map of Arnhem, so people understand what the issue is (Landscape architect 1). People should be informed of all the consequences of heat, not only that it feel unpleasant, but also the real health risks and the effect on other aspects of society such as the economy (Education center 2). Information is needed, since it cannot be expected that the majority of people know of the heat issue on their own (Housing corporation 1). Accordingly, people should be given a motive to change, by including them in the story (Observation 2). It is important the municipal government does communicate clearly that they consider heat an issue (Neighborhood association) and actively ask people to contribute with solutions, facilitating this by making them more informed about heat (Education center 2). At the moment, not all actors are well informed (Housing corporation 1, Housing corporation 2). Information is not only needed for new initiatives, but also to make sure actors do not work on projects that only will increase the heat buildup in houses, as might now be the case with a housing project in which no blinds are made outside of windows (Housing corporation 2). The message for encouraging green is always different, depending who to target (Municipal government). It would be smart already to provide the information to children, as is shown that they are likely to take it into consideration as young adults. For adaptation becomes more important in twenty years, education have to be given to children now (Education center 1). Arnhem as municipality is already very green, but it is important to keep it that way (ibid.). A central place for information would support people with information, for example for all possible green measures (Education center 1, Education center 2). In Arnhem, there are many examples that people are actually interested in information (Neighborhood association). For example, a sort of information meeting organized by the Arnhem urban architect center about climate adaptation interested quite some people (Education center 2). Also in the direct case of a heat wave, providing information is very important as there is also a high request for it (Governmental organization). The municipal government can also inform actors such as a housing corporation to act during a heat wave (Care facility 2). Adapting to heat requires different every day practices, as is seen with energy use as well (Housing corporation 1, Housing corporation 2). For a housing corporation, an option is to communicate with their renters through the magazine and social media, however it must be known first what can be communicated (Housing corporation 1).

Act according to plan

During a period of heat, organizations such as schools, care facilities and events request information and a check list on what to do (Governmental organization). Care facilities should have heat protocols in such periods (Care facility 1, Care facility 2). The municipal government can provide tips for such a protocol, and also provide for a warning when it should be activated (Care facility 2). It has been seen in practice that care workers benefit from specified guidelines what to do during a heat wave, for example on what to pay attention to. This could vary from technical aspects such as



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

whether sun blocks are out, to practical things such as making sure people are dressed for hot whether (ibid.). All health care actors have own protocols. For example, the hospital prepares for patients with symptoms that are linked to heat and dehydration (ibid.). During heat waves, in health care extra attention is very important these symptoms (Care facility 1).

Capacity to improvise

In order to green the city, people have to contribute on their own (Municipal government). The municipal government should keep in mind what they want to achieve, and let society fill in how they would like to approach the issue themselves (Education center 1). The municipal government should facilitate opportunities for change and take away obstacles such as strict laws (ibid.). In Arnhem, a subsidiary is available to support ideas of people for green (Municipal government, Observation 1). Especially with regards to greening of gardens, facades and roofs, in recent years the amount of examples of initiatives in Arnhem has increased (Education center 1, Education center 2, Landscape architect 1, Observation 1). For example, one neighborhood renewed a park completely on own initiative, starting with a little pond and later on green was added. It is important actors have the room to do so, because in this case local residents broke all municipal rules (Education center 1). Another illustration is the Coehoorn Park in Arnhem, which was renewed on initiative of a group of different people that spotted an opportunity. In this project, different ideas were used as input and the local environment was utilized (Landscape architect 2). The Coehoorn Park initiative probably would not have taken place in the more hierarchic structure of the past municipal government (ibid.). As a last example, in the neighborhood Spijkerkwartier several different gardens are created by the residents themselves and many trees are planted, for which the aspect of heat was considered in the motivation (Neighborhood association). In Arnhem, there have also been cases that stranded due to municipal obstacles (Education center 1). It has to be kept in mind that people can contribute a great deal, and possess also expertise and creativity to think of possible solutions (Education center 2, Neighborhood association). Not only urban inhabitant can autonomously work on adaptation, the municipal government in Arnhem also tries to stimulate professionals that could work on heat (Municipal government). For greening initiatives, there are entrepreneurs that see future in projects to stimulate green in the city. An example is a 'vegetable garden' project, in which pots with soil and plants are sold for a low amount of money, making it a simple and easy manner to create green spots by people themselves (Landscape architect 2). For building assignments issued by the government, architects are asked to make a design in which heat is considered (Municipal government, Landscape architect 1). This is presented as an ambition, so actors can develop what they want (Municipal government). Although at the moment not many architects are involved in this (ibid.), there are some that focus on climate proof designing (Landscape architect 1). On a more residential level, the municipal government can provide some directions as guidelines, without putting up constraints (Housing corporation 1). As actors realize heat is a real risk for which a contribution is needed, the market will start to develop solutions as well. Since market parties mainly aim to make a profit, innovation will occur (Housing corporation 1).

The municipal government can create informed actors, which can further spread information in their own manners (Housing corporation 1). Also during a heat event, room to improvise can prove valuable. This is illustrated by the example of a neighborhood in Arnhem that became invested in addressing heat last year, and created a flyer with heat advice and actively provided water at central places in their neighborhood (Governmental organization). In this case, the municipality facilitated the production of the flyer, but the initiative was designed and executed by the people themselves (ibid.). The same applies when a supermarket decides to create a water corner, although for these simple actions there are no big obstacles (ibid.). In professional health care, many networks already exist so the municipal government should not get involved too much (Care facility 1). Only in case co-operation and consultations are not occurring, the municipal government should step in (ibid.). Since it is very time consuming to sit with people at home that receive care, in the future it is



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

possible that creative solutions are invented, such as a digital system to measure water intake (ibid.). Autonomous action plays a large role in reaching all vulnerable people within a municipality during a heat event, for which social cohesion in neighborhoods is very important which cannot be regulated. However, manners to facilitate for this also still need to be found (Governmental organization). Practical experience shows that it helps to create neighborhood networks, so people are more invested in the people living in the same area (Neighborhood association). In society, creative and tailor-made initiatives rise on how to adapt to heat. For example, to make sure no additional heat is created during a heat wave, people can be enthused to eat salads instead of cooked meals (Observation 2). People have to consider what heat means for their own specific situation, and think about measures that are practical (Care facility 1).

The dimension of room for autonomous change

Autonomous change is important, for which people have to be made willing to contribute, both for the spatial and health perspective. As people become more aware of the need for adaptation, they should be provided with the opportunity to take action. Providing information to people on heat within the own environment and all consequences is important, leading to understanding why the theme is important and what can be done. It provides the motive for change, both before and during a heat wave. Plans for action during a heat wave are highly requested, and municipal governments can provide practical guidelines and tips for protocols. Facilitating the capacity to improvise is beneficial since people are able contribute a great deal, and possess also expertise or creativity to think of possible solutions. Both professionals and civil society can be included. Also during a heat wave room to improvise can prove valuable as autonomous action is very important to reach all vulnerable people.

5.2.4 Leadership

Leaders have a positive influence on development, as can be seen as well in organizations outside of the government (Care facility 2, Housing corporation 2, Landscape architect 1).

Visionary leadership

For the issue of heat, a clear vision is needed, or otherwise people within the municipal government do not have a connection to the issue. A few enthusiastic people are needed to encourage this (Housing corporation 1), as has been the case in Arnhem (Municipal government, Observation 2). Support for addressing the issue is not only needed in society but also within the municipal government, and leaders can play a role in that (Education center 2). Without leadership in the municipal government, the issue of heat does not spread out to society. Since developments are still in early phases, people within the municipal government are needed to enthusiasm others (Housing corporation 1). Hereby it can be important that enthusiastic people occupy a certain position within the municipal government, so he or she is being heard (Care facility 2, Housing corporation 2). Also political leaders guiding the municipal government have to be interested in the issue, otherwise people do not get the opportunity to work on it. An example of this can be seen in the municipality of Amsterdam, as the local government has only paid attention to the theme since a few years (Municipal government). It is easier to present this types of issues top down with enthusiasm, than bottom up within an organization (Housing corporation 1, Housing corporation 2). If a local health civil servant considers the issue of heat important, it has more priority to be put into policy (Governmental organization).

Entrepreneurial leadership

Entrepreneurial leadership is important at governmental level, whether this is local or national (Housing corporation 1). The municipal government has to be the ambassador of the issue and of possible solutions for heat adaptation (Municipal government). Leadership within the municipal government in Arnhem leads to governmental departments working on heat (Governmental organization). From a health perspective, leaders have a role in showcasing others that working on



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

the issue is possible (Care facility 2). But also for a greening approach this can be important. For example, for urban agriculture, two civil servants managed to get time to work on it and support initiatives in society (Education center 2). It is important the municipal government addresses heat measures such as green within their own property as well, so someone should keep track of whether that happens (Education center 1, Neighborhood association).

Collaborative leadership

The story of heat has to be shared among many of the people working in the municipal government, in order for an approach to be effective (Municipal government). Examples in practice are seen of people attending heat meetings, and later informing colleagues about the learning points (Observation 2). It is important to bring people together, on the work floor, but also on administrative level (Housing corporation 1). People are needed to think about heat within processes, projects and plan developments, so it is essential they each support the heat approach (Municipal government). Otherwise, there are civil servants that do not support the theme, as experienced in Arnhem as well (Neighborhood association). To further encourage adaptation to heat, also leadership within other organizations is needed (Care facility 2). In Arnhem, an enthusiastic policy adviser does not only try to encourage people within the governmental organization, but also showcases as many examples as possible to actors outside the government (Landscape architect 1). The municipal government can maintain the overview on all projects and bring people into contact with others (Education center 1). Also there, good examples lead to followers (Care facility 2).

The dimension of leadership

Leadership has a positive and driving effect on development. Propagating a clear vision creates support to work on the issue, which is needed both within the government and in society especially since the heat issue is still in its first phases of development. Entrepreneurial leadership is important as the municipal government should be the ambassador of the issue. Leaders have a role in showcasing other actors that working on the issue is possible, and examples have an inspiring function. Collaborative leadership is valuable, since much can be achieved when working together. Within the municipal government there should be people that keep the overview, bring people into contact with each other and encourage others to work on the issue, both within the governments as in society.

5.2.5 Resources

Financial resources

Financial resources always have a role. However, especially for adaptation measures in urban construction and designing public spaces money is needed (Governmental organization). For informal and formal care, not much extra financial resources are needed, as informal actions could include personally handing out flyers, and professional care takers are visiting vulnerable people anyways (ibid.). For measures in healthcare institutions, no appeal has to be made to the municipal government either, as they have funds themselves (Care facility 1). At the moment, only a small amount of subsidiary funds are available in Arnhem for greening, and therefore focus is placed on triggering social actors to act (Municipal government). Individual green initiatives do not require high financial investments from the municipal government. They could, for example, provide materials such as shovels so people can ask for some tools they need for their projects (Education center 1). Actual examples from practice show that small amounts of money are enough to achieve local greening goals (Landscape architect 1, landscape architect 2). There are subsidies for organizations that are involved in stimulating green projects (Education center 2). However, subsidies can be helpful for achieving a certain goal, but often it does not lead to sincere awareness among actors, since a substantial part only participates because of the funds (Housing corporation 1). Awareness is needed, since it is not achievable to keep helping out with financial means. This is valid for market actors (Housing corporation 1), and for civil society initiatives which also require investments from



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

society in order to succeed on the long term (Landscape architect 2). On the other side, small subsidies from governmental bodies can be a starting point for projects to develop (Housing corporation 2, Observation 1). These can be subsidies from regional governments as well (Housing corporation 1, Landscape architect 1), or even European funds (Neighborhood association).

Human resources

Monetary means are less available within the municipal government (Municipal government), however human resources might be more important (Education center 1, Education center 2, Housing corporation 1). The government should possess basic knowledge about the heat issue in her municipality (Municipal government). Knowledge about the importance of the subject and the identification of actors that can address it, is indeed important (Care facility 2). Specific medical expertise at the municipal government is not necessary, since the sector already knows a lot (Care facility 1). The municipal government does not have to possess all expertise themselves, however they should be able to refer to the correct actors and organizations. In order to do so, they should continuously be up to date about developments that are going on and they should make use of the assets that are already there (Education center 1). The same goes for several other supporting actors for green initiatives, so organizations can connect people that are working on similar projects (ibid). People should be able to go to the municipal government for simple and practical questions to help them further (Education center 1, Neighborhood association). Practical aid can be given by conducting human labor, for example if the residents of a neighborhood want to plant trees (Neighborhood association). Also people in policy and people working in projects need to get time to think about the issue (Municipal government, Education center 2). If there is expertise and willingness to act, financial means can be found somewhere (Care facility 2, Education center 2).

Authority

The use of authority for decisions to favor green before asphalt is a constant struggle, and a consideration of the different interests is always involved (Municipal government). For the municipality of Arnhem, there is no official regulation with regards to spatial development for heat. The municipality adds the theme as a suggestion in construction permits and development plans, depending on the heat sensitivity of an area (ibid.). This approach was favored due to the expectation that more can be accomplished from voluntary action than when regulations are in place, since people tend to dislike regulation (ibid). The municipal government can give advice about preferred developments in construction in relation to heat adaptation, as happens with energy at the moment. This should not be strict regulation since people need to become aware of the issue and act voluntary because they see the added value (Housing corporation 1). However, for the greening of public space, requirements could be a little stricter than they are at the moment (Landscape architect 1, Observation 2). For the majority of important actors to join in at some point, regulation might be convenient to justify why people are working on the topic (Housing corporation 2). Specifically for greening space though, it would be difficult to work with hard norms in practice so that is not desirable (Landscape architect 1). On the healthcare side, the municipality has a legal care duty towards her citizens, which means the issue of heat has to be officially addressed (Governmental organization). However, their care could already be expressed by organizing a theme meeting between social actors, as has been done in Arnhem (Governmental organization, Observation 2). Strict regulation with regards to this topic does not seem plausible (Care facility 1).

The dimension of resources

Financial resources are always important to a certain extent. However for heat, especially money is needed for adaptation measures in urban construction and redesigning public spaces. To stimulate green initiatives relatively low financial investments are required as support for the starting phase, as is the case for supporting civil initiatives for awareness raising and social cohesion building. Human resources might be most important, as there should be people within the municipal



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

government with knowledge and time to support societal developments. Not all expertise has to be possessed within the government, as it is mainly key to be updated what developments are going on and to be able to refer to relevant actors and organizations. Authority with regards to the health perspective does not seem relevant, as strict regulation does not seem plausible. On the spatial side, more developments are expected to take place from voluntary action and positive directions than when regulation is in place. However, minor regulation could contribute to broadening the involvement of actors.

5.2.6 Fair governance

Due to more participation in the policy process, variation start to exist in the municipality of Arnhem. Participation leads to governance within a new frame (Municipal government). However, governance should ideally always comply with the criteria of fair governance (Governmental organization, Housing corporation 1, Care facility 2). Policy development and participation is considered more important for urban planning, than for social developments for which social awareness and linked actions are mainly important (Governmental organization). For example, policy in formal health care should be based on scientific knowledge and insights of professionals (Care facility 1).

Legitimacy

The municipal government serves the public interest, and every action must have legitimacy (Municipal government). Specifically for greening, more public support is probably automatically achieved at the moment society gets involved in some projects within the vision of the municipal government (Education center 1). Initiatives should have that public support (Education center 2). To maintain its legitimacy, the government organizes input meetings during which people can express their thoughts about a project or development (Landscape architect 1). However, within the participation ideal, the municipal government should be careful that the process does not become a dialogue between civil parties, since there is still a role for the government (Neighborhood association). Since the municipal government is funded by public money, it should demonstrate some involvement and not put everything back to society (Landscape architect 2).

Equity

Addressing the urban climate is only one theme amongst many others in which different interests play a role, that have to be taken into consideration (Municipal government). For example, often the municipal government has to decide between space for parking lots and space for green. However, it is important that sometimes green gets the preference over other interests (Landscape architect 1). Equity also plays a role in the fact that the municipal government cannot give a subsidy to one group, and not to another in case they are working on similar projects (Municipal government). In addition, when plans are being made for changes in a neighborhood, people should get an equal opportunity to have a say in it, rather than it would be the decision of a small group of people. However, this does depend on the scale of changes that are to happen (Education center 1).

Responsiveness

Upcoming forms of governance are more focused on what people want and less about what the municipal government wants (Municipal government). In Arnhem, in the near future a relative radical new development is taking place, allowing neighborhoods to determine own budget allocation (Municipal government). Practically this means that in one neighborhood more parking lots may come into existence, while in other areas more trees may arise (ibid.). A neighborhood should be able to make an appeal to civil servants of the municipal government (Governmental organization). So if people think the heat issue is important, they have to prioritize it themselves. However, it is questionable if this would be the case at the moment (ibid.), as is the extent to which people are of actions of the municipal government with regards to the theme of heat (Housing corporation 1). For greening initiatives in civil society the municipal government does not want to



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

pose an obstacle, making sure possibilities are provided even if the own approach would have been different (Municipal government). However, to maintain a well-functioning municipality, in some policy areas the municipal government must keep control. In those cases, it is important to listen to people as much as possible (ibid.). In Arnhem the example of the Jansbeek shows that the municipal government has paid attention to the requests of society, before putting energy into the project (Landscape architect 1). Another example of responsiveness is the case of a neighborhood in which the municipal government wanted to cut down trees, but the local residents did not agree. After several meetings with the residents, the municipal government decided to listen to their request (Neighborhood association). It might not be as clear how responsive governance should be specifically for heat, as the issue is not well known enough among people yet (Governmental organization). For health care, it might not always be the best approach not to act if that is what society requests (Care facility 2).

Accountability

In the new governance structure, responsibility of civil society is not non-committal, as is the case when the municipal government takes decisions (Municipal government). The government should always be accountability to some degree, as do other actors dealing with the issue (Governmental organization). This is important, even if a part of society is not interested in it. Accountability also provides for the opportunity to explain how and why certain developments have taken place, which leads in turn to more public support (Care facility 2). Part of governance is showing that the municipal government cannot do everything and that people have an own responsibility (ibid.). Also, the municipal government should mainly be accountable for the overall vision and approach, however if initiatives fit within those conditions that is enough (Education center 1, Education center 2, Neighborhood association). A clear statement from the municipal government on the taken course for heat helps people to understand whether initiatives fit within that approach (Education center 2).

The dimension of fair governance

Governance should always meet the criteria of fair governance. Legitimacy is important as the municipal government serves the public interest and is funded by public money. With involvement of society in projects, more public support can be achieved. Equity plays an important role in considering different interests within decisions, for example within decisions about the design of shared spaces. For the issue of heat, it is not so clear yet how responsive governance should be as it is questionable how well informed society is about the issue. Although upcoming forms of governance are more focused on what people want, it might not be the best approach to not act if that is what society requests. The municipal government should always be accountable for its decisions, as do other committed actors. Accountability is important to communicate the chosen direction, even if people are not interested.

5.3 The relevance of the ACW dimensions

In the case study, during eight interviews enough criteria have been discussed in order for the interviewees to score the dimensions to what extent he or she perceived the dimension as relevant. All interviewees indicated to find it very difficult to determine which dimensions are more important than others, since none of the categories is not important (Education center 2, Care facility 2) and they are somehow connected to each other (Governmental organization, Education center 1, Municipal government). The scores are presented in Table 5.2.

Dimension	Highly relevant	Medium relevant	Less relevant
Variety	4	3	1
Learning capacity	5	3	0
Room for autonomous change	6	2	0
Leadership	3	5	0
Resources	1	4	3
Fair governance	4	1	3

Table 5.2. Scoring of ACW dimensions by social actors. Total n = 8.

Although these scores are taken into consideration, the assessment of the criteria of the ACW below is mainly based on the analysis of the qualitative data gathered in the case study. As is shown in Table 5.2, in general the dimensions of variety, learning capacity and room for autonomous change are perceived as highly relevant by the social actors, as also can be concluded from the analysis and corresponds with the categorization of these dimensions by Gupta et al. (2010) as main categories. Leadership and resources are ranked a little less relevant than these main dimensions. No consensus was found on fair governance, although this dimension proved difficult to fully understand within limited time.

The analysis of the case study has resulted in the assessment of the criteria of the ACW as presented in Figure 5.6.



Figure 5.6. Assessment of the ACW criteria based on the case study.

Variety in problem frames, involvement of multi actor, multi-level and multi sector, and diversity in solutions are all highly relevant for the multiple-sided issue of heat. Redundancy is qualified as medium relevant, as it is acknowledged that heat is a relatively new subject for which the exact direction is not known yet. However, most solutions can be placed within the criteria of diversity by all contributing to better adaptation, rather than being exactly the same. Within the dimension of learning capacity, the criteria trust, single loop learning, discuss doubts and institutional memory are

**Facilitating local adaptive capacity for urban heat**

Master thesis Hester van der Sprong

considered highly relevant. Establishing trust and good communication is key for future co-operation. Single loop learning is important, as it represents the learning process needed to develop further awareness and understanding about heat and how it can be approached. To discuss doubts and to monitor and evaluate progress is key in the process of positive development. Double loop learning is qualified as medium relevant, as the change towards more participation in decision making regarding the own environment can be viewed as changing the assumption behind institutional patterns that governments are the main actor. This also applies for heat and its possible approach, however participation is not occurring due to the heat issue. Room for autonomous change is considered highly relevant in entity, as developments in society are very important, both for health and behavioral change as for spatial planning.

As mentioned above, the dimension of leadership is considered medium relevant. Leaders prove to have potential to be a positive driving force for development, in which aspects of visionary, entrepreneurial and collaborative leaderships come across. However, especially compared to the first dimension, leadership has more a supporting role. This also applies to resources, that are almost always able to contribute to development, but might not be required to a large extent in any case. Financial resources are qualified as medium relevant, as it as an important value in supporting early development for which relatively small amounts are required. Human resources are considered highly relevant and the most important resource, to support society with knowledge and aid if necessary and to monitor and assemble all recent developments. On the contrary, authority linked to regulation seems not to be desired and is therefore assessed as less relevant. The fair governance criteria of legitimacy, equity and responsiveness are qualified as medium important, since the municipal government should always meet the criteria of fair governance in general. Specifically for heat, they have to be taken into consideration although there is no agreement on their actual importance. Accountability does prove to be highly relevant, as it is the manner in which the chosen approaches can be explained and justified.

6. Expert study

In this chapter, the results of the expert study are discussed. First, several important insights derived from the expert study are discussed with regards to the context of the heat issue in Dutch municipalities. Second, aspects of the local urban heat issue linked to the dimensions of the Adaptive Capacity Wheel are discussed. After each dimension, a short summary is included. Third, the relevance of the ACW dimensions is discussed based on the expert study.

6.1 Context of heat within Dutch municipalities

The theme of heat is to an increasing extent relevant for Dutch cities (Expert 4). It can be considered an issue, since Dutch cities are not built on dealing with heat. Urban municipalities are compact and with a high percentage of petrified surface, which is not beneficial for cooling (ibid.). Additionally, heat poses a risk for vulnerable people. The group of vulnerable people in the Netherlands is increasing, since the population is aging, people are living independently till a higher age, and the healthcare sector has seen considerable financial cut backs (Expert 1). At the moment, many municipalities question whether they should work on the issue of heat, exploring whether it is an issue for them and whether they should act. They are not always aware of the fact that if heat is not taken into consideration now during urban redesign projects, the next opportunity arises in 40-50 years (Expert 4). Politics has a large influence on whether the issue gets enough attention (Expert 1, Expert 2). In many municipalities, the first step yet is to prioritize the topic of heat. Therefore, it is important that the discussion about the issue is kept alive, for example by organizing informing meetings since heat is a relatively new theme (Expert 3). However, the urgency for heat is not present in many urban areas, as more attention is paid to water issues due to higher visibility (ibid.). Meetings organized to explore the possibilities for local heat plans do not draw that many municipal governments (Expert 1). Currently, much is known about heat in the city and its impacts, both for the city as for the health of people. The main question now is how to involve people to get them to develop adaptation (ibid.). In the summer of 2015, a public study was conducted with the purpose to make society aware of the aspects of heat, and to make people familiar with the topic (Expert 3). The combination of raising awareness about the risks of climate change on local scale and the occurrence of an event provides opportunity to develop further develop actual action (Expert 1). In recent it is seen in practice the theme is starting to develop, in urban planning but also with a health motive (Expert 1, Expert 4). People in society also become more aware of urban climate and heat (Expert 2). Heat is recently incorporated in several study programs at universities, such as in the minor Climate proof city at the Hogeschool van Amsterdam (Expert 3) and in Wageningen University after lobbying for its importance (Expert 2).

In the national Delta program, it is decided that municipalities have to take climate resilience into consideration in their acting starting from 2020. In 2050, they have to be climate resilience, meaning also public spaces have to be designed to deal with heat (Expert 3). Additionally, starting from 2018 climate adaptation will be part of the reporting duty of municipalities to the Ministry of Infrastructure and Environment within the law public health every four years. However, this reporting still has to shape itself in the next years (Expert 4). At this point, many municipal governments are in a stage in which they are trying to determine what can be done on local level within their municipality. Knowledge institutions can support this process by providing information about appropriate measures in urban development, for example for different types of neighborhoods (Expert 3).

6.2 Heat and the dimensions of the Adaptive Capacity Wheel

6.2.1 Variety

Variety of problem frames

Climate change effects such as heat are presented as risks in the Netherlands, and they are mainly



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

approached from an environmental and spatial planning perspective (Expert 1). More recent, also a health perspective is taken into account (Expert 4). Variety in framing and perspectives is important, since different time scales and impacts of climate risks need to be considered (Expert 1). For heat, the expectation is the effect will increase in an accelerating pace in the next fifty years. Spread over this time period, different approaches have to be taken into account. For short term, these are health plans and behavioral change, for the middle term these are greening initiatives and for the long term urban planning have to be considered. However, for all three this is the moment to start working on them (ibid.). Different approaches have to be coupled in order to have the full heat issue addressed (Expert 3). Room for different approaches is required to get everybody on board (Expert 2). The approach for health is really different from measures that aim to cool the city, however, they link with each other. When the city is completely climate proof, heat plans are not necessary anymore, however this is probably not a realistic idea (Expert 2). Also in urban development, health and wellbeing gains an increasingly important role, a development called healthy urban living. For example, the reason there is more green in cities has an important health aspect (Expert 4). The municipal board should collect the overview of all options for heat and acknowledge cohesion between them, which is not addressed yet at the moment (Expert 1). The approach of heat in redesigning a city, also benefits secondary actors since redevelopment creates a more attractive city. Therefore, climate adaptation should not only be defined as a problem but also as an opportunity providing benefits (Expert 4).

Diversity of solutions

People must work on diverse solutions, since there are varying areas at which heat has an influence, such as health, labor productivity and urban infrastructure (Expert 3). Adaptation is about technical and physical spatial measures, behavior of people and about education (Expert 4). For the spatial approach, in general it is known what can be done and there are different options, as can be found in literature (Expert 2, Expert 4). More green and water helps for the cooling of the city. Trees provide shade and evaporation. Positioning of buildings with regards to the sun and towards natural ventilation is important as well (Expert 4). Initiatives for heat include greening (All experts). There is no blue print approach, tailor made solutions are necessary (Expert 4). For a health perspective, a local heat plan is important, which seems to be a little forgotten at the moment (Expert 1). Part of this are very basic measures such as the warning to nursing homes and elderly people to drink more and not to go outside at certain times. This communication is different than to what an architect can do and different again from the message towards urban inhabitants (Expert 2). Heat health plans are effective, but do not address the urban cause of buildup heat. Therefore, different solutions are needed (Expert 3). A nice scenario would be that the vulnerabilities and risks of heat are identified and that the whole is approached from health, green and urban planning perspectives in order to choose the best fitting solutions (Expert 1). However, solutions do have to benefit the heat issue. It must be considered when really working on heat, that green facades and green streets are more important and effective than green roofs for example (Expert 2). The most effective solutions must be communicated (ibid.).

Multi-actor, multi-level and multi-sector

Different actors have different roles within a variety of solutions (Expert 4). Variety of actors is important, since all of them need to be included and the issue of heat has several interfaces (Expert 3). A heat plan takes several months to be effectively constructed, planting trees takes up to some years to have effect. For considering changes in the urban planning of a city, several decades are needed. For all these approaches, completely different actors are needed (Expert 1). Politicians and municipal government, civil society and professionals are relevant (Expert 2). The municipal government is still an important actor, since adaptation is very context specific (Expert 3) and also since health is a local governmental topic by law (Expert 4). However, the government cannot work alone and neither can civil society and market parties (Expert 3). People in green solutions have to think about a different theme than people in health care, so different professional expertise is



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

required but they add up to the overarching issue of adapting to heat (Expert 1). The GGD (municipal health organization) has an advising role, and actors such as water boards, housing corporations, elderly organizations also have roles (Expert 4). At the moment, researchers are advising municipalities on which measures can be taken (Expert 3). It would be desirable that different approaches and different actors could help each other. Reality is that people are trying to find solutions only within their own sector still, while there are already good solutions from a different angle (Expert 1). In order to put together a heat plan, involvement of health organizations, municipal health institute, the federation of care providers and volunteers organizations is needed (Expert 1). Neighborhood teams and all people that link to vulnerable people are relevant for implementation (ibid.). Care facilities, health insurance companies and housing corporations have a role (Expert 4), although the latter does not often take heat into account yet (Expert 3, expert 4). For example, health insurance companies have an interest in healthy people and could invest (Expert 4). Even though adaptation from a health perspective is a local theme, the national government support local governments and other local actors with a program to formulate health promoting policy (ibid.).

Redundancy

Smart thinking needed, for example, it would be a waste of money to invest hundreds of million in re designing the city if with a couple of million a good working health plan can be constructed that aims at the same (Expert 1). Which approach to take has to be taken in careful consideration in the municipality (Expert 4). It is often said that all green a positive step is in development (Expert 4), however not all green is beneficial for heat as placed in natural cooling areas by wind for example (Expert 2). Solutions can have different time frames (Expert 3), aiming at different aspects of the issue. During a heatwave, personal measures are needed such as more drinking and cooling. This has to be delivered both to vulnerable people in care facilities as to vulnerable people that live at home. Only communicating to drink and cool yourself is not enough to make sure everybody does so (Expert 1). However, this indicates different manners to reach different people, without duplication of measures.

The dimension of variety

According to the experts, the dimension of variety is important since there are different perspectives by which the issue of heat can be approached, for which the solutions have effect on different terms. Health plans enable short term adaptation, greening initiatives make for middle term adaptation and measures concerning urban planning address the long term. The approaches are connected, although for each different actors are needed. Diversity in solutions is needed since they have to be context specific, although redundancy might not be necessary when possibilities are thought through.

6.2.2 Learning capacity

It is difficult to indicate how important learning capacity really is, since developments are all in very early stages and no real, specific implementation has taken place so far (Expert 1, Expert 2).

Trust

The exchange of information between actors on experiences and ideas that could work for heat adaptation could support further progress of the process, however at the moment only the first steps are taken (Expert 3). The municipal government has a role as facilitator for the rise of networks within cities, as can also be seen between cities at the moment (Expert 4). Examples in practice, although not about heat specifically, show that that municipal governments have an important role in stimulating collaborations, without being leaders in the project development itself (ibid). Establishing trust can be considered a condition for beneficial co-operation and collaboration.

Single loop learning and double loop learning

Adaptation has to happen at the right moments, for example when innovations in the city are planned so it does not require huge amounts of money (Expert 3, Expert 4). Understanding the issue of heat lead to insights and awareness on when these moments are. Technical knowledge is available, and it is an upcoming phenomenon that heat and health are taken into consideration in the process of renewing as well (Expert 4), indication a learning process. A heat profile can be made of the city, including all vulnerable locations such as hospitals, nursing homes and primary schools, so it can be considered whether actors are located at hot spots and if something should be changed about that during reconstruction (ibid.). Sharing experiences with other actors stimulates the process of development. Also successful examples could inspire others (Expert 2). People are very interested how certain issues are dealt with in other cities, by which they can learn from best practices (Expert 4). Reality is that people learn from each experience, for heat must be evaluated what has been done and what worked (Expert 1). The idea of a local heat plan is to inform everyone at the start of the summer again about what to do, spread among actors since it can be seen that when no heat wave occurs, preparedness drops as well (ibid.).

Discuss doubts

At the moment, one question that arises within municipalities is when enough has been done, which does not have a strict answer yet (Expert 3). A doubt that should be discussed for heat, is that there is always uncertainty about the exact extent to which heat is going to be a problem in a city (Expert 4). Very robust but expensive measures or flexible and cheaper measures can be taken (ibid.). The consideration can be made between whether a heat care plan is drawn and cool places are created, which is relatively low budget, or whether urban planning measures are taken (Expert 1). This links to the question to what extent people want to structurally plan for the risk of heat. The consideration between high cost urban measures and low cost health measures are not yet made in practice, since the perspectives have not been bridged well enough yet (ibid.). Flexibility and variety prove to be popular in adaptive management strategies (Expert 4). For heat, there is also the issue of haziness which actors have which roles and which responsibilities (ibid.).

Institutional memory

In order to monitor progress, it is difficult to show the effects of measures since there are many variables that influence heat (Expert 3). However it can be useful, in case possible, to make a zero measurement, so it can be demonstrated what results certain measures have achieved (Expert 2). It is possible to see whether reality complies with the goals at a planning level, for example when one aims to have a cool place for everybody within five minutes walking (Expert 3). A monitoring system for the progress of the process of policy planning and awareness raising is conducive to discuss the issue (ibid.). There are different mechanisms to monitor how Dutch municipalities are doing, not only with regards to technical or physiological aspects, but also in the policy process (Expert 4). An upcoming development is mapping of how the process of developing adaptive capacity is going in a municipality. This framework has been created by the Dutch Environmental Assessment Agency and now has to be demonstrated in different municipalities (ibid.). At this moment, there is no local control system that checks whether actors prepare well enough in case of a heat wave. However, when a heat wave occurs, extra attention is paid again to what is stated in permit requirements by security services (Expert 1).

The dimension of learning capacity

From the expert study it appears not many examples are available about cases in which learning is exhibited, either from health or spatial perspectives, so no specific statements can be made based on experiences. Municipal governments can have a role in facilitating collaborations, for which trust is important. Single loop learning is considered key to develop better practices, which can also occur



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

also based on experiences of others. At this moment, double loop learning is less relevant. The main doubt that needs to be discussed concerns which risks and costs people are willing to accept, and which combination of health and spatial approach is chosen. Monitoring the process is important for evaluating what has been done, and what can be done.

6.2.3 Room for autonomous change

Access to information

A heat study conducted in public in Amsterdam during the summer of 2015 drew much attention, mainly from the media (Expert 3), indicating the topic aroused interest. The same summer, also more media attention was given to the issue of heat connected to green (Expert 2). Autonomous change is very important, since heat is an issue that cannot be solved by governments alone due to the fact only a small percentage of land is owned by the municipal government (Expert 2). It is important to get civil society and market parties involved, and collaborate with them by explaining the importance of it (Expert 2). Providing enough information, in order to facilitate social actors to work on adaptation by themselves is very important. For example, architects can be stimulated (Expert 4). A project is running with the aim to create an overview for municipalities what the effects of heat in several cities are (Expert 3). This can be translated as information for inhabitants. Advice can be given to people, for example not completely paving their garden, which is important as people can mainly decide what they want to do with their private property (Expert 2). Educating people enables them to make an informed decision (Expert 4). An interesting initiative by researchers in collaboration with the municipality of Amsterdam, is to develop a climate adapt tool in which people can directly see if they are living in a hot spot area. Possible adaptation measures are provided directly as well. Key is that it is available in one swipe, without having to look up all additional information (Expert 2).

Act according to plan

Especially in the case of a heat wave, plans and protocols are important. In a heat plan, practical tips are included such as sit in the shade, drink enough and open up windows in the morning while closing them in the afternoon. These tips contribute to developing adaptive capacity in society (Expert 4). A local heat plan can organize action during a heat wave, among care professionals and other actors (Expert 1).

Capacity to improvise

Since the issue of heat is not 'simple' enough to clearly demarcate, there should not be strict rules but instead instructions and suggestions can be given to include climate resilience in urban designs (Expert 3). It provides freedom to urban architects and landscape architects on how to incorporate heat. This is not needed because the municipal government does not poses creativity themselves, but due to the fact that it is difficult to make general demands that are specific enough for heat (ibid.). In addition, people can be creative themselves and profit from opportunities from different aspects as they present themselves (Expert 4). This is illustrated by an example of a house for which a green façade was made to save energy due to isolation, but in the summer is also cools the house (ibid.). At the scale of his own house and garden, an urban inhabitant decides himself what he wants to do so a bottom up approach is needed (Expert 2). Municipal governments have an essential role in enthusiasm civil society (ibid.). The municipal government should encourage smart and fitting ideas that support cooling the city, and often there are other benefits as well (Expert 4). For heat measures such as greening autonomous change does depends on the direction is it taking. If it is seen that people still prefer to put only bricks in their garden, subsidies or regulation might be necessary (Expert 1). For health care during a heat wave, the most important thing is that people are available to check up on vulnerable people, preferably multiple times a day. Action within society is needed as people or organizations can mean much themselves (ibid.). At the moment, municipal governments try to stimulate social networks and consider the value a neighbor or a family member



can have in case of a heat wave, since additional professional health care is very expensive (ibid.).

The dimension of room for autonomous change

Autonomous change is very important, since heat is an issue that also requires the input of civil society and market parties. Provision of information is important to educate people and make them aware of the issue of heat and possible solutions. Especially during a heat wave, plans and tips become important to guide people on how to act. Since the issue of heat has multiple aspects and various ways to approach it, the municipal government should encourage society to innovate. People can be creative with solutions, capturing their personalized ability to contribute to the local context.

6.2.4 Leadership

Visionary, entrepreneurial and collaborative leadership

In municipalities in which action is taken concerning heat in the city, it can be observed there are municipal officers that take the lead, out of interest, concern or political motives (All experts). It always helps if there are people taking the lead, visionary to make sure there is support for developments, and leaders might make access to financial or human resources easier (Expert 4). People are also needed to turn visions into actions and bring people together. People fulfilling these leadership roles could be civil servants or politicians (Expert 2). However, also other flagship people in society can adopt the theme and be a driver for developments (ibid.). Leadership is almost always pragmatic, since the person in quest would like to see something change in reality. Within the government, those leaders also try to spread their enthusiasm to their colleagues (Expert 3). Within every organization, it is important that the priorities of the issue presented are acknowledged, since they have to organize themselves especially with regards to awareness (Expert 1). Meetings can be organized in which people are informed about the risks and about their own role. From the government, this can further be spread to other actors as well (Ibid.). The process would be difficult if all developments are bottom up (Expert 4).

The dimension of leadership

Leaders have a key role in strengthening any development and in the municipalities in which people work on the issue of heat, leadership is observed. Visionary leaders create support for developments, entrepreneurial leaders aim to achieve actual change in practice and collaborative leaders connect people, for example by setting up meetings.

6.2.5 Resources

Resources in general are important, especially human and financial resources (Expert 2, expert 4).

Financial resources

Inspiring cases are important to serve as an example for other neighborhoods. The municipal government could facilitate for establishing these examples (Expert 3). It is not the task of the municipal government to fund every development, however, a little seed money is needed to facilitate the start. Also in order to provide education and information, and to make it easier to raise funds for social actors (Expert 4). For greening initiatives for climate adaptation purposes, financial stimulants can play an important role in the emergence of more green in the city, as the municipality of Arnhem is doing at the moment (Expert 2).

Human resources

In the first phases of development, in which many municipalities are at the moment, it is especially important that people at the municipal government have enough time to work on this theme without too much pressure, since a lot of pioneers work (Expert 3). It is almost needless to state that within the municipal government knowledge, expertise and human capital hours need to be available in order to stimulate adaptive capacity in society (Expert 2). The specific heat issue is



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

different in every city, so it is important for a municipal government to have knowledge about heat within the own city (Expert 4). Money can be used to hire external expertise, but also the own capacity can be used to help actors think about the issue (Ibid.). In practice, this does not happen for heat adaptation yet but it can be observed for developments within the concept of healthy urban living (Ibid.). To be able to adapt during a heatwave requires some organization from the municipal government and thus preparation by people is needed (Expert 1). At the moment, a heavy emphasis is placed on communication, which is working well, but a real organization to aid people during a heatwave is not seen yet (Ibid.). The municipal government has a role as supervisor to steer projects in the right direction, without getting involved too much themselves (Expert 4).

Authority

Not much specific regulation is needed, since the issue of heat is not concrete enough with regards to demonstrable specific approaches for each situation. It is a theme that has to be mainstreamed with other plans (Expert 3, Expert 4). In other words, a strict directive is not necessary, but a conscious reconsideration in each design for the city for example is needed, with attention for heat and thermal comfort (Expert 3). In the Netherlands, it is questionable how desired rules and laws are with regards to the heat topic in urban planning since people are not keen on regulation (Expert 2, Expert 4). However, fact is that it could be effective if there would be a simple requirement that only a certain percentage of the garden can be paved surface (Expert 2), which could always be an option as it is in other countries when an undesired direction is taken in society (Expert 4). For heat and care, regulations are also very limited (Expert 1).

The dimension of resources

To facilitate adaptive capacity, mainly financial and human resources are important. Financial resources could especially support the first phase of development in society and can be used to subsidize examples. Human capital in the municipal government is needed to carry out the theme, keep the overview and function as information source. Authority is less important, since regulations do not have a large role at the moment.

6.2.6 Fair governance

Fair governance is as much important for the heat issue as it is for other issues (Expert 1, Expert 3, Expert 4). One has to be careful with praising the participation society, since it also came to rise as the result of shortage in budgets (Expert 2). For several heat related themes it might be important to keep control within the municipal government in order to make sure the right developments take place, for which civil society does not possess the knowledge to make decisions about (Ibid.).

Legitimacy, equity, responsiveness and accountability

Governance means a relatively new form of governing which the municipal government still has to figure out (Expert 4). A smart government drafts some frames and is active in stimulating society. By doing this and involving people into issues and making them part of the solution, a lot of support can be created (Ibid.). It is the task of the municipal government to pay attention to the fair governance criteria. Simple examples are whether everybody is involved, at the same time, and whether everyone's interests are considered. Especially when participation becomes more important, it is important to guard the process (Ibid.). It is also a task of the municipal government to have knowledge of the heat issue, even though society does not ask for this specifically, since people cannot make an estimation about how important the topic is (Expert 3). Civilians are not in possession of enough expertise to make decisions based on analysis and extent of the issue and the opportunities (Expert 2). An additional issue for heat is that a large part of the population is enjoying the warm period. That makes it difficult to mentally relate with people that are experiencing negative effects (Expert 1). The municipal government has a care duty and that means they have to have knowledge about heat, because the average citizen does not have knowledge of all risks and issues. Once you have familiarized yourself with the issue, you have to communicate with people



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

and comply with the other criteria of fair governance (Expert 3). Explaining what has been done is important, so people can read about it and understand the moves made (Expert 2). For heat, responsibility questions play a role, but board directors cannot get away with the argument that there was force majeure because a proactive attitude is requested. In that sense, the fact that there is time spent on the issue of heat can be justified (Expert 1). However, participation also means that the municipal government is not solely responsible anymore, financially and administrative (Expert 4).

The dimension of fair governance

Complying with the criteria of fair governance is always important, especially for the municipal government as a public institution. When considered specifically for the heat issue, experts argue it is important to ensure public support and gain legitimacy. Equity is to be maintained in the process, especially in the upcoming participation society. However, responsiveness on this issue depends how aware people are of the heat issue and regardless, it should still be picked up by the government. By being less responsive, accountability and explaining what has been done becomes more important.

6.3 The relevance of the ACW dimensions

Combining the insights of the expert study as presented above into the assessment of the criteria of the ACW, leads to the distinction as presented in Figure 6.1. The figure aims to create nuance between the different criteria, however it does not claim that criteria that are assessed as less relevant are not important at all. Based on data collected in the expert study, the difference between the dimensions variety, learning capacity and room for autonomous change as main dimensions versus the dimensions leadership, resources and fair governance as supporting dimensions can be acknowledged. Although both needed, conditions such as leadership, resources and fair governance fulfill a different function than process conditions such as variety, learning capacity and room for autonomous change.

From the expert study, it can be concluded that variety in perspectives, actors and solutions all contribute to the larger entity of the issue of heat, which is a complex issue as it also links to many other developments and interests. Redundancy is qualified as less relevant, as this might not be necessary since there is quite some scientific knowledge on risks and effective solutions. The insights regarding learning capacity are partly based on expert assumptions, as it has not been exhibited in practice yet. Building trust for collaboration and single loop learning are considered to be basic to further development. Double loop learning is assessed as less relevant, as no direct indication has been given it is important. Although a change within institutional patterns concerning civil participation can be observed, there is indication this is specific for heat. Openness about doubts is mainly relevant for discussing which course of action is to be taken, monitoring and evaluation are important to clearly map what has been discussed and done, and what can be improved. The criteria of room for autonomous change are all highly relevant, as autonomous developments within society among different actors are very important.

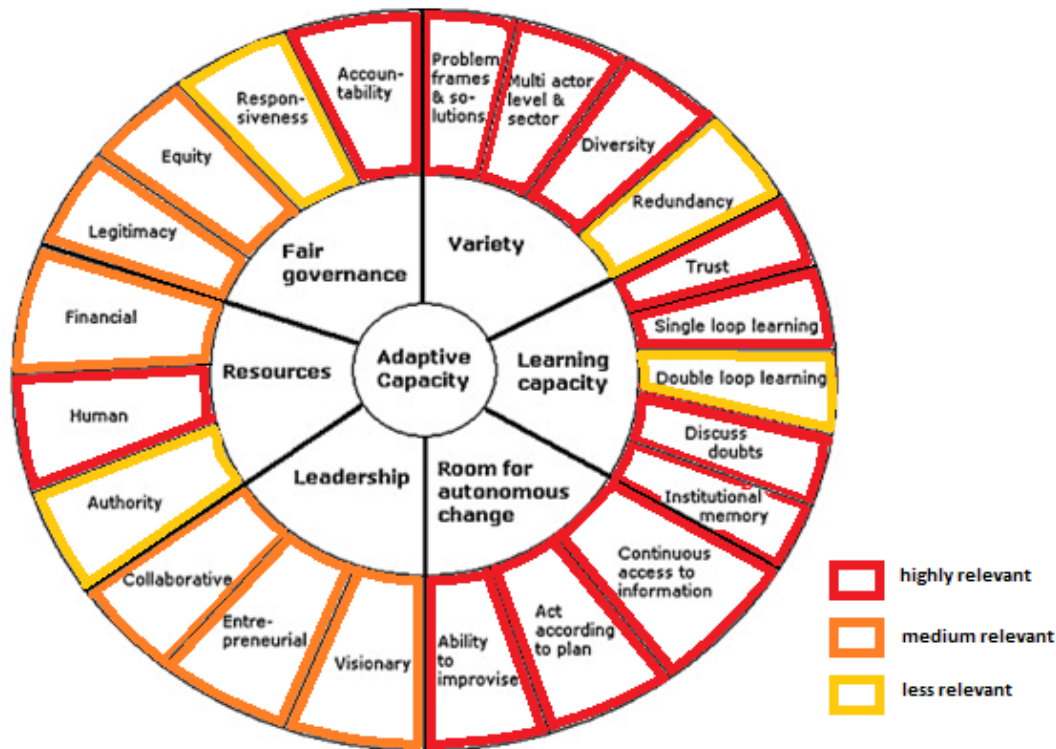


Figure 6.1. Assessment of the ACW criteria based on the expert study.

Both the dimensions leadership and resources are considered to be supporting of new developments. Without leaders, no change would occur and without resources, very limited action would be possible. They are not key dimensions, since also leaders within leaders in society can play an important role addressing the issue and the same is valid for resources. Although it might help in a starting phase, resources within society are for further development more important than those within the municipal government. Financial resources are qualified as medium relevant, as sources of funding can also be found outside the government and authority is considered less relevant, as regulation might have a minor place within the heat issue. On the other hand, human resources are very important as people are needed to provide direction, guidelines and keep the overview. Fair governance is important for every issue, as a basic value within Dutch society for governmental bodies. However, the criteria of legitimacy and equity do not appear highly important for the theme of heat and therefore qualified as medium relevant. Responsiveness for heat in particular is assessed as less relevant, mainly based on the suggestion the municipal government should work on the issue of heat, even if this request does not come for society. Accountability on the contrary, is highly relevant to justify the chosen approaches.

7. Conclusion

The aim of this research project was to contribute to the theory on how local governments can facilitate the development of adaptive capacity in society for local heat. This ability is referred to as institutional adaptive capacity. A literature study, case study and expert study have been conducted in order to research which dimensions of the Adaptive Capacity Wheel, as developed by Gupta et al. (2010), could be most relevant for stimulating local heat adaptation in Dutch urban municipalities. These dimensions are (1) variety, (2) learning capacity, (3) room for autonomous change, (4) leadership, (5) resources and (6) fair governance, and are each defined by several criteria. The relevance of each criteria for local heat according to this research project, is indicated in Figure 7.1 for all three studies.

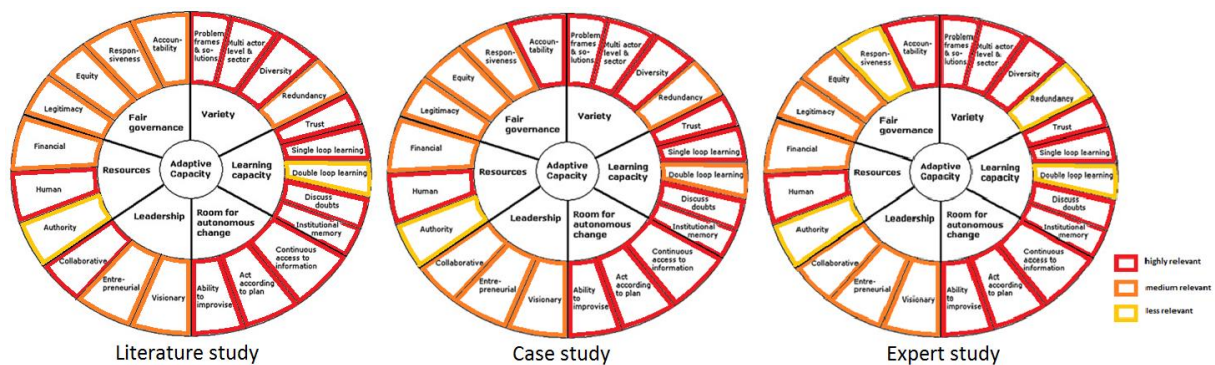


Figure 7.1. Relevance of the ACW criteria for the heat issue, based on a literature study, case study and expert study. For full size figures, see p.X, p.XX and p. XXX.

Variety

The dimension of variety is highly relevant, as there is variety in perspectives, multi-actor, multi-sector and multi-level involvement, and a broad diversity in solutions that all contribute to the context of the issue of heat. All approaches, that have different time scales, have to be combined with a focus on the coherence between the physical and the social aspects. There are different types of actors mentioned as important to include, such as both health and spatial planning professionals, but also broader market parties and civil society. Only the criteria of redundancy is considered medium relevant in the literature and case study, cause even though heat is a relatively new subject for which the exact direction is not known yet, possible measures seem to complement each other and only specific measures overlap completely. In the expert study, redundancy is even qualified as less relevant, as quite some scientific knowledge is present about situations and fitting solutions.

Learning capacity

Within the dimension of learning capacity, the criteria trust, single loop learning, discuss doubts and institutional memory are considered highly relevant. Establishing trust and good communication is key for future collaboration. Single loop learning is important, as it represents the learning process needed to develop further awareness, better understanding of heat and the development of better practices. Scientific uncertainty about certain measures seems not to be large issue as much is known, both for health and spatial planning although it is addressed to some extent in literature. However, especially the question how to achieve change and how to address and involve society is very open, which leads to the need to discuss doubts about chosen approaches. An additional issue to discuss concerns which risks and costs people are willing to accept, and which combination of health and spatial approach is to be chosen. Monitoring the process is important for evaluating what has been done, and what can be done in the future. Resulting from the literature study and



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

expert study, double loop learning is qualified to be less relevant, as it is not indicated such change has to occur for heat. Concluding from the case study, double loop learning is qualified as medium relevant, as the change towards more participation in decision making regarding the own environment can be viewed as changing the assumption behind institutional patterns, for which municipal government used to be the main actor. This development influences the possible approaches for heat, however participation is not occurring due to the heat issue.

Autonomous change

Room for autonomous change is considered highly relevant in entity, as developments in society are very important, both for health and behavioral change as for spatial planning. Providing information is important to educate people about heat and make them aware of all the consequences, leading to understanding why the theme is important and what can be done. It provides the motive for change, both before and during a heat wave. Especially during a heat wave, plans and tips become important to guide people on how to act. Since the issue of heat has multiple aspects and various ways to approach it, the municipal government should encourage society to innovate. People can be creative with solutions, capturing their personalized ability to contribute to the local context. Also during a heat wave room to improvise can prove valuable as autonomous action is very important to reach all vulnerable people.

Leadership

Leaders have a key role in strengthening any development, as is observed for heat to some extent as well. Visionary leaders create support for developments, which is needed since the heat issue is still in its first phases of development. Entrepreneurial leaders aim to achieve actual change, by showcasing other actors that working on the issue is possible, and examples have an inspiring effect. Collaborative leadership is valuable, since much can be achieved when working together. Governmental leaders should keep the overview, bring people into contact with each other and encourage others to work on the issue, both within the governments as in society. Leadership within the municipal government is considered medium relevant, since leading people within society could fulfill a similar function. Only within the literature study, collaborative leadership specifically is concluded to be highly relevant, as it is shown that the municipal government could have a specific function in connecting actors. In the other studies, this is also discussed as the role the municipal government has in facilitating trust for learning capacity.

Resources

In order to facilitate for adaptive capacity in society, mainly financial and human resources are relevant. Financial resources are needed for stimulating spatial initiatives such as greening by providing subsidies, as well for supporting social initiatives with regards to raising awareness for heat, health and behavioral change. However, no large amounts are necessary as the intent is to support the first phases of development. Human capital might be most important resource, in order to be updated on all ongoing developments and in order to provide support as source of information and point of reference. Authority is less relevant, as both for the health and behavioral perspective as for the spatial planning side, no strict regulation is to play a role.

Fair governance

Meeting the criteria of fair governance is important for any issue, especially for the municipal government that is serving the public interest and is funded by public money. However, the criteria do not seem to play a highly important role for the theme of heat and are therefore qualified in the literature study as medium relevant. The case study and expert study offer some nuances, as they both consider accountability highly relevant in order to communicate, explain and justify the chosen direction and its added value. Additionally, resulting from the expert study responsiveness with regards to heat is qualified as less relevant, as it is questionable how well informed society is about the issue. The assumption however, is that it should still be picked up by the government.



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

Based on the study on the relevance of each dimension of the ACW for the local heat issue, it can be concluded that each dimension has value. A main distinction can be made between the key dimensions variety, learning capacity and room for autonomous change as they proof to be especially important for process development, and supporting dimensions leadership, resources and fair governance. The latter do have their own relevance and development would be difficult if they would be missing.

8. Discussion

In this chapter, a discussion is presented with regards to the limitations of the research project. In addition, the implication of the research results are addressed, both for theory and practice.

8.1 Reflection on the research project

The issue of heat and facilitating for development of adaptive capacity is a relatively new subject for Dutch urban municipalities. Therefore, it is interesting to consider what is important in this perspective to pay attention to, both for a theoretical and practical point of view. However, the research project encountered some limitations, as there are in any research project (Verschuren & Doorewaard, 2010), which should be addressed.

The external validity is limited since the project included a single-case study. In order to gain the most valuable insights possible to refine theory, this case has been selected through strategic sampling. The municipality of Arnhem is considered to be a frontrunner for the theme of heat and therefore is assumed to be able to present the most relevant experiences. It does mean the city is not representative for all urban municipalities in the Netherlands. In order to strengthen the validity of the research results, a preliminary literature study in advance of the case study has been conducted, and the case study was followed by an expert study. For each of these studies, several key notes must be considered.

First, a literature study was conducted. Finding specific insights fitting the dimensions of the Adaptive Capacity Wheel seemed somewhat challenging, especially for the dimensions of leadership, resources and fair governance. This can be explained by the relatively new character of the research topic, as not many studies have been conducted to research the specific role and characteristics within urban municipal governments with regards to heat. In literature, also less notice was made about the connection between different options to address heat, such as greening and developing social cohesion. This also can be explained by the fact there has been limited research on the topic with a holistic approach, as research to health aspects and spatial aspects of heat adaptation are often separated. A more extensive literature study could have provided more detailed information, however, due to the nature of the research question the case study and expert study are considered to be able to more accurate insights.

Second, the case study was conducted for in which the interviews were the main source of information. Two observations and some key notes derived from the visionary policy document of the municipal government of Arnhem 'Structuurvisie 2020-2040' have been included to complement insights, although not acknowledges as a strong triangulation of sources. In practice, also within the municipality of Arnhem the subject of heat was in relatively premature development. As a consequence, statements made within the case study were partly based on experiences and partly on assumptions and opinions of the interviewed social actors. During the interviews, it turned out that some of the dimensions were not so straightforward to interpreted for actors, as was also concluded by Munaretto & Klostermann (2011). Partly due to this fact, it is possible that for several criteria, such as double loop learning, people did not made clear statements. Within interviews in the case study, reconfirmation of insights took place however, indicating there was agreement between actors. It was not possible to explain every question into detail, due to time constraints. Then again, the aim was also to identify what people considered to be important and providing them with enough room during the interviews to go in-depth was therefore preferred. This did lead to the fact that in two case study interviews, no scores were given by the interviewee for the ACW dimensions, as they had not all been sufficiently discussed. Due to this semi-structured approach, also other important aspects were mentioned to be relevant in order to support society in developing more adaptive capacity, such as political awareness and support. However, it was chosen



Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

to adopt the operationalization of the ACW dimensions as provided by Gupta et al. (2010), since the main aim of this research project is to make a statement about the relevance and applicability of the ACW for urban heat.

Third, the expert study was conducted, which in this project validated the results of the case study. It was observed that the experts approached the ACW dimensions from a different perspective, leading to complementation of the data gathered in the case study. As it proved to be difficult in the literature study and case study to link health and spatial aspects of heat adaptation, experts were able to provide a better overview of the total issue.

Since no assessment is made in this study, for which the ACW was developed, the framework has been used in a manner different from other case studies. In order to make a valuable contribution to the ACW, all data have been attempted to be clearly and consistently structured within the different dimensions and criteria. However, as there is overlap and tension between various dimensions, as mentioned by Gupta et al. (2010) as well, for several criteria important insights more explained within other criteria still contributed to the relevance.

8.2. Theoretical implications of the results

The main objective of this research project was to contribute to the academic theory on how local governments can facilitate and enhance the development of societal adaptive capacity for heat. This was ought to be done by refining the relevance of the ACW for heat. The framework has been developed for social capacity assessment, providing a detailed analysis of strengths and weaknesses of institutions to adapt to climate change (Grothmann et al., 2013). Thus, what can be considered as strengths and weaknesses first has to be taken into consideration for heat.

The results of the research project indicate that five of the six dimensions are useful when assessing the institutional adaptive capacity of a municipal government. The relevance of the dimension of fair governance within the ACW is questionable, when it is used to assess institutions that are part of the municipal government, as this seems to be a undeniable criteria, which is not required for the heat issue in specific, but in general from governmental bodies. Further, there seem to be differences in the relevance of the dimensions, as all three studies concluded to assign a high relevance to variety, learning capacity and room for autonomous change, and a lower relevance to resources and leadership. However, since it cannot be stated those dimensions are not relevant at all, the exact weighing of the ACW dimensions in an assessment still depends on the case, as suggested by (Grothmann et al., 2013). Adger et al. (2007) argue that lessons from studies of local-level adaptive capacity are context-specific, and this still applies for the heat issue. It must also be acknowledged that as the included criteria in the ACW especially relevant are for western cultures (Munaretto & Klostermann, 2011), the results of this research project are as well and due to the emphasis on the case study and expert study, especially for Dutch society.

Further research could validate the results of this research, by studying multiple cases in the Netherlands or Europe. However, it would be more interesting to make actual assessments of institutional adaptive capacity at urban governments for heat with the use of the ACW. This would have to be postponed for several years, as municipalities should be selected that have further advanced policy for heat. As insights within this research are partly based on opinions, in the case of an assessment conclusions can be made based on evidence in practice.

8.3. Policy implications of the results

As a result of the research project, two main recommendations can be made to urban governments that aim to facilitate adaptive capacity in their municipality. First, a focus on process development seems highly recommendable. It means a focus on allowing and stimulating variety in the policy process is desirable, as is actively facilitation for learning among actors and allowing room for autonomous change. Institutions shape social practices, and then again social practices constitute institutions (Gupta et al., 2008). This seems more important than having resources or having leadership within the municipal government, although both also contribute to a certain extent. Second, the case study and expert study both very clearly indicated that the first step should be to increase awareness about the heat issue, both within the municipal government and in society. Also, the link between social and physical approaches could be more clearly established and communicated. The assumption behind the ACW is that when institutions possess more of the identified dimensions, they are better able to stimulate adaptive capacity in society (Mandryk et al., 2015). Consistently, the assumption is that a society with more adaptive capacity will result in more adaptation (Gupta et al., 2010).



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Facilitating local adaptive capacity for urban heat

Master thesis Hester van der Sprong

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Appendix 1: Topic list and interview guide

The topic list as shown below provided the structure for the interviews. During both the case interviews as the expert interviews, the main focus was on the importance of the ACW dimensions and criteria for the heat issue, and if possible illustrated by examples. Furthermore, the experts were also asked about the level of awareness of heat in the Netherlands. The case interviewees were asked to score the dimensions in a Dutch ACW, as shown in Appendix 2.

Interview topic list

- ❖ Introduction
 - Introduction interviewee
 - Involvement within the heat issue and link with heat adaptation
- ❖ Adaptive capacity dimensions
 - Variety:
Problem frames, solutions, multi-actor, multi-level and multi-sector, redundancy
 - Learning capacity
Trust, single loop learning, double loop learning, discuss doubts, institutional memory
 - Room for autonomous change
Access to information, act according to plan, capacity to improvise
 - Leadership
Visionary, entrepreneurial, collaborative
 - Resources
Financial, human, authority
 - Fair governance
Legitimacy, equity, responsiveness, accountability
- ❖ Case study specific
 - Scoring ACW dimensions
- ❖ Expert study specific
 - Awareness of the heat issue within municipal governments and society
- ❖ Conclusion
 - Additional interesting input

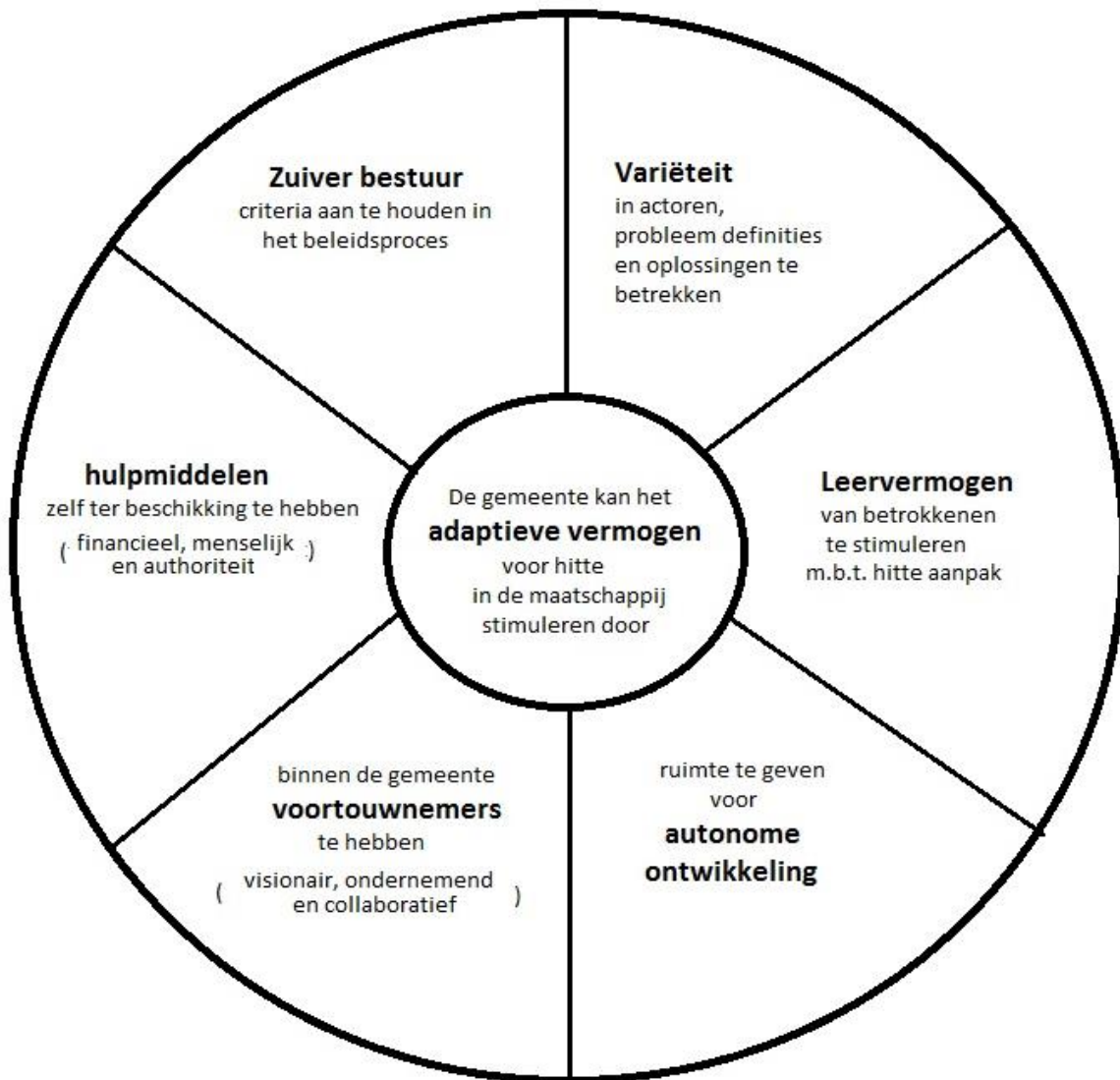
In Table Appendix 1, the original Dutch interview guide is included as well, which was used as a handhold for the researcher during the interviews. In practice, the main emphasis was put on the importance of a dimensions according the interviewee.

Categorie		Interview gids case study	
Algemeen		1.	Kunt u uw organisatie kort introduceren?
		2.	Aan welke hitte adaptatie maatregelen wordt er bij uw organisatie gewerkt?
		3.	Aan welke hitte adaptatie maatregelen zouden in de toekomst eventueel gewerkt kunnen worden bij uw organisatie?
Kern elementen	De eerste 3 kenmerken sluiten specifiek aan op het stimuleren van adaptief vermogen. De onderstaande vragen hebben betrekking op het hitte beleidsgebied met als doel het adaptief vermogen van maatschappelijke actoren te stimuleren.		
Variëteit		4.	Biedt de gemeente in het beleidsproces ruimte voor: <ul style="list-style-type: none"> a) verschillende probleem frames en oplossingen; b) betrokkenheid van verschillende actoren, bestuursniveaus en sectoren; c) diversiteit in oplossingen; d) overmaat aan oplossingen op de korte termijn?
		5.	Is het volgens u belangrijk dat de gemeente hitte aanpak vanuit een perspectief van variëteit benaderd?
Leervermogen		6.	Toont de gemeente in staat te zijn het leervermogen van actoren te stimuleren door: <ul style="list-style-type: none"> a) de ontwikkeling van een band tussen verschillende actoren aan te moedigen; b) betrokken te zijn bij zowel single loop als double loop leren; c) onzekerheden bespreekbaar te maken; d) institutioneel geheugen te stimuleren?
		7.	Is het naar uw mening belangrijk dat de gemeente maatschappelijke actoren aanmoedigt te leren en een beter begrip van de situatie te ontwikkelen?
Ruimte voor autonome verandering		8.	Zorgt de gemeente ervoor dat maatschappelijke actoren: <ul style="list-style-type: none"> a) toegang tot informatie hebben; b) in staat zijn een plan of protocol te volgen; c) in staat zijn te improviseren?
		9.	Is het naar uw inzicht belangrijk dat de gemeente maatschappelijke actoren stimuleert zelf aanpassingsmaatregelen te nemen door de bovenstaande zaken te faciliteren?
Ondersteunende elementen	De laatste 3 kenmerken gaan over eigenschappen van de gemeente die bijdragen aan de capaciteit om adaptief vermogen te faciliteren. De vragen hebben betrekking op het hitte vraagstuk met als doel het adaptief vermogen van maatschappelijke actoren te stimuleren.		
Leiderschap		10.	Voor zover u weet: is er binnen de gemeente sprake van visionair/intellectueel, ondernemend en collaboratief leiderschap?
		11.	Is het naar uw inzicht belangrijk om leiderschap - visionair, ondernemend of collaboratief - te hebben binnen de gemeente?
Hulpmiddelen		12.	Vindt u dat de gemeente (1) de autoriteit om beslissingen te nemen rondom hitte, (2) voldoende expertise, kennis en arbeidskracht en (3) de economische middelen ter beleidsondersteuning bezit?
		13.	Is het volgens u belangrijk dat de gemeente voldoende autoriteit, menselijk kapitaal en financiële middelen heeft?
Zuiver bestuur		14.	Vindt u dat het beleid- en besluitvormingsproces in praktijk legitiem en responsief is, dat er sprake van gelijkheid is en dat er verantwoording wordt afgelegd?
		15.	Is het naar uw mening belangrijk dat het bestuursproces legitiem en responsief is, gelijkheid gepromoot wordt en er verantwoording wordt afgelegd?
Mate van belangrijkheid	De kenmerken van gemeentelijke capaciteit om het adaptief vermogen voor hitte te stimuleren kunnen verschillen in mate van belangrijkheid. Sommige kunnen elkaar zelfs ook tegenwerken.		
		16.	Zou u in het bijgevoegde figuur (figuur 2) een score kunnen aangeven voor de mate waarin de dimensies naar uw mening belangrijk zijn voor het ontwikkelen van meer adaptief vermogen voor hitte in de maatschappij?
Afsluiting		17.	Is er nog iets dat u zou willen bespreken dat nog niet ter sprake is gekomen?

Table Appendix 1. Interview guide case study in Dutch.

Appendix 2: Dutch Adaptive Capacity Wheel

To conclude to interviews in the case study, social actors have been asked to fill in a score for the relevance of each dimension of the Adaptive Capacity Wheel. For this purpose, the ACW has been simplified and translated to Dutch, so six dimensions with a short explanation were presented. This adjusted figure is presented below. The scoring options in the accompanying table range from 0 as not important to 3 as highly important.



Score	Beoordeling
0	niet belangrijk
1	weinig belangrijk
2	medium belangrijk
3	heel belangrijk

Figure Appendix 2. Simplified Dutch version of the Adaptive Capacity Wheel.