Private homeowners climate adaptive

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26-05-2021

Private homeowners climate adaptive!

An exploration on how private homeowners can be stimulated to adopt small scale climate adaptive measures.

by

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to obtain the degree of Master of Science

at the Delft University of Technology,

to be defended publicly on Wednesday 26th of May, 2021 at 12:30 pm.

Student number: 4961501
Project duration: September, 2020 – May, 2021

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Acknowledgements

Deze scriptie betekent het einde van mijn master water management aan de TU Delft. Het onderwerp klimaat adaptatie heeft mij enorm geboeid en ik hoop erin door te gaan! Het gedichtje hieronder illustreert naar mijn mening goed waar klimaat adaptatie om gaat:

Je hebt geen controle,

Over storm en over regen.

Maar met een jas en paraplu,

Kun je er wél iets beter tegen.

- Martin Gijzemijter

Allereerst dank aan de participanten van dit onderzoek. Jullie waren de data voor mijn onderzoek en hebben het zodoende mogelijk gemaakt. Ook de geraadpleegde experts wil ik bedanken voor hun tijd en input. Het was heel leuk om weer met zoveel nieuwe mensen in contact te komen. Mocht iemand mijn scriptie over een aantal jaren nog lezen (ik hoop het), dan is het goed om te weten dat dit onderzoek samen viel met een wereldwijde pandemie waardoor sociaal contact wat lastig was. Ik heb daarom extra genoten van de vele gesprekken die ik mocht voeren met zoveel verschillende mensen.

Daarnaast wil ik mijn begeleiders bedanken. Martine, door het gesprek met jou aan een picknicktafel bij de Green Village ben ik me gaan verdiepen in klimaat adaptatie. Zelfs na ongeveer 8 maanden onderzoek vind ik het nog steeds een interessant onderwerp. Daarnaast zagen wij elkaar toen mijn scriptie vorm had gekregen wekelijks. Hartstikke bedankt dat je elke week weer tijd vrijmaakte voor mijn powerpoint presentaties en me van feedback voor zag. Erik, jij had altijd wel een 'half uurtje' de tijd. Vaker duurde deze gesprekken een uur en hadden ze lang niet altijd direct iets met mijn scriptie te maken. Ik vond het een hele fijne manier van begeleiding en het bracht de lol vaak weer terug. Nico, vlak voor mijn midterm meeting ben jij er pas bijgekomen. Toch had je gelijk scherpe feedback waardoor ik terug naar de tekentafel kon.

Ik ga niet iedereen bij naam bedanken, maar een speciaal bedankje voor mijn huisgenoten, Martijn, huisgenoten van Martijn, Timo en Roos. En als laatste natuurlijk Paps en Mams, heel erg bedankt voor de steun.

Stijn Muntjewerff, mei 2021

Abstract

Understanding the perceived stimuli and barriers by private homeowners is key knowledge to realise effective climate adaptive policy and consequently the adoption of SSCAM by homeowners. Q-methodology was used to unravel the perspectives of 25 homeowners from the Vruchtenbuurt, Den Haag and Hillegersberg-Zuid, Rotterdam on climate adaptation. The Model of Proactive Private Adaption to Climate Change structured the Q-methodology and was complemented with a policy analysis into climate adaptive policy of Den Haag and Rotterdam and a literature review of SSCAM. Four perspective groups, called factors, were identified amongst homeowners, : 1) Major problem, but what is the solution?!, 2) Together we make it better!, 3) I don't know how I am part of a solution and 4) Act when it is needed. The diversity of homeowners' perspectives implies no one-size-fits-all solution exists to stimulate adoption of SSCAM, two policy instruments which take this into account are proposed. Firstly, an extensive communication strategy is advised which clarifies the need for climate adaptive measures, establishes a relation with homeowners and stimulates homeowner's participation through an adaptive network. This should be complemented with an enabling instrument for garden and roof SSCAM, which can be tailored to the different barriers and stimuli perceived by the perspectives.

Keywords: Climate adaptation, Private Homeowners, Q-methodology, Policy

Contents

Nomenclature

CFA	Centroid Factor Analysis
cr	composite reliability
DIT	Diffusion of Innovation Theory
DPRA	Deltaplan Ruimtelijke adaptatie
EV	Eigenvalue
KADE	Ken-Q Analysis Desktop Edition
MPPACC	Model of Private Proactive Adaptation to Climate Change
PCA	Principal Component Analysis
PMT	Protection Motivation Theory
Q	Q-methodology
SSCAM	Small Scale Climate Adaptive Measures
TPB	Theory of planned behaviour
UDS	Urban Drainage System
UHI	Urban Heat Island

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Introduction

The problem is introduced after which the scope is determined. This consequently results in the knowledge gaps, research questions and the approach to answer the posed research questions. Subsequently, the study areas are selected elaborated. Lastly, a reader's guide and a schematic overview of this research is provided.

1.1. Governing climate change in the Netherlands

In this section the consequences of climate change are discussed firstly. Secondly, the choices to focus on adaptation in urban areas and the reason to research private homeowners is elaborated. Lastly, the identified knowledge gaps are provided.

Consequences of climate change

Climate change caused by increased atmospheric concentrations of greenhouse gases seems unavoidable (IPCC, 2007; KNMI, 2014; NASA, 2020; Sluijter et al., 2018; Vinther et al., 2009). Although many uncertainties exist about the consequences for human and nature, higher temperatures and more frequent extreme weather events such as intense precipitation events, longer periods of drought and heat are expected globally (IPCC, 2007; NASA, 2020; Vinther et al., 2009). In the Netherlands the Dutch meteorological service, KNMI, have already shortened the return periods for extreme precipitation events and droughts, i.e. extreme weather events have been observed to happen more frequently (KNMI, 2014; Sluijter et al., 2018).

The urgency to act upon climate change has become evident and can be categorised in two approaches: mitigation and adaptation (Rijksoverheid, 2018). Mitigation addresses the causes of climate change and thereby minimises their possible impacts (UN, n.d.). Since climate change is already an observed phenomenon, mitigation alone does not suffice. Complementary to mitigation, adaptation refers to "anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause" (European Commission, 2014, p.1).

Cities are especially vulnerable to the effects of climate change and amplify them (Voskamp & Van de Ven, 2015). Cities not only inhabit more than half of the world population, they also account for 80% of the GDP worldwide cities and are a concentration of industries, services, knowledge and culture (Beard et al., 2016). Climate change increases already experienced pressures on cities such as natural disasters, a shortage of resources and economic and social inequality due to the high concentration of built up area (Beard et al., 2016; Voskamp & Van de Ven, 2015). Therefore the focus of this research is on climate adaptation, hereafter adaptation, in urban areas.

Adaptation in the Netherlands

In the Netherlands the national adaptation policy is documented in the Deltaplan Spatial Development (DPRA). The DPRA provides an adaptation road map for the four climate change consequences that will most likely impact the Netherlands the most; sea level rise, drought, heat waves and flooding (Rijksoverheid, 2018). The goal is to become climate resilient and water robust in the Netherlands by 2050 (Rijksoverheid, 2018). Climate resilience is understood as "*the ability of a system to adapt and adjust to changing internal or external processes*" imposed by a changing climate (Pickett et al., 2004, p.373). Water robust is "*a system that generally withstands extreme events and meets various possible future scenarios*" (STOWA, 2018b, p.1, Translated from Dutch). 'System' is in both above mentioned citations understood as urban area. In the construction covenant of the Province South-Holland a minimum 70mm storage capacity of rainfall is for example required.

A decentralised manner is chosen in the DPRA due to the expectation that regions will be affected differently. Municipalities are firstly tasked to conduct a 'stress test' to indicate which areas are likely to experience nuisance due to climate change (Rijksoverheid, 2018). Consequently, the stress tests provide input for the risk dialogues with all relevant actors involved to arrive at adaptation plans to achieve climate resilience and water robustness (Rijksoverheid, 2018). Cooperation is encouraged, strongly motivated by the fact that municipalities do not own all the land in their jurisdiction, e.g. in Rotterdam 60% is privately owned (Rotterdams Weerwoord, 2018). The goal set by the DPRA is to become adaptive by 2050 nevertheless applies to the whole area of municipal jurisdiction.

Role of private homeowners

Private homeowners, hereafter referred to as homeowners, are recognised as an important actor in adaptive policy (Rijksoverheid, 2018). This is motivated by the fact that in Rotterdam 37% of the houses is owned (CBS, 2019). Private and housing corporation tenants, living in 43% and 20% of the houses in Rotterdam (CBS, 2019), are not included in this research due to their lack of ownership which causes a dependence on the owner to adopt adaptive measures. The role of homeowners, although important, has remained unclear (Hegger et al., 2017; Wamsler & Brink, 2015). Role is defined as "*the expectations and prescriptions regarding their actions, responsibilities and attitudes as held by themselves or others*" (Hegger et al., 2017, p.337). This is key knowledge in order to realise adaptive measures on private homeowner's property (Hegger et al., 2017; H. Mees, 2014; Wamsler & Brink, 2015). The role of homeowners in adaptation is evaluated based upon the expectations of both the Dutch government and homeowners, actions available to homeowners, division of responsibilities between the municipality and homeowners and lastly the attitude of homeowners.

Expectations of the national government are to achieve adaptive cities with all relevant actors and as such formulated as goals in the DPRA (Rijksoverheid, 2018). The DPRA does not clarify what sort of cooperation and participation is strived for which is therefore open for every individual municipality to shape (Rijksoverheid, 2018). Even though the expectations of all relevant actors have been found to be key knowledge as stated above, this has is not explicitly mentioned in the DPRA (Rijksoverheid, 2018). The expectations of municipalities are illustrated in local public policy and can (slightly) differ from one another as presented in chapter 4. Research was found for British and Welsh but not for Dutch homeowners' perspectives on adaptation and is therefore missing (Bichard & Kazmierczak, 2012; Taylor et al., 2014). The expectation of homeowners themselves can also differ from one another but have not been drafted yet. To obtain their expectations it should thus be researched.

Actions are understood as the adaptive measures that can be adopted by private homeowners. Roughly two type of adaptation measures can be distinguished in literature: grey and blue-green measures (Alves et al., 2020; Voskamp & Van de Ven, 2015). Grey adaptation measures can be viewed as more traditional civil engineering way; concrete structures, pumping stations and larger dimensioned drain pipes (Alves et al., 2020). Blue-green adaptation measures are less rigid, more self-adaptive and produce co-benefits such increased biodiversity, liveability improvement and a positive effect citizen's health(Alves et al., 2020; Voskamp & Van de Ven, 2015). A hybrid of blue-green and grey measures is thought to boost the best results in urban spaces

as several benefits are considered simultaneously (Alves et al., 2020). This hybrid of blue-green and grey measures is called small scale adaptive measures (SSCAM) in this research. A lack of knowledge regarding the wide range of possible SSCAM is a barrier identified to impede the implementation of such measures (Wihlborg et al., 2019).

Responsibility is in this research defined as: "*something that is your job or duty to deal with*" ("Cambridge English dictionary", n.d.). It is a major question mark what responsibilities different relevant actors, including homeowners, have (H. Mees, 2014). The unknown division of responsibilities between the public and private stakeholders is reason for concern since it is thought to both reduce the effectiveness of climate policy and slow the adoption of SSCAM down (Driessen et al., 2018; Gilissen, 2013; H. Mees, 2014; Runhaar et al., 2012). Active involvement of private stakeholders is expected to raise the legitimacy and increase the effectiveness of legislation and policy (H. Mees, 2014; Reed, 2008). However, Dutch private homeowners suffer an 'awareness gap' to key water management functions; risks are perceived lower than they actually are (OECD, 2014). Additionally, Dutch homeowners do not perceive the responsibility to act themselves due to a high trust in the water managing governmental bodies (OECD, 2014). This illustrates that incorporating responsibilities for private stakeholders in policy and/or legislation does not guarantee it is acted upon in practise (Driessen et al., 2018; Runhaar et al., 2012). The DPRA risk dialogues are intended to positively influence the awareness gap and increase the perceived responsibility (Rijksoverheid, 2018). This assumption is not based upon a scientific research and no confirmation was found (Baart, 2021; Crane & Livesey, 2003). Dutch homeowners are thus expected to perceive a low responsibility to adopt SSCAM.

Attitude or perception is to be considered for active involvement of a group of stakeholders with (potentially) contradictory interests(Driessen et al., 2018). The perceptions of several important stakeholder have been identified in previous research and their conclusion are presented hereafter (Castanos, 2020; H. Mees, 2014). Amongst several Dutch municipalities the organisational values and willingness to act upon adaptation among municipal officials has been researched (H. Mees, 2014). The three distinctive perspectives identified are (1) start today; (2) not for us to lead; and (3) shared responsibility. There is an agreement on the problem, climate change, and its potential impacts. Disagreement over the time frame for action and the allocation of resources on solutions exists. The perspectives of Dutch business parks and companies on this matter have been researched as well. (Castanos, 2020). Businesses have different perceptions from each other on the urgency and the need for adaptation, driven by differences or a general lack of intrinsic motivation. Reducing institutional barriers and increasing the effectiveness of communication were identified as most effective measures for municipalities (Castanos, 2020). Providing subsidy was characterised negatively for all perceptions identified amongst businesses (Castanos, 2020). The perception of Dutch homeowners on adaptation is missing in research as verified through a Google Scholar search.

It has become evident that adaptation will require the alteration of amongst others the characteristics of the urban area. Private homeowners are an important actor. The lack of clarity regarding their role reduces the chance of successful collaboration and participation, consequently leading to slow adoption of SSCAM (De Bruijn et al., 2008; Driessen et al., 2018; H. Mees, 2014). Homeowners are expected to be able to effectively adopt SSCAM for the climate themes heat, drought and flooding are included, in line with this the three climate themes are included in the scope.

Knowledge gaps

Private homeowners can potentially play an important role in adapting cities to climate change, but four aspects still remain unclear:

a) The role defined for homeowners in adaptive policy;

b) The decision-making by homeowners to adopt SSCAM, i.e. their motivation;

c) The perspectives regarding the adoption of SSCAM amongst homeowners;

d) The policy instruments municipalities can use to promote climate change adaptation by homeowners.

These four aspects are valuable, or even indispensable, information for local policy makers to engage homeowners in adopting SSCAM.

1.2. Research approach

In this section the research question and the approach to answer this question are presented.

This research will contribute by filling in the identified knowledge gaps with the following research question:

How can private homeowners be stimulated to adopt small scale climate adaptive measures in urban areas?

This research takes an exploratory approach to understand homeowner's barriers and stimuli for adopting SSCAM. Q-methodology (Q) is used in combination with a desk study, interviews and two panel meetings to answer the research question. Q is a mixed quantitative/qualitative research method, which enables to explore the homeowners' perspectives regarding the adoption of SSCAM. The method is thoroughly explained in chapter 2. Sub-research questions are drafted which serve as the building blocks to perform this research. Below, the sub-questions and their respective summarised methods are listed.

1. *What behavioural/decision-making theory can be applied to identify variables that influence the adoption of climate adaptive measures by private homeowners?*

   Firstly, it is important to understand how homeowners make decisions in order to be able to to stimulate them in doing something. Therefore a literature study into decision-making theories was conducted. Then the suitability for their application in adaptation is evaluated, after which determining influencing variables are extracted. These variables are used to structure the Q.

2. *What are possibilities to stimulate climate adaptation through public policy amongst private homeowners for the cities of Den Haag and Rotterdam?*

   The municipal websites were consulted to retrieve all relevant policy documents during the policy analysis. Policy documents containing the terms; adaptation, climate mitigation, participation, community initiative, resilience and sustainability were analysed. Consequently, two interviews were conducted with governmental officials to verify the findings. The question is subdivided into three questions to be answered and are addressed individually below.

   - How are private homeowners currently included in climate adaptive policy in Den Haag and Rotterdam?

     The current public policy of Den Haag and Rotterdam on adaptation and the involvement of homeowners is analysed first. This provides a baseline of what is already known and being done within both municipalities.

   - What policy instrument can be used to stimulate homeowners to adopt small scale climate adaptive measures?

     This questions explores policy instruments that can be used by municipalities to stimulate homeowners to adopt SSCAM.

   - Which policy instruments are currently used to stimulate homeowners to adopt climate adaptive measures in Den Haag and Rotterdam?

     Consequently, the identified policy instruments are used to analyse how Den Haag and Rotterdam are currently stimulating homeowners.

3. *What small scale climate adaptive measures can private homeowners be advised to adopt?*

In order to establish what private homeowners can practically do to contribute to a adaptive city, a literature review was conducted into SSCAM.

The set of measures presented in chapter 5 was validated by experts in a semi-structured interview. The performance of the measures assessed the suitability of a measures. The question is answered through three sub-question which are addressed below.

- What are causes of the climate themes heat, drought and flooding in urban areas?

  Understanding of the causes of the climate themes heat, drought and flooding in urban areas is provided. Understanding the cause of a problem is critical information in formulating a solution.

- What small scale climate adaptive measures exist?

  A overview of SSCAM is presented based upon existing literature reviews.

- How do the small scale climate adaptive measures perform?

  The performance of SSCAM is qualitatively assessed based upon applicability and functionality of the measure.

4. *What behavioural/decision-making variables play a role in the adoption of small scale climate adaptive measure by private homeowners?*

   Through Q-methodology the perspectives homeowners were explored. These perspectives are characterised using the input from the previous questions.

5. *What are the implications of the findings for local governments to improve adoption of small scale climate adaptive measures for the different private homeowners?*

   The answers on the other sub-question was used to formulate policy instruments to improve adaptive policy in Den Haag en Rotterdam with additions or new policy instruments. Consequently, panel meetings with participants and experts are set up to evaluate the proposed policy instruments.

1.3. Selection of study areas

The Vruchtenbuurt, Den Haag and Hillergersberg-Zuid, Rotterdam are selected as study areas. Studying two areas enables the possibility to study the effect of different adaptive policies on the adoptive measures amongst private homeowners. Preferably more municipalities were compared, but this is due to the limitations of a master thesis not feasible. The choice for the study areas is elucidated in Appendix A.

The municipalities were selected based upon their expected difference in adaptive policy. To make the comparison regarding the effect of adaptive policy possible, the other selection criteria should be more or less comparable. The total amount of residents was evaluated since this is expected to influence the resources available for a municipality. Secondly, the population's cultural diversity should be similar. Next, culture can influence one's perspective, additionally being surrounded by more or less cultures can have an influence as well. Additionally, the experienced nuisance may influence the priority given by a municipality and the level of involvement of homeowners. Lastly, accessibility and contact is a very practical concern as was therefore lastly verified. The criteria are summarised below:

- Difference in climate policy
- Comparable in total inhabitants
- Similar cultural diversity among inhabitants
- Comparable expected climate nuisance
- Accessibility and contact

Due to the vastness of both municipalities the choice was made to evaluate two comparable socio-economic neighbourhoods with the same neighbourhood typology; Vruchtenbuurt, Den Haag and Hillegersberg-Zuid, Rotterdam.

1.4. Summary of methods used

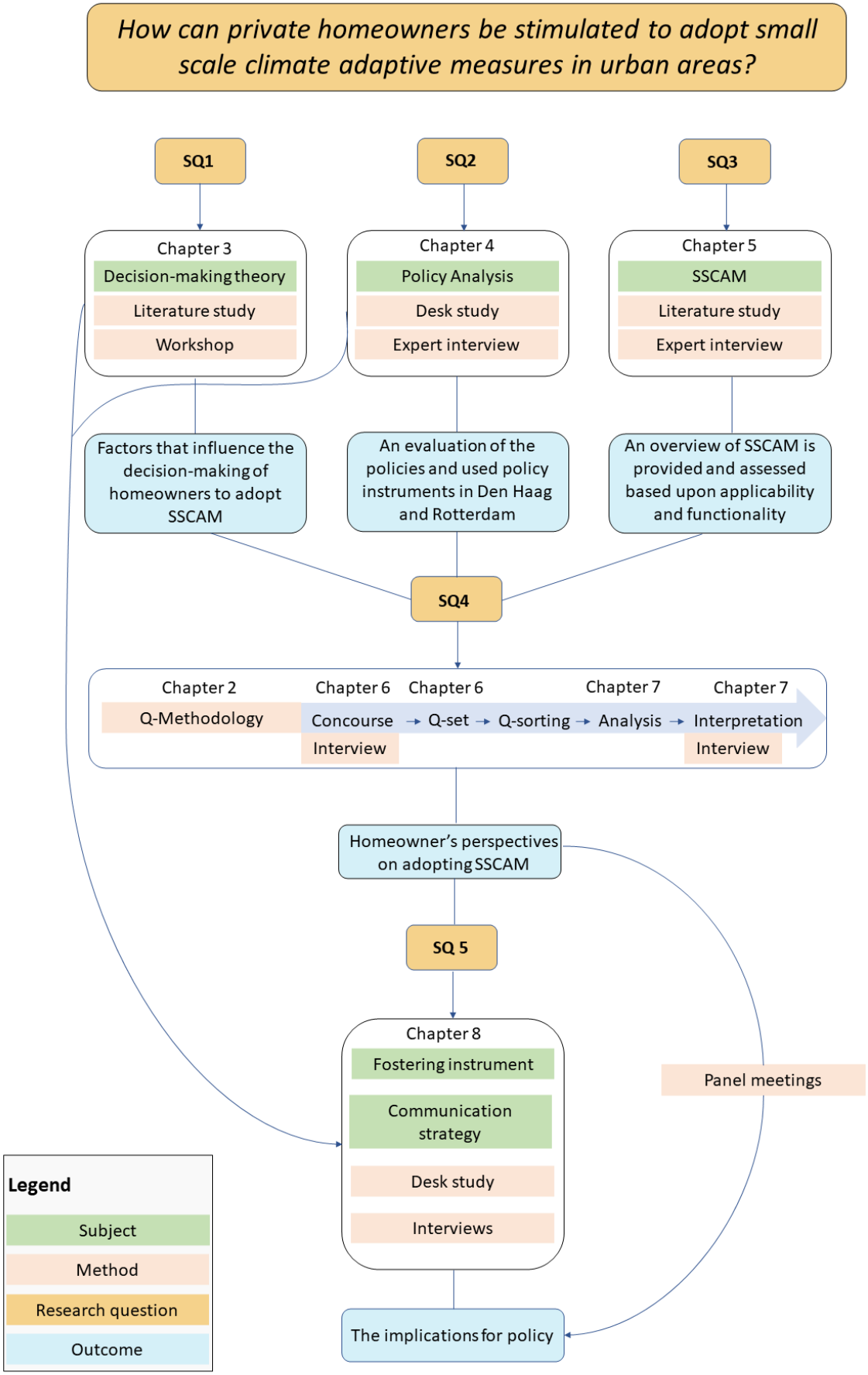
This research used triangulation to increase the validity and reliability of the results. A literature study into decision-making theories and the functionality and applicability of SSCAM was conducted firstly. Three identified decision-making theories were evaluated through a workshop which aided the choice for a specific decision-making theory. The SSCAM have been discussed and complemented with two experts of VP Delta. Consequently, a policy analysis was performed on the adaptive policies of Den Haag and Rotterdam. Two interviews were conducted with municipal officials of Den Haag and Rotterdam to to verify the outcomes of the policy analysis. Next, Q was used to in-depth study the perspectives of homeowners regarding the adoption of SSCAM. Part of the Q were semi-structured interviews with homeowners to verify the concourse, this term is explained in section 6.1. Additionally, three trial Q-sorts were held to guarantee the proper functioning of the constructed website and clarity of the participants' task. The results and suggestions for policy were discussed in two panel meeting. One panel meeting was held with five homeowners who had participated. The second meeting was attended by two experts from VP Delta, four municipal officials of Rotterdam and three municipal officials of Den Haag.

1.5. Reader's guide

Chapter 2 will elaborate on used methods. Chapter 3 presents the choice of a decision making theory to analyse behaviour of homeowners. The adaptation policies of Den Haag and Rotterdam are analysed in chapter 4, after which an overview of SSCAM is presented in chapter 5. This provides input to construct the concourse and develop the Q-set in chapter 6. The analysis and interpretation are presented in chapter 7. Chapter 8 follows by presenting the implication of these results for policy and advocating two novel policy instruments or strategies. Lastly, the discussion and conclusion are presented in respectively chapter 7 and 8.

The schematic overview below presents the relations of the research question and sub-questions.

Research flow diagram



2

Methods

The research flow diagram provided an overview of the research an and which methods are used. This chapter elaborates on the used methods to answer the sub-questions and consequently the research question. The used methods are discussed in order of appearance to answer the sub-questions. The table below provides an overview of the used methods to answer the sub-questions and in which chapter the research question is answered.

Table 2.1: Overview of used methods to answer the sub-questions

Sub-question	**Method(s)**	**Chapter**
1	Literature study, workshop	3
2	Policy analysis, expert interview	4
3	Literature study, expert interview	5
4	Q-methodology	6& 7
5	Panel meeting & previously used methods	8

Interviews with experts were conducted to verify and complement information obtained from the other data sources. In Table 2.2 a list of the experts, their involvement in a municipality/institute and the discussed subject is provided. The experts were approached based upon their online depicted knowledge of the topic and through suggestions provided by the experts themselves.

Table 2.2: Overview of experts, their involvement and the discussed subject

Expert	**Involved with**	**Discussed subject**
Arthur Hagen	Den Haag	Climate adaptive policy Den Haag, Q-set
Jack Amesz	Den Haag	Climate adaptive policy Den Haag and vision Den Haag
Tim de Waele	Rotterdam	Climate adaptive policy Rotterdam, Q-set
Herman Kasper Gilissen	Utrecht University	Climate adaptive legislation
Robert van Roijen	TU Delft	SSCAM
Emilie Buist	TU Delft	SSCAM
Tjerron Boxem	Hoogheemraadschap Delftland	Climate adaptive policy waterboard Delfland
Annie Breeuwsma	Papaver	Involving homeowners in climate adaptation

2.1. Sub-question 1: Literature study & Workshop

Decision-making theories to describe climate adaptive behaviour amongst private actors were researched to identify positive or negative influences on adoptive behaviour of homeowners. This aided the development of the Q-set, which is discussed in subsection 2.4.2. In the literature research the terms presented in Table 2.3 were used.

Table 2.3: Search terms literature review decision-making theories

Topic	**Decision-making theory**		
Concept group	*Decision-making theory*	*Adaptation*	*Private homeowners*
Key words	Decision-making theory	Climate adaptation	Private, homeowners,
	behavioural theory,	sustainable	citizens, residents
	receptivity,	resilient	
Truncation	Concept 1 and (concept 2 and/or concept 3)		

Three decision-making theories were chosen and consequently evaluated in a workshop with fellow master students and teachers of the Hogeschool Rotterdam and University of Technology Delft involved with the Delta Futures Lab. Groups were formed which had to critically analyse one randomly assigned decision-making theory. Consequently, each group gave a short presentation of the findings and a written evaluation was sent to the author.

2.2. Sub-question 2: Policy analysis & Expert Interview

A desk research was applied to analyse the climate adaptive policies of Den Haag and Rotterdam and the division of responsibilities between the municipality and private stakeholders in legislation to understand what possibilities are available to stimulate SSCAM adoption amongst homeowners. Information and policy documents published by Den Haag and Rotterdam were evaluated. Policy documents containing one of the following search terms were initially included; climate adaptation, climate mitigation, participation, community initiative, resilience and sustainability. An overview of the analysed policy documents and their timeline is presented in Table 4.1.

The list of policy documents was reduced by choosing one of periodically formulated documents such as coalition agreements, municipal sewerplans or other redrafts of a policy document. The Den Haag and Rotterdam coalition agreement of 2014-2018 was chosen since it was the first to address climate change, climate adaptation and participation of private stakeholders. The most recent municipal sewerplan of both municipalities was analyse, 2016-2020. In Rotterdam the updated version of the Waterplan was analysed. No updated version of the Den Haag equivalent published in 2013, Toekomst bestendig Haags Water, was encountered.

The climate adaptive policy of Rotterdam was discussed with Tim de Waele. Jack Amesz and Arthur Hagen provided insights on the climate adaptive policy of Den Haag. Lastly, Herman Kasper Gilissen was interviewed to gain understanding in Dutch legislation regarding climate adaptation. Lastly, Tjerrom Boxem of waterboard Delfland was interviewed to obtain a broader understanding of the municipal policies. Waterboard Delfland is operational in both Den Haag and Rotterdam.

2.3. Sub-question 3: Literature study & Expert Interview

An overview of SSCAM was constructed, complemented with functionality and applicability criteria to formulate an advise on what SSCAM to adopt by homeowners. The literature research into SSCAM was conducted to provide an overview. Individual functioning and necessities of each measure was determined independently. In Table 2.4 the search terms are presented which have been used in the literature review to provide an overview of SSCAM.

Table 2.4: Search terms literature review SSCAM

Topic	**Performance small scale climate adaptive measures**		
Concept group	*Climate adaptive measures/solution*	*Small scale*	*Performance*
Key words	Climate adaptive measures/solutions,	Small scale, household,	Performance, Efficiency
	Blue-green measures/solutions,	home, private urban	Effective
	adaptive measures/solutions,		
	sustainable urban drainage systems		
Truncation	Concept 1 and (concept 2 and/or concept 3)		

An interview was conducted with Emilie Buist and Robert van Roijen to verify the comprehensiveness of the overview and discuss the functionality and applicability criteria.

2.4. Sub-question 4: Q-methodology & Interviews

In this research Q is used to unravel and thoroughly examine homeowners' perspectives regarding the adoption of SSCAM (Watts & Stenner, 2012). A multitude of homeowners, who have varied perceptions on climate change adaptation for a variety of reasons, were studied. Q enables classification of homeowners in groups that resemble each other, called factors (Brown, 1980; Watts & Stenner, 2012). The results were used to understand what variables influence the adoption of SSCAM. This was consequently input for the development of improved climate adaptive policy on municipal level.

Q is a mixed quantitative/qualitative research method designed to study subjectivity of participants, which includes their beliefs, values, opinions and tastes (Brown, 1980). The subjectivity of individuals is studied and consequently structured by grouping them based upon their differences and similarities (Brown, 1980; Raadgever et al., 2008; Watts & Stenner, 2012). Q-sorting is the most objective method to classify groups based upon their perspectives (Raadgever et al., 2008). Due to limitations in daily life as a result of Covid-19, a worldwide pandemic, the decision was made to conduct an online Q. The online Q can be divided into five sequential steps which also structure this section (Van Exel & De Graaf, 2005):

1. Definition of the concourse
2. Q-set development
3. P-set selection
4. Q-sorting
5. Analysis and interpretation

2.4.1. Definition of the concourse

The 'concourse' is a concept that describes all possible statements participants can make concerning the research topic (Brown, 1980). This research's concourse is; the variables which play a role in homeowners' decision-making to adopt SSCAM. This can be expressed verbally, with objects, pictures or any other way deemed possible (Van Exel & De Graaf, 2005). All sorts of material can be gathered to obtain a concourse, however "*the level of the discourse dictates the sophistication of the concourse*" (Brown, 1993, p. 95). To obtain a higher level of sophistication the concourse is determined through literature studies, a policy analysis and semi-structured interviews as presented above.

2.4.2. Q-set development

The Q-set is a reduced statement set of the concourse of usually 40-60 statements which is presented to the participants (Brown, 1980; Raadgever et al., 2008). Successful results have however also been obtained with 20-30 statements (Watts & Stenner, 2012). The Q-set development is identified as a crucial step, it is however also said to be "*more an art, than a science*" (Brown, 1980, p. 186). Different researches can develop differ-

ent Q-sets from the same concourse. This is not a problem since it is the subject that gives meaning to the statements by sorting them and both Q-sets can still be representative of the concourse (Watts & Stenner, 2012). A limited set of comparative studies indeed shows that different Q-sets converge on the same conclusion (Van Exel & De Graaf, 2005). In this study a limited number of statements is used to effectively reduce the participation barrier for homeowners (Watts & Stenner, 2012). The most motivated homeowners would still participate, but the P-set should be as diverse as possible which is explained in subsection 2.4.3. A more limited Q-set is believed to reduce this barrier effectively.

An important consideration for the Q-set is that it ought to be well-balanced and represent the concourse (Watts & Stenner, 2012). In order to achieve this criterion, the Q-set should not be "*value-laden or biased towards some particular viewpoint*" (Watts & Stenner, 2012, p.58). First of all, to prevent value-laden formulation all statements were presented positively if possible. Secondly, bias towards a particular viewpoint was anticipated by categorisation of statements in the concourse. An equal amount of statements per category demonstrates no bias, whereas an unequal amount of statements per category signifies a bias. Lastly, the statements were presented to Arthur Hagen (Den Haag), Tim de Waele (Rotterdam), Erik Mostert TU Delft), Martine Rutten (TU Delft) and homeowners approached in the Buitenhof, Delft to support elimination and selection of statements based upon content and clarity.

2.4.3. P-set selection

The P-set is a group of 20-40 non-random selected participants (Raadgever et al., 2008). A higher amount of participants does not equal better results for Q and can even decrease the quality of the results Brown, 1980. The participants should be selected based on their relevance for the research topic. The P-set should include all major perspectives on the research topic to prevent an unduly homogeneous participant group (Brown, 1980; Watts & Stenner, 2012).

The P-set selection was geographically limited to the Vruchtenbuurt, Den Haag and Hillegersberg-Zuid, Rotterdam. Both neighbourhoods have an active neighborhood association which was contacted. The invitation letter shared with the neighbourhood associations is included in Appendix F. Actively involved homeowners are presumed to have a common trait with each other, namely neighbourhood interest. Additionally, it was assumed that only homeowners with interest in the topic could be persuaded to participate in this passive invitation manner. Therefore canvassing was used. Canvassing enabled participation of not intrinsically motivated homeowners, which positively influenced the diversity of the P-set. The canvassing was structured with a pre-drafted walking route which included all the streets through the Vruchtenbuurt, Den Haag and all the streets west of the Straatweg in Hillegersberg-Zuid, Rotterdam. In the streets east of the Straatweg are more industrial and therefore not inlcuded in the walking route. It was decided to randomly ring the doorbells of houses on ground level in each street, since most climate adaptive measures can be taken on ground level. In each street at least three doorbells were rung. When a resident indicated the street mostly contained rented houses, the street was passed without ringing three doorbells. The invitation conversations had a similar structure as the invitation letter enclosed in Appendix F, but could differ slightly per homeowner. Over 150 doorbells were rung over the course of six days of which three days in Den Haag and three days in Rotterdam.

The criterium to evaluate participants based on their relevance to the topic was relieved to being a homeowner and willing to participate. This could inflict a homogeneous P-set, but could not be overcome due to the voluntary nature of the research. Both neighbourhoods are socio-economically diverse, therefore it was expected to be expressed in the random selection of the P-set as well. The neighbourhood associations provided four participants for the research. Through canvassing 21 homeowners participated in the research. Four homeowners participated through the neighbourhood associations.

2.4.4. Online Q-sorting process

This subsection elucidates the online Q-sorting process due to a worldwide pandemic. Firstly, the general process of Q-sorting is described. Next, the design choices for the Q-sort are discussed. Lastly, the construc-

tion of the website to facilitate the Q-sorting is explained.

Q-sorting

Q-sorting is a process in which participants are asked to rank a Q-set resulting in an individual scoring pattern called a Q-sort. The participant ranks the statements according to a 'rule' (Van Exel & De Graaf, 2005). This rule is most often the participant's point of view (Raadgever et al., 2008; Van Exel & De Graaf, 2005). The ranking is conducted on a score sheet with score categories on a continuum ranging from most disagree/uncharacteristic to most agree/characteristic (Brown, 1993). Often a fixed, symmetric distribution is set, to force participants to evaluate the statements relatively to each other (Raadgever et al., 2008). The steepness of the fixed distribution can be designed as well. Q-sorts administered to research controversial subjects are better designed 'flat' (Brown, 1980). More attention is thereby given to the most and least characteristic parts of the Q-sort. As such, this provides a more thorough understanding of the disagreeing viewpoints and the participants additionally feel less restrained to fill in the Q-sort (Brown, 1980). Unknown or less interesting subjects are better researched with a 'steep' Q-sort (Brown, 1980). This prevents participants sorting statements they feel neither characteristic nor uncharacteristic with as such since the majority of statements are ranked in the neutral or little (un)characteristic (Brown, 1980). Examples of a steep and shallow Q-sort are shown in Figure 2.1.

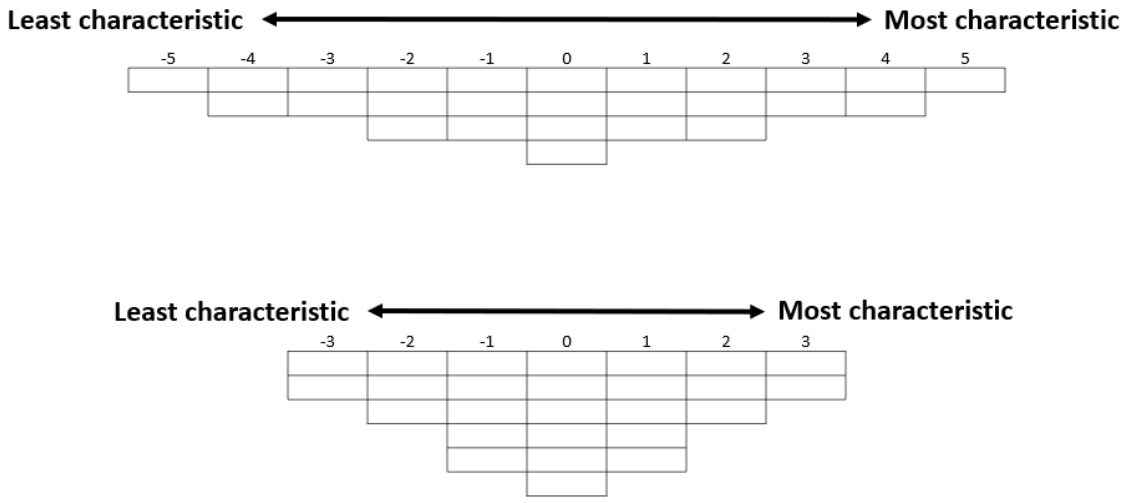


Figure 2.1: Examples of a steep and shallow Q-sort. Up: shallow flatter or platykurtic distributed Q-sort, Down: A steep, near-normal distributed Q-sort.

Q-sorting can be performed online and in real life. A real life Q-sort enables the researcher to observe unclarities regarding statements and to immediately ask follow up questions which are utilised to improve the understand of the results (Van Exel & De Graaf, 2005). Online Q-sorts should have more clear and consistent instructions for the participant since the researcher is not physically present to answer questions during the Q-sorting itself (Van Exel & De Graaf, 2005). This can however also be achieved by scheduling an online meeting with the participant during the Q-sorting. The follow-up conversation can likewise be conducted through an online meeting. During this follow-up conversation the motivation for a participant's Q-sort can be clarified (Brown, 1980). The Q-sort provides the structure and input to the conversation.

Design Q-sort

A steep, forced distributed Q-sort design as depicted in Figure 2.1 was chosen since it was assumed that homeowners are not well aware of the plans and changes in policy. The topic is expected to be novel for most homeowners, since the DPRA has only been in effect since 2018. A forced distribution was chosen over a free distribution to guarantee that statements are also placed at the extremes were participants are

very characteristic or uncharacteristic with a statement since the extremes provide more significance (Brown, 1980).

A random order of statements was chosen to prevent unintentional correlation between statements that follow each other (Brown, 1980). Such correlations could arise because participants can evaluate statements based upon the association with the previous statement (Brown, 1980). This could be used to the advantage when certain correlations are expected to be present according to Watts and Stenner (2012). The random order however fits the exploratory propose of this research better.

Q-sort website

The online Q-sort was hosted on a website which is constructed with a HTML and Javascript code template provided by Shawn Banasick. The template is specifically intended to be used by researchers to perform online Q-sorts. Through the Github page of Shawn Banasick, https://github.com/shawnbanasick/easy-htmlq, the template could be downloaded. The template included the following documents which were modified to serve the needs of this online Q: 'map', 'statements', 'language', 'config' and 'firebaseinfo'. In the XML-document 'map' the amount of statements and the steepness was modified as discussed above. The statements were added to the XML-document 'statements'. The XML-document 'language' contained the text displayed on the website. The website guided the participant through the study with a welcome page, a short introduction and five steps. The guidance material is provided in Appendix G. The possibility to do a follow-up interview was included as a voluntary option to maintain a sufficient amount of participants. An interview provides background which can be useful in the interpretation of the results, but is not necessary (Watts & Stenner, 2012). In the 'config' XML-document the rule to shuffle the cards was added and the requirement to included one's email was relieved to guarantee anonymity. Lastly, JavaScript-file was modified to establish a connection with the Firebase Console account created for this research. Firebase Console provided the storage of the data. The collected data was hosted in the Firebase real-time database accessed through: https://console.firebase.google.com/. The data was exported for analysis as a JSON file.

2.4.5. Factor analysis & interpretation

Factor analysis is a data reduction method which consists of four steps. First the aim of factor analysis is explained. Afterwards the five consecutive steps are identified which are discussed in the order of appearance; correlation matrix, factor extraction, factor rotation, evaluation criteria and factor interpretation.

The goal of factor analysis is to describe similarities between participants through their Q-sorts, to obtain clusters of similar perspectives called factors. Factor analysis identifies underlying correlations between Q-sorts to describe the data set and account for the variance in it. The analysis of the obtained Q-sorts is considered the quantitative and scientific base of Q Watts and Stenner, 2012. Open source software packages are available to perform the Q factor analysis. This research used the Ken-Q Analysis Desktop Edition (KADE) due to its easy set-up with the Firebase database. In this section a short explanation of the analysis procedure is provided. The steps are:

1. Correlation matrix
2. Factor extraction
3. Factor rotation
4. Evaluation criteria
5. Factor interpretation

Correlation matrix

The Pearson correlation coefficient of all Q-sort pairs was calculated. The Pearson correlation coefficient is a value between -1 and 1, respectively indicating a perfect positive or negative linear relationship between two Q-sorts. The Pearson correlation coefficient is calculated with the following formula:

$$r_{xy} = 1 - \frac{\sum d^2}{2Ns^2} \tag{2.1}$$

- r_{xy}: Pearson correlation coefficient for Q-sorts X and Y
- d: difference in scores for statements between Q-sorts X and Y
- N: total amount of Q-sorts
- s: variance of the forced distribution

Factor extraction

The amount of factors to extract is an iterative process. As a rule of thumb, seven factors is the magical number to start with (Brown, 1980). Two factor extraction methods are frequently used in Q; Centroid Factor Analysis (CFA) and Principal Component Analysis (PCA) . PCA extracts uncorrelated linear Q-sorts combinations and analyses all the variance in the Q-sorts (Akhtar-Danesh et al., 2017). It resolves into "*a mathematically best solution*" (Watts & Stenner, 2012, p.99). The first factor explains most variance, the second factor the second most variance and so forth. In PCA the assumption is made that two Q-sorts sorted by one person have a perfect positive correlation, i.e. 1's in the diagonal of the correlation matrix. CFA is a very similar method, but the self correlation is based upon communalities (Brown, 1980). The communality is defined as the proportion of the variance that is explained by the other Q-sorts. The communalities are estimated through an iterative process (Brown, 1980). A thorough explanation on the calculation of communalities is presented in the technical notes of Brown (1980)

This study used the CFA since a perfect self-correlation is deemed highly unlikely. This is demonstrated by Q studies where participants were asked to structure the Q-sorts several times, resulting in different factors (Eden et al., 2005). Additionally, PCA does not enable engagement with the data and does not permit factor rotation (Akhtar-Danesh et al., 2017). A strong debate exists whether PCA is even applicable in Q since it is technically not characterised as a factor analysis method for Q (Watts & Stenner, 2012). Without entering this debate, the main reason to choose CFA is that PCA is the highly unlikely perfect self-correlation (Brown, 1980; Watts & Stenner, 2012).

Factor rotation

The outcome of the factor extraction process is the unrotated factor matrix, which displays the Q-sorts' loading on the extracted factors. Through factor rotation the factors are rotated such that they become better interpretable (Akhtar-Danesh et al., 2017). The two most used rotation procedures are judgmental and varimax.

Judgmental rotation is by hand rotation of two factors in a two dimensional plot. Normally an orthogonal rotation, maintaining a 90 degree angle between the two factors, is adhered to ensure statistically independent factors. Judgemental rotation's potential benefit is the ability to test a hypothesis regarding important factors (Akhtar-Danesh et al., 2017). It is however a time costly process when a great number of Q-sorts are researched and its subjectivity.

Varimax is an statistical orthogonal rotation technique that distributes the variance across the factors so each Q-sort has the highest degree of association with only one factor (Brown, 1980). The drawback of this method is the fact that is can eliminate a predominant factor in the data (Brown, 1980). Since the research is exploratory, the more holistic outcome of varimax rotation is chosen.

Both factor rotations methods have been applied. Firstly the unrotated factor matrix was rotated by hand to provide insight in the data. Consequently, varmix was performed to prevent exclusion of predominant factors and to obtain a better result.

Evaluation criteria

The evaluation criteria discussed below determine the amount of factors to extract for interpretation. This is considered the most important decision in Q (Brown, 1980; Watts & Stenner, 2012). This paragraph will state the criteria that have to be met to arrive at the amount of extracted factors for interpretation.

- Representativeness, a minimum of %50 of the participants should significantly load on one factor (Watts & Stenner, 2012).
- Eigenvalue (EV), a factor with an EV > 1.0 is deemed significant. A factor 's EV is calculated with the following formula:

$$EV = \sum f_i \tag{2.2}$$

  f_i is the loading factor of each Q-sort on the factor.

- Scree test, this commonly used criteria is based on plotting the eigenvalue of the factors along the y-axis and the factors on the x-axis (Watts & Stenner, 2012). The factor that causes a bend in the plot is the number of factors to include for the next step. This test is however specially developed for PCA not for CFA and will therefore not be used (Watts & Stenner, 2012).
- Humprey's rule, the factors that have two or more significant factor loadings after extraction proceed to the factor rotation process (Brown, 1980). The significance can be chosen, but is commonly set at p<0.0.5. This research set a level of 0.05 significance, thus the following formula is used to determine the significant factor loading:

$$f_{sig} = 1.96 * \frac{1}{\sqrt{N}} \tag{2.3}$$

  f_{sig} is the loading factor of each Q-sort on the factor

  N the total number of Q-sorts.

- Composite reliability (cr) , the reliability of a factor refers the amount of distinguishing statements and the Q-sorts loading on a factor. The majority of the common variance is required. If a participant has a significant loading on more than one factor it has a shared view with other factors. The participant will consequently not be flagged for any factor. A cr > 0.94 is deemed reasonable using following formula(Brown, 1980):

$$cr = \frac{0.8p}{(1 + (p1) * 0.8)} \tag{2.4}$$

  p is the amount of flagged Q-sorts for a factor.

Factor interpretation

The factor interpretation provides the narrative to each perspective based upon the individual and relative to other factor's statement score. Factor interpretation is not ascribed one method, on the contrary "*there is very little that tells anyone how to do the job effectively*" (Watts & Stenner, 2012, p.147). A first step is to modify the factors to factor arrays. Each factor can be attributed a Z-score for each statement. The Z-score is the weighted average of the score assigned to a statement by the Q-sorts loading on a specific factor. A composite Q-sort for each factor can be constructed based upon the Z-scores and the reconstructed scores on statements, called a factor array (Watts & Stenner, 2012).

The Z-score variance of a statement indicates the whether the statement is a consensus or disagreement statement. A high Z-score variance indicates a disagreement statement, whereas a low Z-score variance indicates a consensus statement. Disagreement statements provide the distinguishing traits for a perspective, consensus statements are however important in providing the whole narrative. Cribs sheets are consequently constructed to evaluate the highest ranked statements, the lowest ranked statement and the more positively/negatively ranked statements in the factor array than in the other factor arrays (Watts & Stenner, 2012). The same ranked statements in more than one factor can be identified and assigned less importance. Low ranking statements on the contrary can be assigned more importance in the evaluation when they are ranked higher/lower then in the other factors (Watts & Stenner, 2012). Through this method the focus is shifted from the extreme rankings only to the full factor array. Lastly, the composite Q-sorts can be depicted as a visual tool for the interpretation process.

2.5. Sub-question 5: Panel meetings

The answers of the previous sub-questions were combined to formulate suggestions for policy instruments to stimulate SSCAM among homeowners. Annie Breeuwsma was interviewed to get more acquainted with stimulating policy instruments. Additionally, two panel meetings were held to validate the results of this research and obtain input on the implications for policy.

During the panel meetings the researcher firstly presented the identified factors and suggestions for policy. Consequently time was available to ask critical questions, after which a discussion was started to discuss the results and the suggestions for policy. This aided the validation of the obtained results study and brought useful insights for policy instruments forward. The first panel meeting was attended by homeowners. Due to promised anonymity in participation the names of the homeowners are not stated but indicated with numbers. The second panel meeting was focused on professionals and was attended by two employees of the Delft University of Technology and municipal officers of Den Haag and Rotterdam. The list of professional attendees is presented in the table below.

Table 2.5: Overview of the participants in the panel meeting with professionals

Participant	**Involved with**
Arthur Hagen	Den Haag
Arie Markus	Den Haag
Sander Brinkman	Den Haag
Tim de Waele	Rotterdam
Andre Rodenburg	Rotterdam
Eline van Weelden	Rotterdam
Daan Vermeer	Rotterdam
Elijan Bes	Rotterdam
Robert Roijen	TU Delft
Emilie Buist	TU Delft

3

Decision-making theories: to adapt or not

In this chapter decision-making theories are researched to evaluate homeowners behaviour. Firstly, the motivation to address decision-making theories is provided. Next, three decision-making theories are discussed; the Receptivity model, the Theory of planned behaviour (TPB) and the Model of proactive adaptation to climate change Model of Private Proactive Adaptation to Climate Change (MPPACC) . Lastly, the choice for one of these three theories is motivated.

Homeowners make a decision by either adopting climate adaptive measures or not. Awareness regarding these consequences has proven not to be the only variable influencing decision-making (H. Mees, 2014; Runhaar et al., 2012). Identifying the variables that influence the decision-making process provide a better chance for local governments to encourage homeowners to adopt SSCAM and as such meet the goal set by the DPRA (Bemelmans-Videc et al., 2011; H. Mees, 2014; Spurling et al., 2013).

In this research decision-making theories that have been successfully used to describe climate adaptive behaviour amongst private actors were studied. A literature research was started with the search terms "decision-making theory" and "behavioural theory" and resulted in respectively 2.200.000 and 3.750.000 results. Due to the fact that the research titles did at first sight not have anything in common with climate adaptation the search terms were immediately narrowed down. The search term "behaviour theory climate adaptation" resulted in 980.000 including research on the TPB and the MPPACC. Both are well cited and deemed applicably for this study. Consequently, the search term "receptivity theory/model climate adaptation" was used, inspired by the goal of this research to stimulate homeowners. This resulted in the well cited Receptivity theory, which was both due to its simplicity and relative difference to the other two theories deemed interesting.

3.1. Receptivity model

Receptivity is "*the extent to which there exists not only a willingness (or disposition) but also an ability (or capability) in different constituencies (individuals, communities, organizations, agencies, etc.) to absorb, accept and utilize innovation options*" (Jeffrey & Seaton, 2004). The concept of receptivity is broken down into four components which are thought of as phases, but do not necessarily have a linear structure:

- Awareness – The recognition of the problem, knowledge about alternative options then the status quo and capability to acquire new knowledge.
- Association – Identification of potential benefits of this new knowledge and a association with subject's own needs and capabilities.
- Acquisition – The ability to acquire the alternative option opted.
- Application – The ability to implement and maintain to achieve a perceived benefit.

A schematic representation of the receptivity model is provided in Figure 3.1. Receptivity is the centre of the four component's interface.

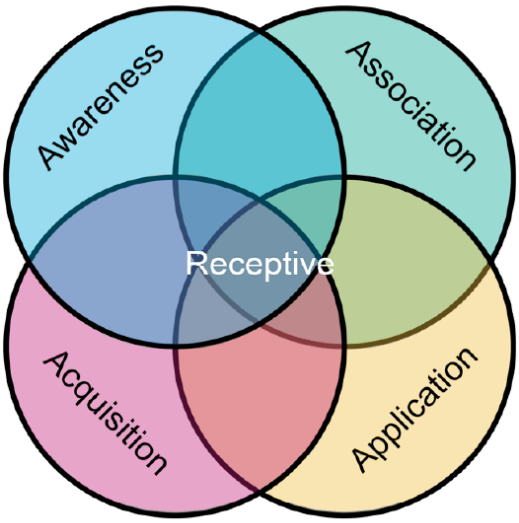


Figure 3.1: Schematic representation of the Receptivity model (Krijnen, 2020)

3.2. Theory of planned behaviour

Azjen's TPB states that behaviour is dependent upon intention and influenced by perceived behavioural control (Ajzen et al., 1991). Intention itself is in turn dependent on three independent variables; attitude, subjective norm and perceived behavioural control as depicted in Figure 3.2 (Ajzen et al., 1991). The variables are one by one explained underneath Figure 3.2.

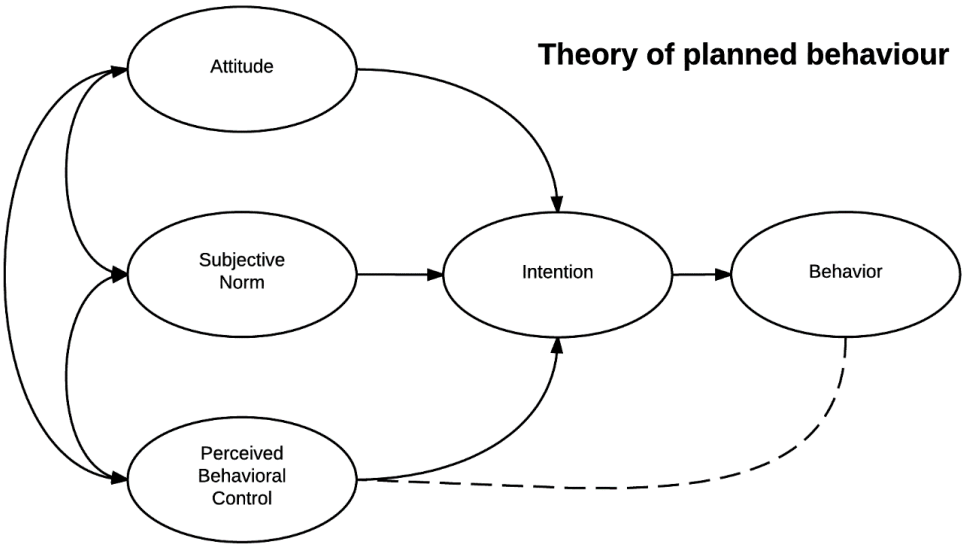


Figure 3.2: Azjen's schematic representation of the theory of planned behaviour (Glanz et al., 2015)

Attitude is determined by individual's belief about outcomes or attributes of performing the behaviour (behavioural beliefs), weighted by evaluations of those outcomes or attributes (Ajzen et al., 1991). Thus a person

who holds strong beliefs that positively valued outcomes will result from performing the behaviour in question will have a positive attitude toward the behaviour. Conversely, a person who holds strong beliefs that negatively valued outcomes will result from performing the behaviour in question will have a negative attitude.

Similarly, a person's subjective norm is determined by his or her normative beliefs: whether important referent individuals approve or disapprove of performing the behaviour (Ajzen et al., 1991). A person who believes that certain referents think that he or she should perform a behaviour and who is motivated to meet their expectations will hold a positive subjective norm. Conversely, a person who believes that certain referents think that he or she should not perform a behaviour will hold a negative subjective norm. A person who is not motivated to meet their expectations will hold a neutral subjective norm. The subjective norm thus also includes the perceived social pressure from a group or community ()

Perceived behavioural control refers to people's perception of the ease or difficulty of performing the behaviour of interest, must often based upon experience and knowledge perceived necessary (Ajzen et al., 1991).

Intention refers to the plan to perform a certain behaviour. Intention is not the same as behaviour in the TPB, since the intention can be impeded due to a negative influence of the perceived behavioral control.

A more favourable, attitude, subjective norm and perceived behavioral control generally results in a stronger intention to perform the considered behaviour (Ajzen et al., 1991). However, the relative importance of each independent variable is expected to differ based upon presented situation and considered behaviour (Ajzen et al., 1991). This means that in some instances only the subjective norm is found to be an significant impact on intention, whereas in others all three variable provide an independent contribution to the intention (Ajzen et al., 1991).

3.3. Model of Proactive Private Adaptation to Climate Change

The MPPACC is a decision-making theory build upon the Protection Motivation Theory and focuses specifically on why some people show adaptive behaviour and others not (Grothmann & Patt, 2005). An schematic overview of the MPPACC is depicted in Figure 3.3. The model can be divided into two successive main components which are elaborated on firstly: the risk appraisal and adaptation appraisal. In line with the jargon of this research appraisal is interpreted as perception. Consequently the other components; reliance on public adaptation, risk experience, cognitive biases, the social discourse, objective adaptive capacity and avoident maladaptation are shortly discussed. These component together finally influence the adaptation intention.

Risk perception is a person's perception of a threat's probability and the potential losses inflicted on things valued. The risk perception consists of two sub-components. The perceived probability is the expectancy of the subject to become exposed to the threat (the consequences of climate change; drought, heat and flooding). Secondly, the subject's taxation of how harmful the consequences of the threat would be, i.d. the impact of the threat, is called the perceived severity.

Adaptation perception starts after a specific threshold has exceeded in the risk perception process, i.e. "*A minimum level of threat or concern must exist before people start contemplating the benefits of possible actions and ruminate their competence to actually perform them*" (Grothmann & Patt, 2005). The adaptation perception is divided into three sub-components. The first sub-component is perceived adaptation efficacy, a subject's belief in the effectiveness of preventing harm of a threat upon oneself or others by adopting adaptive measures. Secondly, perceived self-efficacy is a subject's perceived ability to carry out adaptive responses. The last sub-component is the assumed costs of adopting the adaptive measure or perceived adaption costs. Self-efficacy and adaption costs are strongly related, but it is thought useful to differentiate. A person subject might have a tremendous knowledge regarding gardening and drought resistant plants (perceived self-efficacy), but due to the perceived expected costs and time not execute the project.

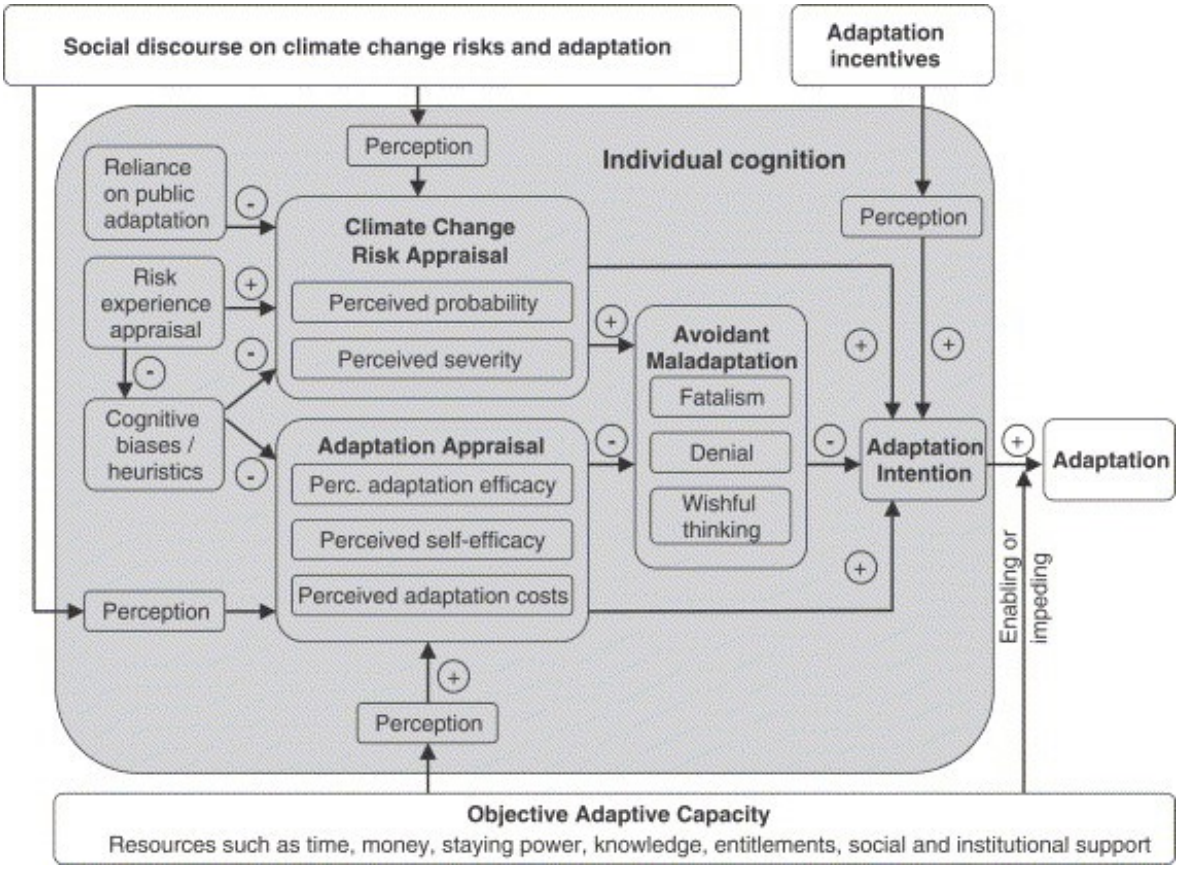


Figure 3.3: Schematic representation of the Model of Proactive Private Adaptation to Climate Change (Grothmann & Patt, 2005)

If the decision is made to action, an adaptation intention is formed (Grothmann & Patt, 2005). It should be noted that intention does not equal actual behavioural adaptation in the MPPACC. People often have intentions but do not demonstrate the behaviour. Objective adaptive capacity can enable or impede this last step from intention to behaviour in forms such as money, time, knowledge an so forth.

Adding to the complexity, extra components are included which address a person less rational than the original PMT. With the reliance on public adaptation component it is recognised that adaptive measures taken by the government will also provide protection for the private property, thereby decreasing the need to take precautionary measures for a homeowner (Grothmann & Patt, 2005). If a person has experienced a threat preparedness increases, thus positively influencing the risk appraisal. This influence strongly relates to the severity of the experienced threat (Weinstein, 1989). The social discourse refers to the perceived narrative provided by the social environment one moves in (Grothmann & Patt, 2005). It is trivial that our opinions and behaviour are influenced by how we perceive the opinions of valued people from our social environment. This influence can both positively or negatively affect both the risk and adaptation appraisal (Grothmann & Patt, 2005). The human brain does however not judge its environment or choices very well (Daniel, 2017). People for example judge the risk of being harmed by a disaster as smaller than the average risk (Daniel, 2017). On the other hand, a disaster that occurred recently is expected to happen more often than the average (Daniel, 2017). This flawed thinking is called cognitive biases or heuristics, and is thought to have a negative influence on both the risk and adaptation appraisal (Grothmann & Patt, 2005). Lastly, adaptation incentives can serve as an extra motivation, but in the case of no risk perception can also facilitate an outsourced motivation by a governmental body through proactive public policy (Grothmann & Patt, 2005).

3.4. Choice of decision-making theory

MPPACC will be used to structure the Q-set development in section 6.2 and has attributed with following seven categories: Climate change, Risk perception, Self assumed capability, Adaptation capacity, Adaptation costs, Responsibility and Social Influence. Below the (dis)advantages of each model are elaborated upon.

The MPPACC provides a stronger link with intention based upon the norms included. The TPB recognise subjective norms, in the MPPACC and Receptivity theory the subjective norm is not explicitly mentioned (Ajzen et al., 1991; Grothmann & Patt, 2005; Jeffrey & Seaton, 2004). Descriptive norms are included in the MPPACC in the social discourse, but are missing in the TPB and Receptivity Theory even though it provides a stronger link with intention than the subjective norm (Grothmann & Patt, 2005; White et al., 2009). Lastly, personal injuctive norms are not considered in all the three theories, while it emerged as an important predictor of intention (Grothmann & Patt, 2005; Jeffrey & Seaton, 2004; White et al., 2009).

The receptivity model is better applicable for the evaluation of implemented water management policy instruments (Jeffrey & Seaton, 2004). This research however aims to formulate improved climate adaptive policy which incorporates amongst others homeowner's perceptions. The receptivity model is thus well suited for future research when the new policy is in place.

TPB is a widely recognised and used theory, but is substantially criticised (Ajzen, 2011). Meta-studies found the correlation between attitude, subjective norm and perceived behavioural control to be 0.59 to 0.66. In perspective, behaviour theories rarely achieve a correlation higher than 0.75 (Ajzen, 2011). Although this is a reasonable performance, TPB also received substantial criticism stating that TPB assumes a too rational agent (Ajzen, 2011). This reason is decisive not to proceed with the TPB.

The MPPACC is specifically focused on identifying why an agent adopts climate adaptive measures through two successive components and a detailed set of extra influences which makes it highly applicable for this research. Critical remarks can be made regarding the MPPACC. It has a predetermined negative influence between cognitive biases and both the risk appraisal and adaptation appraisal. Additionally, it appears the agent in this theory is considered to some extent rational, but this is reduced compared to the original PMT which appears to regard an agent comparably rational as the TPB (Norman et al., 2005). MPPACC is the most elaborate theory, which provides guidance in choosing determining characteristic for the development of the Q-set. And although its more recent appearance, it has been cited extensively.

4

Policy analysis: public policy on climate adaptation

In this chapter the relevant public policy in the Netherlands is analysed. Policy is understood as a set of ideas or a plan of what to do in particular situations, that has been agreed to officially by a governmental body (Bacchi, 2009; Loorbach, 2010). Firstly, a summarised policy analysis and the main differences in the public policies of Rotterdam and Den Haag are highlighted. The policy analysis serves to establish a baseline to identify the extent of climate adaptive policy Den Haag and Rotterdam have in place, which is based upon Loorbach's framework for transition policy. The elaborate policy analysis is included in Appendix C. To understand how a government can achieve its expressed ambitions, the policy instruments categories available to a government are reviewed next. Lastly, the policy instruments used in Den Haag and Rotterdam are presented for each municipality. Dutch legislation for each climate theme is assumed background knowledge and is summarised in the text box below.

The consulted policy documents were retrieved from the municipal websites. The relevance was established by scanning the documents for one of the following search terms; climate adaptation, climate mitigation, participation, community initiative, resilience and sustainability were analysed.

Dutch legislation on flooding drought and heat

Flooding
Homeowners have the responsibility to cope with rain falling on their property (art. 3:5 of the Waterwet). If this cannot be reasonably facilitated, the municipality has the care of duty to cope with the run-off from that property (Waterwet, art. 3.5). A municipal sewerplan is drafted for a set time period in which amongst others measures for the collection and processing of run-off as meant in Waterwet art. 3.5 is addressed (Wet Milieubeheer, art., 4:22). An UDS is one of the measures taken by the municipality to reasonably prevent run-off form public space and cope with run-off from private property. Reasonable is translated into a non-binding building norm for the sewer system to cope with rains events that happen once every two years. This is provided further guidance by the verdict of the Court of Arnhem which has determined that a road should at least withstand rain events happening every two to three years (Rechtbank Gelderland, 1997). Homeowners are however to tolerate run-off water from upstream following the natural course, which is defined as not adapted in its course, capacity or quantity (Burgerlijk wetboek, art. 5:38 and 5:39).

Drought
Drought is a relatively new phenomenon in the Netherlands, therefore little jurisprudence and legal research is available. It appears homeowners are primarily responsible to protect themselves and their property against damage induced by drought and are also liable themselves for the damage caused.

The municipality is however not free of responsibility since they have a care of duty to prevent structural hindrance. Due to climate change, dry summers are expected to become more common (KNMI, 2014). This could be interpreted as a requirement towards municipalities to take actions to avoid hindrance (Gilissen, 2013). If this holds true, maintaining a water level by the operating government body as much as possible would probably also require them to act (Gilissen, 2013). Municipalities might be liable to to compensate damage which is caused by leaking sewers or sewers with a too limited capacity if their actions constitute an 'unlawful act' (Burgerlijk wetboek art. 6:162, 6:174).
Leaking sewers have a draining effect, which can result in lowering groundwater tables. The municipality is responsible for a well functioning sewer system (Waterwet art. 3.5, Wet milieubeheer art. 4:22). However, a homeowner has the responsibility to avoid damage and nuisance by groundwater to their property based upon the the current circumstances and reasonable accounted changes (Gerechtshof Den Haag, 2011). This verdict demonstrates homeowners have a substantial own responsibility in safeguarding their property. If climate change can be regarded as reasonable accounted change is still to be determined.

Heat
Just as drought, heat stress does not appear to have a firm basis in Dutch jurisprudence or legal research. The Gemeentewet, art. 21 states that the municipality has a general care of duty for habitable land and a improvement for the living environment. The municipality can provide further guidance by including heat stress reduction in a development plan, this is used for the purpose of good spatial planning (Wet Ruimtelijk ordening, art. 3.1.1). Good can be regarded as a container concept, severe experienced heat stress in residential area can therefore be regarded as not good. The development plan is a tool for the municipality to follow up on the duty of care.
In practice homeowners have a responsibility to take adequate measures to reduce heat stress as has become evident during the past heat waves in the Netherlands (H. Mees, 2014). However, liability e.g. the cost of health damage that occurs in spite of possible measures the person lies with the health care insurer after the own risk of the person has been spent (H. Mees, 2014).

4.1. Loorbach's framework for transition policy

Adaptation can be viewed as a transition, which is a change in the culture, structure and procedure of a system (Loorbach, 2010). A different approach towards spatial planning is needed which incorporates adaptation (Driessen et al., 2018). To facilitate this in the Netherlands the DPRA has provided the municipalities with responsibility to achieve climate adaptation (Rijksoverheid, 2018). In the urban spatial domain alterations of the current characteristics are required to cope with the effects of climate change (Alves et al., 2020; Voskamp & Van de Ven, 2015). The adaptation transition should thus provide a safe living environment.

Governmental institutions attempt to facilitate and accelerate this adaption transition through policy (Bemelmans-Videc et al., 2011; Rijksoverheid, 2018). Loorbach's framework of transition can be used to analyse the drafted policy to achieve the adaptation transition (Loorbach, 2010). Loorbach (2010) discriminates between four levels of governance activities: strategic, tactical, operational and reflective. The policy documents of Den Haag and Rotterdam are analysed below using these four levels. An overview of the analysed policy documents is provided in Table 4.1.

Table 4.1: Overview of the policy documents in Den Haag and Rotterdam

Den Haag	Rotterdam
Haagse Kracht coalitie akkoord (Gemeente Den Haag, 2014)	Waterplan Herijking 2 (Gemeente Rotterdam, 2013b)
Regionale klimaat strategie Haaglanden (Stadsgewest Haaglanden, 2014)	Rotterdamse adaptatie strategie (Gemeente Rotterdam, 2013c)
Resilience strategy Den Haag (Gemeente Den Haag, 2019)	RotterdamsWeerwoord (Rotterdams Weerwoord, 2018)

Gemeentelijk rioleringsplan (Gemeente Den Haag, 2015a)	Gemeentelijke rioleringsplan (Gemeente Rotterdam, 2015)
Uitvoeringsplan klimaatbestendig Den Haag (Gemeente Den Haag, 2012)	Rotterdam resilience strategy (Gemeente Rotterdam, 2017)
Toekomst bestend Haags water (Gemeente Den Haag, 2015b)	Rotterdamse Stijl (Gemeente Rotterdam, 2013a)
Agenda Ruimte voor de sta (Gemeente Den Haag, 2016b)	
Actieplan burgerparticipatie (Gemeente Den Haag, 2016a)	

4.1.1. Strategic

Strategic refers to the vision and long terms goals set by the municipality. The important activities are distinguished on a strategic level (Loorbach, 2010). Strategic activities have an interaction with the culture of the social system (Loorbach, 2010).

The definitions of the goal 'climate adaptive' differs in the policy of both cities. Rotterdam defines a climate proof city in its Adaptation Strategy as: "minimally disrupted by and maximally benefiting from climate change both then and throughout the following decades" (Gemeente Rotterdam, 2013c, p. 22). Then refers to the set deadline to become climate adaptive in 2025. Den Haag has defined its intention to become climate neutral, this however refers to climate mitigation. No definition could be obtained for climate adaptation or climate proof, the closest resembling statement was obtained form the resilience strategy. Resilience is defined in the Resilience strategy Den Haag as: "The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience" (Gemeente Den Haag, 2019, p. 10).

The vision of the Den Haag and Rotterdam also appear to differ. Rotterdam regards the transition to become a climate adaptive city as a way to highlight its international importance once more and tries to make a business case out of it. This is partially thought to be motivated by the financial importance of the low lying port of Rotterdam, therefore Rotterdam has to demonstrate internationally that it is acting upon climate change. Den Haag has formulated its ambition to increase research and was one of the first to have the stress tests conducted in 2015. The Zandmotor, a man-made sand island in front of the Den Haag coast, was established to reinforce the dunes of the Netherlands. This project has received wide international attention, but was initiated and conducted by Rijkswaterstaat and the Province of Zuid-Holland.

Lastly, differences are observed in the content of climate adaptive policies of Rotterdam and Den Haag, although both have advanced climate adaptive policy formulated which meet the requirements from the DPRA. The first remarkable notion is that drought does not appear in the policy documents of Den Haag, except for Uitvoeringsplan klimaatbestendig Den Haag. In that policy document the consequences of drought and general solutions are briefly presented. In the Rotterdam policy drought is discussed more elaborate. A potential explanation is the fact that Rotterdam is mostly build upon clay and peat areas, which are more vulnerable to subsidence due to drought. Large parts of Den Haag are build on sand. The remainder polder areas are are less susceptible to drought induced subsidence, because due to their low lying position the groundwater can more easily be kept high.

4.1.2. Tactical

The tactical level refers to allocating resources and setting timelines between five and 15 years (Loorbach, 2010). Politics are predominantly active on this level of steering with setting political agendas, decision-making processes and interest groups lobbying. Therefore, firstly the organisations set up to focus on climate adaptation are introduced. Subsequently, the timelines of Den Haag and Rotterdam policy are presented.

Both municipalities have introduced a separate foundation for climate adaptation, Duurzaam Den Haag and

Rotterdams Weerwoord. Additionally, climate adaptation is intertwined in the departments through the resilience strategy.

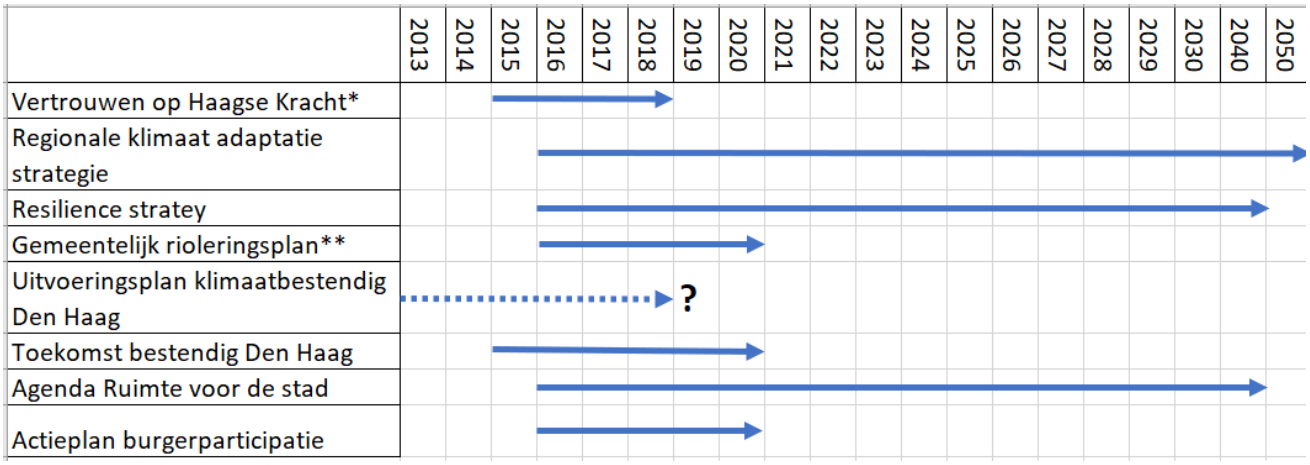


Figure 4.1: Overview of evaluated policies in Den Haag with the timeline of each policy

Timeline climate adaptive policy Rotterdam

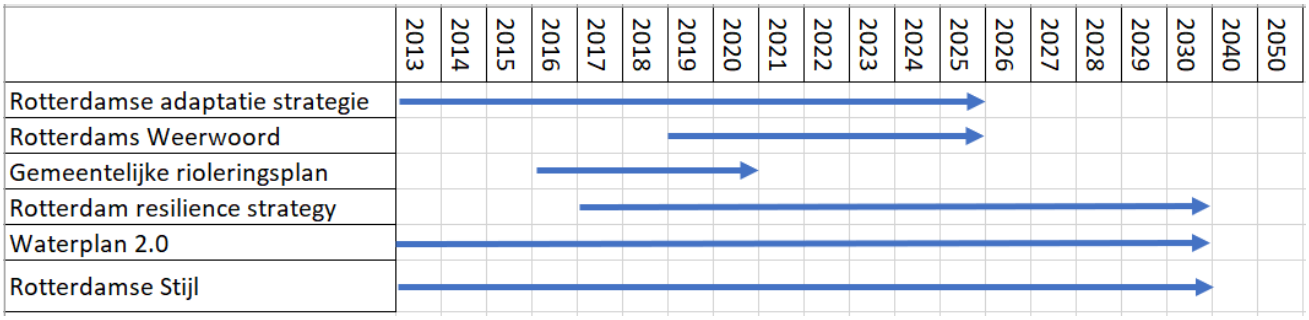


Figure 4.2: Overview of evaluated policies in Rotterdam with the timeline of each policy

Rotterdam has formulated its ambitions with a clear time horizon. Den Haag lacks a clear time horizon one of its policy documents; the Uitvoeringsplan klimaatbestendig Den Haag. The date of publication is set as the starting date for this policy document, but that was not formulated either. The lack of a clear term decreases the vigour of a policy document (Loorbach, 2010). Additionally, Rotterdam has set its time horizons more ambitious, which can be observed in the end dates set for the policy documents.

4.1.3. Operational

The operational level consists of experiments and activities with a short time span. The focus is on improving institutionalised practices by developing new practises. This requires innovation, which are "all societal, technological, institutional, and behavioral practices that introduce or operationalise new structures, culture, routines, or actors" (Loorbach, 2010, p.170).

An operational difference in policy can be observed most strongly in the communication approach of the two municipalities, Rotterdam takes a proactive role. Two small scale climate adaptive pilots in the Afrikaanderbuurt and the Robert Fruinstraat were employed to actively stimulate and cooperate the connection homeowners. Den Haag has put more focus on leading by example in the public domain and has not deployed similar projects. One practical example is that every municipal building should is made climate adaptive. Lastly, both municipalities aid citizen initiatives with their network and help professionalise them through their organisational expertise.

4.1.4. Reflection

The municipal sewer plans of both municipals have a clear reflection incorporated. The other policy documents of both municipalities do not provide a clear reflection upon how the achievement of their goals are evaluated however.

4.2. Available policy instruments

Politics is most active on the tactical level of Loorbach's framework of transition (Loorbach, 2010). Policy instruments correspond to this level (Loorbach, 2010). Policy instruments are understood as tools utilised by the government to overcome problems and achieve objectives as defined in public policy (Bacchi, 2009; Loorbach, 2010). Policy instruments thus have a purpose, namely, to induce or avoid change (Bacchi, 2009; Bemelmans-Videc et al., 2011). It has become evident in chapter 1 that climate adaptation will require the alteration of the characteristics of the world people live in, i.e. change. Understanding the decision-making process and values of homeowners is valuable if not critical information to develop a founded strategy towards climate adaptation. Policy instruments that do not fit in the core values of an actor stand little chance of success (De Bruijn et al., 2008). Three policy instrument typologies are depicted in 4.3, mixes of these policy instruments are possible and frequently used (Bemelmans-Videc et al., 2011).

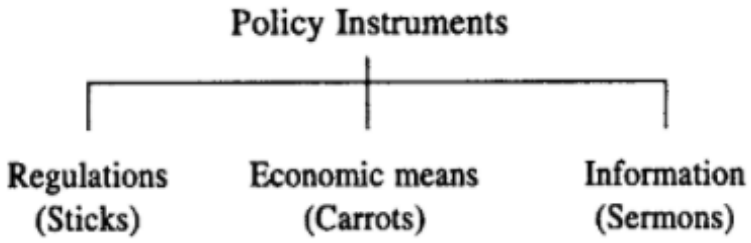


Figure 4.3: Policy instrument typologies (Bemelmans-Videc et al., 2011)

Sticks are regulative instruments, mandates formulated in rules and directives that require people to act upon what is ordered in these rules and directives (Bemelmans-Videc et al., 2011). Regulations are often associated with negative sanctions or other types of punishment, but need not be the case (Bemelmans-Videc et al., 2011). An example of regulative climate adaptation policy is the Green roof policy of the canton Basel. The canton Basel passed a Building and Construction Law requiring green roofs on all new developments with flat roofs in 2002. Later on this law was complimented with an amendment which also required greening of renovated flat roofs. In the Netherlands legal foundation in enforcing homeowners to cope with rainwater is provided by the Waterwet art 3.5 and 10.32a van de Wet Milieubeheer for municipalities. The municipality Laren has put regulation in place which allows the municipality to designate areas where no run-off of private property is allowed.

Carrots are economic policy instruments and involve "handing out or the taking away of material resources while the addressees are not obligated to take the measures involved"(Bemelmans-Videc et al., 2011, p.11). Since the mid-1990s the canton of Basel has employed two large subsidy programs developed for green roofs. The reasoning behind these two programs was twofold; to bring down the costs of instalments (carrot) and to serve as a testing period for green roof suppliers and architects to gain experience in the field (H. Mees, 2014). Later on a storm-water fee reduction was administered when a green roof was installed (H. Mees, 2014).

Sermons are an informative instruments aimed to influence people by providing knowledge and a reasoned argument regarding the objective often attributed with a persuasive element, i.e. a carrot (Bemelmans-Videc et al., 2011). The sermon is however perceived one sided, therefore the sermon is reformulated as 'communication'. This is a two way rather than one way stream of information. Continuing the example of Green roof policy, Stuttgart uses education and information campaigns to promote green roofs are extensively supported by public authorities and the green roof industry itself (H. Mees, 2014).

4.3. Policy instruments used in Den Haag & Rotterdam

The information provided in this subsection originates from the municipal websites of Den Haag and Rotterdam and from two conversations and emails with Tim de Waele, Rotterdam and Arthur Hagen, Den Haag. Table 4.2 summarises the policy instruments used in Den Haag and Rotterdam.

Table 4.2: Overview climate adaptive policy instruments Den Haag and Rotterdam

Policy instrument	Den Haag	Rotterdam
Stick	-	-
Carrot	Subsidie duurzaamheid	Subsidie klimaatadaptatie
	Subsidie groene daken	Subsidie bewonersinitiatief
	Operatie steenbreek	
Sermon	Duurzaam Den Haag	Rotterdamse Weerwoord

Both municipalities formulated economic and informative climate adaptive policy instruments. Neither municipality has made use of the regulative instruments in their climate adaptive policy. The climate adaptive building covenant of province South-Hollands has come into effect since has into effect since 2019, but does not apply on existing constructions.

Economic policy instruments

Den Haag formulated three economic policy instruments. A sustainability subsidy is established to finance sustainable neighbourhood projects, such as greening or adding blue, but also energy reductive measures or creative waste management. The green roof subsidy provides financial support when a homeowner or company wishes to construct a green roof. The costs are between €30 for an extensive and €120 per squared metre for an intensive green roof, assumed that a average roof has 60m$\hat{2}$ the costs for an extensive green roof are €1800. A total of €5000 euros can be applied for. In 2020 the available subsidy of €175.000 was not entirely spent, roughly €15.000 was left over. A total of 150 subsidy requests have been handled and a total of 7.000 m2 green roof has been constructed. A major applier for the green roof subsidy was Staedion, a housing corporation. The available subsidy for 2021 is €175.000. Lastly, Den Haag is an active member and financial facilitator of Operatie Steenbreek, a nationwide action program in which tiles can be changed for plants.

Rotterdam formulated two economic policy instruments. The subsidy residents' initiative provides financial support for neighbourhoods initiatives. Climate adaptive measures such as greening a square to increase the feeling of safety or facilitating a communal garden are examples. Projects limited to support of €10.000 are provided through a separate foundation, projects above €10.000 have to be applied for with the municipality. Secondly, the climate adaptation subsidy focuses specifically on projects that are intended to reduce the consequences of climate change. These projects can be an individual, a communal or a company's project. Two subsidies types are differentiated: till 1500 and €1500-€50.000. Although the application criteria are set for the same goal, climate adaptation, the application procedure differs. In 2020 the available subsidy of €500.000 was spent entirely. The available subsidy for 2021 is €500.000.

Communication policy instruments

Den Haag introduced the foundation Duurzaam Den Haag to stimulate and support inhabitants to make Den Haag more sustainable. Duurzaam Den Haag supports climate adaptation primarily through information supply upon requests and directing people to information sources on their website. Additionally, creative knowledge campaigns such as an exhibition of green in public area have been organised to stimulate climate adaptation which fits well to Den Haag's vision to lead by example.

The communication policy of Rotterdam is more powerful than that of Den Haag due to the fact that it is collaborating/facilitating climate adaptation. Both municipalities have set the ambition to lead by example in the public space. Rotterdams Weerwoord is a similar foundation introduced by the municipality Rotterdam.

The website of Rotterdams Weerwoord contains similar information as Duurzaam Den Haag. Rotterdams Weerwoord is involved in more climate adaptive initiatives than Duurzaam Den Haag. Additionally, Rotterdams Weerwoord is actively approaching inhabitants and has set out pilot neighbourhoods to experiment how to implement climate adaptation in such a way that homeowners are involved.

5

Small scale climate adaptive measures

This chapter firstly outlines the research approach briefly. Next it elaborates on the root causes of the climate themes heat, drought and flooding in urban areas. Consequently, an overview of small scale climate adaptive measures is presented which contains evaluation and functionality criteria to identify suitable SSCAM for homeowners. Lastly, the most suitable SSCAM are presented in the conclusion.

The search terms provided in Table 2.4 resulted mostly in policy related documents and were therefore not useful in identifying SSCAM. The choice was therefore made to obtain the sources of SSCAM displayed on the websites of Amsterdam Rainproof and Rotterdams Weerwoord, as Amsterdam and Rotterdam are considered front running municipalities in the Netherlands (H. Mees, 2014). The Adaptation Support Tool developed by Deltares was additionally suggested by one expert from VP Delta as a source for SSCAM. Consequently, when no new SSCAM were encountered each SSCAM was individually researched in literature using the name(s) of the the SSCAM. This resulted in the overview and the functionality and applicability criteria of SSCAM presented in this chapter.

5.1. Causes and consequences of heat, drought and flooding

The subsequent section elaborates per climate theme on the cause, impact and expected negative consequence of heat, drought and flooding in urban areas.

5.1.1. Heat

Heat is a part of the total energy referred to as sensible heat; the energy required to change the temperature of an material without involving any phase change. Sensible heat is the product of heat capacity, mass and temperature difference of an object. Latent heat is the energy added to or subtracted from a substance to change its phase between gas, liquid and solid of which the evaporation of water is an example. The amount of energy available to a material is determined by the ratio between received and reflected radiation upon a object called albedo.

Cities are significantly warmer than its surrounding rural areas, an effect called the urban heat island (UHI) . Cities are built using lower heat capacity materials, such as steel and concrete, replacing vegetation and water which have a low albedo (Döpp et al., 2011; Kleerekoper, 2016). On top of that urban materials evaporate a limited amount of water, as the materials have a limited storage capacity of water (Döpp et al., 2011; Kleerekoper, 2016). Lastly, waste heat produced by human activities heats up the urban environment, increasing the UHI. (Döpp et al., 2011).

The UHI increases the amount of hot days and heat waves, thereby negatively impacting human health. UHI is directly linked to fatigue, concentration problems, low productivity and poor night rests which in turn cause significant health problems on its own (Tan et al., 2010). More strikingly, in the 21th century heat waves

have accounted for the greatest number of casualties due to climate hazards in Europe. (Mora et al., 2017). Since the UHI increases the amount of heat waves, it directly increases the amount of casualties caused by heat waves (Tan et al., 2010).

5.1.2. Drought

Drought is described as a deficiency of water. Different concepts of drought can be identified in literature which include: meteorological, agricultural, hydrological and socio-economic drought (Mishra & Singh, 2010). The hydrological drought fits best with the scope of this research due to the direct incorporation of subsurface water resources, whose importance is illustrated in the next paragraph. A hydrological drought is defined as: "*a period with inadequate surface and subsurface water resources for the established water uses*" (Mishra & Singh, 2010, p.206).

Droughts in Dutch urban areas are caused by a high percentage of impermeable surface area due to built-up area (Kleerekoper, 2016; Voskamp & Van de Ven, 2015). Most run-off is quickly drained out of the city by the sewage system and urban drainage system (UDS) , reducing the recharge of the groundwater storage by rainwater (STOWA, 2018a). The flux of rapid runoff being removed from an area increases due to the increase in impermeable surface area (STOWA, 2018a). The problem is compounded during dry periods when urban vegetation evaporates groundwater, which decreases the groundwater levels (STOWA, 2018a).

Droughts have significant economic consequences (Van den Born et al., 2016). Homeowners have already observed slight inconveniences such as a drop in water pressure in some parts of the Netherlands. Of greater consequence, droughts contribute to subsidence of houses which is estimated to cause 3-5 billion euros of damage by 2050. Additionally, 16-30 billion is needed to improve or replace wooden foundation piles of existing houses (Van den Born et al., 2016). This subsidence is caused by a fluctuating groundwater level and settling soil (Van den Born et al., 2016). During a drought the ground water level can drop, which causes increased ground settling, exposing foundation piles to air causing oxidation of the piles (Van den Born et al., 2016). This inevitably leads to a required replacement of the foundation poles.

5.1.3. Flooding

Flooding is an overflow of water, submerging normally dry land. In Dutch urban environments, urban pluvial floods most common (STOWA, 2018a). An urban pluvial flood is caused by an intense rain storm that saturates the urban drainage system causing water on the streets.

Urban pluvial floods are amplified by a high percentage of impermeable surface area, little surface water storage possibilities and an under-dimensioned UDS. A high percentage of sealing inhibits infiltration which causes most of the rain to become runoff. Additionally, run-off reaches higher velocities due to the smoothness of concrete compared to the natural landscape. This reduces the coping capacity of the urban drainage system since it is required to process the run-off water in a shorter period of time. Reduced surface water storage options also results in a greater percentage of rain converted to runoff. Lastly, Dutch standards admit once in two year rain events to cause water from the UDS on the streets in urban areas. Dutch UDS are thus under-dimensioned for rain storms surpassing the once in every two year return period. Due to the fact that the return periods of rain storms has reduced, the Dutch UDS have become more under-dimensioned (KNMI, 2014).

Although urban pluvial floods seldom pose a threat to peoples in the Netherlands, resulting stagnant water has a significant economic impact as well as an increased risk to the public health. Flooded houses and cellars cause considerable economic damage. Additionally, the Netherlands uses combined sewers in most cities, therefore flooding results in sewer water being flushed into the streets and water reservoirs deteriorating the surface water quality posing increased health risks.

5.2. Overview of small scale climate adaptive measures

In this section SSCAM homeowners can adopt on their property are provided. Firstly, SSCAM are shortly introduced. Consequently the SSCAM are assessed based upon their associated functionality and evaluation criteria. Lastly, the most suitable SSCAM for homeowners are provided.

SSCAM are the actions homeowners can take on their property to reduce the impact of floods, draughts, and the UHI effect. SSCAM include small scale blue, green and grey infrastructure. As stated in the introduction, a hybrid of green-blue and grey measures is thought to produce the best results in urban areas. (Alves et al., 2020). Green and blue measures refer to vegetation and water, often the two are combined as green-blue measures. Grey infrastructure is thought of as traditional civil engineering measures such as sewer pipes, pumps, but can also include climate adaptive built such as permeable pavement or a water roof (Voskamp & Van de Ven, 2015). In this research, grey infrastructure will be used to refer to materials that can be used. An overview of SSCAM is provided in Table 5.1 with a short description, for further detail refer to Appendix B.

Table 5.1: Summary of small scale climate adaptive measures available for homeowners

Blue green measure	Description
Coating	Coat the bricks or roof tiles a lighter shade
Porous pavement	Pavement that enables transport of water through it
Infiltration crates	Install crates that are 96% porous underground to facilitate infiltration
Extensive green roof	Plant mosses and sedums on the roof
Semi-intensive green roof	Plants grasses, and shrubs on the roof
Intensive green roof	Plants grasses, shrubs and small trees on the roof
Green facade	Facade of a building is covered with climbing vegetation
Living wall	Vegetation fixed in a soil medium attached to the facade
Add a tree	Planting trees
Add a grass/herbs	Replacing paved surfaces by grass or herbs
Green garden	75% of the garden is covered with vegetation
Mixed garden	50% of the garden is covered with vegetation
Water roof	Water basin on the roof
Rain garden	Lowered area filled with gravel topped with a humus layer and vegetation
Infiltration strip	Lowered filled with gravel topped with a humus layer and vegetation
Water pond	Depression which fills up with water
Lower part of the garden	Creating a depression in the garden functions as additional water storage
Rain barrel	Water tank connected to the gutter

The score for the functionality and evaluation is presented in Table 5.2 criteria for each identified measure. The functionality criteria are derived from Voskamp and Van de Ven (2015) and entail: water storage, cooling, infiltration and attenuation. The functionality scores are based on (Pötz, 2012; Voskamp & Van de Ven, 2015) and verified with scientific papers and technical reports consulted for each individual SSCAM in Appendix B. The measures are additionally assessed based upon evaluation criteria adapted from Pötz (2012) and Rijksoverheid (2014). The evaluation scores provided are based upon (Pötz, 2012) and the individual papers and technical reports consulted for each individual SSCAM in Appendix B. The scores of the evaluation and functionality criteria are qualitative. A '+' indicates a measure is as such, '0' is neutral and '-' indicates it is not typified as such. Aesthetic value was not included in the evaluation criteria due to the expected wide diversity in perspectives on the positive or negative influence on SSCAM.

- Generic; refers to a measure that can be applied in the studied neighbourhood area, the Vooroorlogse neighbourhood typology.
- Effort; applies to costs and time of construction and maintenance.

- Space; indicates the spatial dimensions needed.

Aesthetics can also influence how SSCAM is evaluated. The choice was made not to included Aesthetics in the evaluation criteria, since aesthetics are highly personal which it is therefore thought to inhibit an objective score (Rietkerk et al., 2016). The scores of the evaluation criteria are based upon (Pötz, 2012) and the papers and technical reports consulted for each individual SSCAM in Appendix B. The scores of both the evaluation and functionality criteria are qualitative.

Table 5.2: Overview of blue green measures with a score on their evaluation criteria and functionality. A '+' signifies the measure is typified as such, '0' is neutral and '-' signifies the measures is not typified as such; adapted from (Pötz, 2012; Rijksoverheid, 2014; Voskamp & Van de Ven, 2015)

SSCAM	**Evaluation criteria**			**Functionality criteria**			
	Generic	*Space*	*Effort*	*Storage*	*Cooling*	*Infiltration*	*Attenuation*
Coating	+	0	-	0	+	0	0
Porous pavement	+	0	-	0	+	+	0
Infiltration crates	+	0	-	+	0	+	0
Extensive green roof	0	0	-	0	+	0	+
Semi-intensive green roof	-	0	-	+	+	0	+
Intensive green roof	-	0	-	+	+	0	+
Green facade	+	0	-/0	0	+	0	+/0
Living wall	+	0	-	0	+	0	+/0
Add a tree	+	-	0	0	+	0	+
Add grass/herbs	+	-	0	0	+	+	+
Green garden	+	-	-	+	+	+	+
Mixed garden	+	-	-	+	+	+	+
Water roof	-	0	-	+	+	0	+
Rain garden	+	-	-	+	+	+	+
Infiltration strip	+	0	-	+	+	+	+
Water pond	+	-	0	+	+	0	+/0
Lower part of the garden	+	-	0	+	0	0	+
Rain barrel	+	0	0	+	0	0	0

5.3. Conclusion on small scale climate adaptive measures

Based upon the evaluation and functionality criteria, the best performing measures for evaluation are green facade and rain barrel. The best performing measures on the functionality criteria are green garden, mixed garden, rain garden and infiltration strip. Since there is no overlap in SSCAM performing best on either categories no objective 'best' SSCAM can be identified. This research does nevertheless emphasises the importance of garden SSCAM. Garden SSCAM are the best measures based upon their multi-functional criteria performance, but require space and effort in the form of maintenance. The garden measures are generic due to the fact that they can be compromised of a wide variety of measures to include.

Roof and wall SSCAM are to such an extent limited in either the evaluation or functionality criteria that they are not expected to significantly increase climate adaption in neighbourhood with Vooroorlogs typology. Roof SSCAM meet all the functionality criteria except for infiltration, but they are not generic. The roof SCCAM cannot be applied on a angled roof, most Vooroorlogs houses have however an angled roof. Wall SSCAM score well on the evaluation criteria, but only provide cooling in the functionality criteria. Wall SSCAM are strongly encouraged by the author from a different point of view though: they positively influence the biodiversity and aesthetics ()

6

Concourse and Q-set development

This chapter defines the concourse which is based on the literature study and workshop on decision-making theories presented in chapter 3, the policy analysis of Den Haag and Rotterdam and expert interviews provided in chapter 4, the overview of SSCAM displayed in chapter 5 and lastly semi-structured interview with homeowners. Consequently, the Q-set development is eludicated resulting in the Q-set.

6.1. Concourse

The concourse is used to find out what variables influence homeowners decision-making to adopt SSCAM and is therefore defined as; the variables that play a role in homeowners' decision-making to adopt small scale climate adaptive measures. The concourse is determined through semi-structured interviews and literature reviews including policy documents, scientific literature and technical reports to obtain a higher level of sophistication (Watts & Stenner, 2012). The literature review is presented firstly after which the semi-structured interview outcomes are provided

6.1.1. Literature review

Firstly, the MPPACC was chosen to provide understanding in how people in general tend to make decisions. The MPPACC distinguishes two phases that follow-up on each other. The first phase is the risk appraisal. Only when a specific threshold is surpassed in the risk appraisal, the adaptation appraisal process is initiated. In this phase the possibilities and capabilities to counteract the perceived risk are explored. External components influence the two phases. A total of seven categories were extracted based upon the MPPACC to structure the Q-set development: Climate change, Risk perception, Self assumed capability, Adaptation capacity, Adaptation costs, Responsibility and Social Influence.

Consequently, the legislative perspective on the adoption of climate adaptive measures by homeowners is provided by a policy analysis and background information regarding applicable legislation. The responsibilities of homeowners to adopt climate adaptive measures are ill defined to not defined for heat and drought. Flooding is thoroughly addressed in legislation, but limited jurisprudence makes interpretation complicated. In chapter 4 policy of Den Haag and Rotterdam is analysed. Both cities have recently established policy to incorporate climate adaptation in their governance as required by the DPRA. Both municipalities have also chosen to only use economic and communicative policy instruments to involve homeowners, which are regarded as partners, in climate adaptation. In Rotterdam a more pro-active attitude to engage with stakeholders is applied. Two categories were obtained to structure the Q-set: Policy ideas and Legislation.

Lastly, a broad understanding of SSCAM available for homeowners to adopt is established in chapter 5. A set of evaluation and functionality criteria have been drafted. The evaluation criteria influence the probability a homeowner adopts the measure. The functionality criteria provide a qualitative estimation of the SSCAM's effect.

6.1.2. Semi-structured interviews

Firstly, the goal of conducting semi-structured interviews is presented after which answers that influenced the discourse and variables during the interviews are included. This resulted in the addition of the category Miscellaneous to the Q-set development.

The goal of the semi-structured interviews was twofold; verifying and discovering variables that influence the adoption of SSCAM by homeowners. Semi-structured interviews were used to retrieve more hands on and local knowledge. The interviewees were selected based upon known differences in viewpoint regarding climate change, perceived self-efficacy, knowledge on climate adaptive measures and socio-economic class. The interviewees are acquaintances and homeowners in the neighbourhood were the researcher lives Buitenhof, Delft. The choice for semi-structured interviews is motivated by the need to verify the identified variables in literature on the one hand, while providing the possibility for unexpected answers that could introduce new variables. The semi-structured interview questions are presented in Appendix D. In four out of the five interviews with homeowners the order and the questions themselves changed due to the nature of the answers. Below an analysis is provided of answers that influenced the discourse and variables that were mentioned in the interviews.

Value of the house

The value of the home was a variable mentioned by one interviewee. The homeowner had a tiled garden and expressed the worry that constructing a green roof, planting a tree or making a pond would negatively affect the value of the house. A rain barrel or the removal of a few tiles for a flower bed was however not perceived as a problem. The worry was mainly that more permanent climate adaptive measures would require more labour and money to modify them again if a new suitor for the house would not fancy the measures. Functionality of the garden also played a part in the value of the house and is elaborated on below.

Functionality

Homeowners perceive their garden as an part of their living space. Although the gardens were quite differently designed by most homeowners, they all served a purpose which could be expressed by the homeowners. In other words, all gardens had a functionality to the homeowner. Three homeowners perceived the adoption of SSCAM as a threat to the currently desired functionality of their garden.. Since the functionality of a garden is perceived differently, this could require customisation. The functionalities mentioned were: Relaxing which included low maintenance for two homeowners, for the children to play, hobby, social activities and lastly one homeowner indicated that they had a pet animal which lives in the garden. The functionality of both a facade garden or green roof was not threatened by SSCAM.

Climate change

Initially the questions were phrased with the terms 'consequences of climate change' and 'climate adaptive measures'. This caused the interview with two interviewees to be difficult. Interviewee 2 did not believe climate change was a threat and did therefore not understand why the questions were relevant. Interviewee 4 appeared to take offence in hearing climate change.

Over the course of the conversation a solution was formulated which included to views of both interviewees. Interviewee 2 did believe more nuisance was to be expected due to heat, drought and rain which was thought to be caused by urbanisation only. The irritation caused in interviewee 4 was caused by the fact that this person did not believe climate change is anthropogenic induced. The agreement was made that, anthropogenic or not, climate change involves more nuisance by heat, drought and rain.

To prevent similar reactions from participants the choice was made to rephrase 'consequences of climate change' to 'nuisance by heat, drought and rain' or 'extreme weather'. Additionally, 'blue green measures' were mentioned rather than 'climate adaptive measures'. The reformulation of these terms is not expected to have a negative effect on the results of this study since the interest of this study is in stimulating climate adaptive measures to increase the coping capacity of urban areas during extreme weather conditions.

Mitigation vs adaptation

The distinction between mitigation and adaptation is not always evident. When asked what measures could be taken to prevent nuisance by climate change, it resulted firstly in an answer relating to mitigating measures in four out of five interviews. This could be caused by the fact that mitigation has received substantial attention recently, in the form of the Paris Treaty and the energy transition. It appeared that the interviewed homeowners did not have the knowledge or association with adaptive measures they could take themselves at first. Examples such a rain barrel or green roof did however trigger homeowners to explain measures they thought possible. Adaptation seems to be lesser known than mitigation and the two terms are used interchangeably.

Significance

Although most questions were asked by the researcher, two times a similar question was posed to the researcher: Does adopting SSCAM actually have an effect on such a small scale?. The response was that the effect on heat can be quite dramatically observed by the homeowner. The effect on flooding is mostly a communal effect, since the SSCAM can effectively reduce most to all run-off. This prevents clogging of the drainage and sewer pipe network and consequently local flooding. Lastly, the effect SSCAM can have on drought was formulated very nuanced with mentioning that storage facilities such as a rain barrel are effective in providing water for low water quality purposes. Additionally, organic soils contain and store water better.

6.2. Q-set development

In this section the development from the Q-set based on the concourse is firstly discussed. Then the final Q-set is presented.

The final Q-set of this study contains 26 statements selected from a total of 71 statements presented in Appendix E. The 71 statements were unevenly distributed over the 10 categories identified categories, which structured the development of the Q-set. The categories were obtained from the concourse. The MPPACC provided seven categories: Climate change, Risk perception, Self assumed capability, Adaptation capacity, Adaptation costs, Responsibility and Social influence. The policy analysis added the categories Legislation and Policy ideas. Lastly, the semi-structured interviews resulted in the category Miscellaneous. This includes statements regarding SSCAM and the functionality of a garden and the added or reduced value of SSCAM both aesthetically and financially. In total 10 categories were used to structure the development of the Q-set.

The last step of the Q-set development was a review by two municipality officials of Rotterdam and Den Haag, two researchers of the Delft University of Technology, six homeowners and three fellow students. Consequently, 30 statements were still remaining. Two test Q-sorts were conducted. Four statements were unclear for at least one trial participant and therefore eliminated. This resulted in the final Q-set of 26 statements which is depicted in Table 6.1.

Table 6.1: The Q-set, statements are ranked based upon their corresponding category.

Climate change	
1	The climate is changing.
Risk perception	
2	I experience nuisance by flooding, drought and/or heat stress in the direct proximity of my house.
3	I am worried about the consequences of heat, drought and heavy rain for the area I live in.
Self assumed capability	
19	I want to look for my own information before I adopt blue green measures.

14	I have adopted many blue green measures already.
Adaptation capacity	
25	I am skilled thus I can adopt blue green measures myself.
4	I do not want to much maintenance on my home and/or garden.
5	I have sufficient space to take blue green measures.
26	I know where to find the needed information to adopt blue green measures against extreme weather conditions myself.
Adaptation costs	
6	I think that blue green measures are rather expensive.
9	A subsidy should be installed for blue green measures.
12	Adopting blue green measures increases the value of my property.
Responsibility	
7	The municipality should do more to prevent nuisance by heavy rain, drought and/or heat.
17	I am responsible for water nuisance on my property due to weather conditions.
15	I am willing to adopt blue green measures.
Legislation	
16	I am aware of the municipality's expectations regarding the prevention of nuisance due to heavy rain, drought and/or heat.
8	The municipality should oblige the adoption of blue green measures on private property.
24	It is a good idea to fine homeowners who do not take blue green measures to prevent nuisance due to heavy rain.
Policy ideas	
21	Blue green labels, such as the energy labels, are a good idea.
10	Exhibiting examples of blue green measures at garden centres is a good idea.
Social influence	
22	If somebody in my neighbourhood starts an initiative I would like to join.
20	The consequences of extreme weather are a conversation topic in my social environment.
18	I am willing to take blue green measures to prevent nuisance for my neighbours due to heavy rain, drought and/or heat.
Miscellaneous	
11	Adopting blue green measures improves my living environment.
23	I rather take blue green measures in my garden than at my home.
12	Before I took part in this research I did not put thought into whether I can do something to prevent nuisance by extreme weather.

7

From perspectives to factors

This chapter presents the analysis and the results of the Q-sorts. The statistical approach towards the number of factors to extract is provided firstly, consequently the factors are interpreted. Then the factors are compared based upon demographic characteristics and the MPPACC features. Lastly, the discussion of the factors with homeowners and experts in two separate panel meetings is provided.

7.1. Q-sort factor analysis

In this section the factor analysis procedure as described in subsection 2.4.5 is applied to all the administered Q-sorts. The text box below summarises the P-set characteristics.

P-set characteristics

The P-set consists of 25 homeowners. The participants were inquired for the following information: city of residence, sex, age, highest level of education, presence of a front yard and the surface area of the backyard if present. A follow-up interview was conducted with nine homeowners who were willing. Each interpreted factor in this chapter was represented in this group of willing homeowners: four loaded on factor 1, two loaded on factor 2, one loaded on factor 4a and two loaded on factor 5.

- City of residence: "Den Haag" = 11; "Rotterdam" = 14.
- Sex: "Female" = 6; "Man" = 19.
- Age: "18-30" = 3; "31-40" = 5; "41-55" = 7; "55-67" = 6 ;"67+" = 4.
- Highest received education: "Lagere school" = 0 ; "Middelbare school" = 3; "MBO" = 4; "HBO" = 9; "WO" = 9.
- Presence of a front yard: "Yes" = 9; "No = 16".
- Backyard: "less than 25m^2" = 3; "26m^2-75m^2" = 15; "More than 75m^2" = 6; "I don't have a backyard" = 1.

The first criterion that should be met is the representativeness, the factors should together load at least 50% of the participants. The last column of Table 7.1 illustrates that all factor solutions pass this criterion. The flagged percentage is the summed percentage of participants loading on a factor.

The second criterion is an EV higher than 1.0. The CFA was applied on 7 factors and resulted in five factors with a EV > 1.0 as depicted in Table 7.2. Factor 3 was not considered for further analysis since it had a EV of 0.1195. Due to the the program set-up factor 3 could not be removed, the presence of factor 3 should therefore be ignored. For clarification, a factor solution with factors 1, 2, 4 is a 3-factor solution. The explained cumulative variance of the first 5 factors, factor 1, 2, 4, 5 and 6, was 55%, which is a sound solution considering the advised standard for explained variance is 35-40% (Watts & Stenner, 2012). The choice was made to

Table 7.1: Representativeness of the factors based on each factor loading

Factors	Flagged	Unflagged	Flagged percentage %
2	24	1	96
3	24	1	96
4	22	3	88
5	24	1	96
6	20	5	80
7	18	7	72

initially keep six factors for the next criterion, Humphrey's rule, since factor seven has an EV of almost 1.0 as shown in Table 7.2.

Table 7.2: The Eigenvalue and explained variance of each factor

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Eigenvalues	8.8553	1.7942	0.1195	1.4841	1.6769	1.0188	0.9991
% Explained Variance	35	7	0	6	7	4	4

Humrey's rule requires two participants to load significantly on each factor in the unrotated factor matrix. The significance is 0.392, as was calculated with formula 3.3. In the unrotated factor matrix, Table 7.3, the loading of each participant on the factors is presented. Factor 6 and 7 did not meet Humphrey's rule and were also excluded from further analysis just as factor 3. A 2-, 3- or 4-factor analysis solution is still possible with factors 1, 2, 4 and 5.

Table 7.3: Unrotated factor matrix, the green cells have a significant loading on a factor

No. participant	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.5924	0.3789	0.1141	0.0395	-0.2057	-0.1155	0.3219
2	0.3689	0.248	0.0467	0.4859	0.4586	0.2113	0.1929
3	0.431	-0.3984	0.1248	-0.3356	0.3436	-0.1985	-0.3282
4	0.7667	-0.2376	0.0416	-0.2393	0.061	0.1236	0.0815
5	0.7213	-0.2276	0.038	0.3342	0.1743	-0.0038	0.2052
6	0.4936	-0.3453	0.0913	0.1203	0.0592	0.126	0.1699
7	0.6108	-0.2411	0.0427	-0.1799	0.1653	-0.0761	0.1441
8	0.4521	0.157	0.0184	-0.2045	-0.2176	-0.2868	0.1809
9	0.6642	0.0295	0.0007	-0.3092	0.0564	0.0148	-0.0708
10	0.7457	0.4408	0.1597	-0.1145	-0.1773	0.1395	-0.0519
11	0.7136	-0.3199	0.0776	-0.0355	-0.1835	0.179	-0.2874
12	0.5107	0.1523	0.0173	-0.4084	0.3273	-0.0611	0.0959
13	0.431	-0.3451	0.0912	0.1365	-0.048	0.5081	0.05
14	0.7879	-0.2435	0.0439	0.0585	0.1182	-0.045	0.0402
15	0.1111	-0.3724	0.1076	-0.2555	-0.4093	0.1062	0.1935
16	0.6282	0.2137	0.0344	0.0574	-0.3363	-0.247	-0.074
17	0.5676	0.2336	0.0413	0.0092	-0.0498	0.1419	-0.3548
18	0.6152	0.3203	0.0796	-0.2114	-0.1815	0.1983	0.0883
19	0.6982	-0.069	0.0033	0.3263	-0.2556	-0.1944	-0.1693
20	0.7512	0.0423	0.0015	-0.0768	0.052	0.1131	0.0859
21	0.5181	-0.064	0.0028	-0.2004	0.2299	-0.3073	-0.0786
22	0.4036	0.2561	0.0499	0.3131	0.2986	-0.18	-0.502
23	0.6555	0.2495	0.0473	0.0774	-0.3851	-0.1272	0.1918

24	0.5622	-0.1873	0.0253	0.2731	-0.2467	-0.32	-0.0302
25	0.5859	0.3254	0.0823	0.3646	0.5166	0.2426	-0.0851

The varimax rotation of the unrotated factor matrix results in the factor loadings presented in Table 7.4. It can be observed that factor 4 has three positive loads and one negative load, which signifies it is a bipolar factor (Brown, 1980). Hence factor 4 was split into Factor 4a and 4b so all Q-sorts loaded positively. Consequently factor 4b was removed from further analysis, since it only had one Q-sort significantly loading on it. Factor 4a was kept in the factor interpretation. Q-sort 20 did not load significantly on any factor.

Table 7.4: The factor loadings on each factor; green is positively, red is negatively and grey is not significantly loading upon a factor.

No. participant	Factor 1	Factor 2	Factor 4	Factor 5
1	0.6939	0.1472	0.1982	0.0832
2	0.0805	0.1881	0.7751	0.0547
3	-0.0907	0.2752	-0.0319	0.703
4	0.3335	0.4517	-0.0102	0.6255
5	0.1803	0.6735	0.3839	0.2851
6	0.0618	0.5483	0.0801	0.2761
7	0.1755	0.3763	0.052	0.5636
8	0.5072	0.0925	-0.0797	0.2131
9	0.4354	0.1862	0.0369	0.5589
10	0.8332	0.1147	0.1937	0.2628
11	0.3536	0.6248	-0.1024	0.3558
12	0.29	-0.0781	0.1729	0.6618
13	0.0759	0.5427	0.0039	0.1779
14	0.276	0.5993	0.1996	0.4728
15	0.0988	0.2686	-0.5463	0.0902
16	0.6763	0.3031	0.0599	0.0563
17	0.5123	0.1774	0.2135	0.2029
18	0.6905	0.0699	0.051	0.2836
19	0.4754	0.6365	0.1609	0.019
20	0.4687	0.3384	0.1934	0.4458
21	0.1893	0.1848	0.136	0.5255
22	0.21	0.1506	0.5841	0.0995
23	0.7373	0.315	0.0617	0.0237
24	0.3267	0.6127	0.0519	0.0159
25	0.2479	0.1898	0.831	0.2568

The factor statistics of the different factor analysis solutions are presented in Table 7.5. It can be observed that the cr criterion, cr > 0.94, excludes the factor solution of table B, which refers to a 3-factor analysis solution. A 2- and 4-factor analysis solution both remain possible. The choice was made to interpret the 4-factor analysis solution since this solution will bring forward more information of homeowners' perspectives which would otherwise be lost in the in 2-factor solution. The 4-factor solution has a cumulative explained variance of 55%. Two Q-sorts were eliminated from in the 4-factor solution, the negatively loading Q-sort on the bipolar factor 4 and the unflagged Q-sort as presented in Table 7.1.

Table 7.5: The factor statistics of a 2, 3, 4-factor analysis, respectively presented in table A, B and C

Table A	Factor 1	Factor 2
No. of Q-sorts loading	13	11
cr	0.981	0.978
No. Of distinghuising statements	16	17

Table B	Factor 1	Factor 2	Factor 4
No. of Q-sorts loading	9	9	3
cr	0.981	0.978	0.923
No. Of distinghuising statements	16	17	6

Table C	Factor 1	Factor 2	Factor 4	Factor 5
No. of Q-sorts loading	7	7	4	6
cr	0.966	0.966	0.941	0.96
No. Of distinghuising statements	9	5	6	5

7.2. Factor interpretation: 4-factor solution

This section starts with the consensus statements and the distinguishing statements per factor. Consequently, the factor arrays are presented which are input for the crib sheets. The consensus statements, distinguishing statements, factor arrays and crib sheets aid in providing an objective interpretation of each factor.

A factor is composed of similarly arranged Q-sorts which indicate a similar perspective on the subject of interest. Each factor is thus a 'fictive homeowner' which represents the similar perspective. During the interpretation, the composite Q-sort of one factor is compared in relation to the composite Q-sorts of the other factors. It should be noted that due to the forced distribution adhered in this study, the relative position of statements provides key information on top of the individual statements themselves. In Appendix H supplementary material for the interpretation such as the crib sheets and the composite Q-sorts are provided of each factor.

7.2.1. Consensus statements

The consensus statements provide a first glance into the data and can be distinguished based upon the Z-score variance. A high Z-score variance indicates a disagreeing point of view on a statement, conversely a low Z-score variance signifies an agreeing point of view on a statement. The top five consensus statements are presented in Table 7.6.

Table 7.6: Top 5 consensus statements

No. Statement	Statement	Z-Score variance
6	I think that blue green measures are rather expensive.	0.025
21	Blue green labels, such as the energy labels, are a good idea.	0.029
16	I am aware of the municipality's expectations regarding the prevention of nuisance due to heavy rain, drought and/or heat.	0.053
22	f somebody in my neighbourhood starts an initiative I would like to join.	0.064
26	I know where to find the needed information to adopt blue green measures against extreme weather conditions myself.	0.092

7.2.2. Distinguishing statements

Table 7.7: Factor 1 distinguishing statements: significance P<0.05, P<0.01 with an asterisk (*)

#	Statement	F1	F2	F4a	F5
7*	The municipality should do more to prevent nuisance by heavy rain, drought and/or heat.	3	0	1	1
20*	The consequences of extreme weather are a conversation topic in my social environment.	2	0	-2	-2
3*	I am worried about the consequences of heat, drought and heavy rain for the area I live in.	2	-2	0	-1
11	Adopting blue green measures improves my living environment.	1	2	3	0
5	I have sufficient space to take blue green measures.	0	-1	-3	3
17	I am responsible for water nuisance on my property due to weather conditions.	-1	0	-2	2
25*	I am skilled thus I can adopt blue green measures myself.	-1	1	1	0
8*	The municipality should oblige the adoption of blue green measures on private property.	-2	-3	0	-3
12*	Before I took part in this research I did not put thought into whether I can do something to prevent nuisance by extreme weather.	-3	-1	0	-1

Table 7.8: Factor 2 distinguishing statements: significance P<0.05, P<0.01 with an asterisk (*)

#	Statement	F1	F2	F4a	F5
14*	I have adopted many blue green measures already.	-2	1	-3	-1
17*	I am responsible for water nuisance on my property due to weather conditions.	-1	0	-2	2
20*	The consequences of extreme weather are a conversation topic in my social environment.	2	0	-2	-2
5	I have sufficient space to take blue green measures.	0	-1	-3	3
4	I do not want to much maintenance on my home and/or garden.	1	-2	0	2

Table 7.9: Factor 4a distinguishing statements: significance P<0.05, P<0.01 with an asterisk (*)

#	Statement	F1	F2	F4a	F5
9*	A subsidy should be installed for blue green measures.	1	1	3	1
8*	The municipality should oblige the adoption of blue green measures on private property.	-2	-3	0	-3
24*	It is a good idea to fine homeowners who do not take blue green measures to prevent nuisance due to heavy rain.	-3	-3	0	-3
17	I am responsible for water nuisance on my propery due to weather conditions.	-1	0	-2	2
5*	I have sufficient space to take blue green measures.	0	-1	-3	3
14*	I have adopted many blue green measures already.	-2	1	-3	-1

Table 7.10: Factor 5 distinguishing statements: significance P<0.05, P<0.01 with an asterisk (*)

#	Statement	F1	F2	F4a	F5
5*	I have sufficient space to take blue green measures.	0	-1	-3	3
4	I do not want to much maintenance on my home and/or garden.	1	-2	0	2
17*	I am responsible for water nuisance on my property due to weather conditions	-1	0	-2	2
11*	Adopting blue green measures improves my living environment.	1	2	3	0
25	I am skilled thus I can adopt blue green measures myself.	-1	1	1	0

7.2.3. Crib sheets

Crib sheets are devised to systematically approach factor interpretation and improve reproducibility (Watts & Stenner, 2012). A crib sheet's input is the factor arrays, the scores attributed to each statement by a factor, of all four factors. The crib sheet provides further insights on top of the distinghuising statements (Watts & Stenner, 2012). A crib sheet offers the opportunity to explore the less extreme statements as well. As such cribs sheets result in a more encompassing factor narrative (Watts & Stenner, 2012). Cribs sheets include the following four basic categories of statements:

- The highest ranked statements
- The lowest ranked statements
- The statements ranked higher by the factor under research than the other research factors
- The statements ranked lower by the factor under research than the other research factors

In Table 7.11 the factor array of each factor is depicted. In Table 7.12 the crib sheet of factor 1 is shown as an example, the remaining crib sheets can be accessed in Appendix H.

Table 7.11: Factor array of all four factors

Item number and wording		**Factor arrays**			
#		*F1*	*F2*	*F4a*	*F5*
1	The climate is changing.	3	3	2	1
2	I experience nuisance by flooding, drought and/or heat stress in the direct proximity of my house.	0	0	-1	-2
3	I am worried about the consequences of heat, drought and heavy rain for the area I live in.	2	-2	0	-1
4	I do not want to much maintenance on my home and/or garden. and/or garden.	1	-2	0	2
5	I have sufficient space to take blue green measures.	0	-1	-3	3
6	I think that blue green measures are rather expensive.	-1	-1	-1	0
7	The municipality should do more to prevent nuisance by heavy rain, drought and/or heat.	3	0	1	1
8	The municipality should oblige the adoption of blue green measures on private property.	-2	-3	0	-3
9	A subsidy should be installed for blue green measures.	1	1	3	1
10	Exhibiting examples of blue green measures at garden centres is a good idea.	1	1	2	1
11	Adopting blue green measures improves my living environment.	1	2	3	0
12	Before I took part in this research I did not put thought into whether I can do something to prevent nuisance by extreme weather.	-3	-1	0	-1
13	I rather take climate adaptive measures in my garden than at my home.	-1	-1	0	0
14	I have adopted many blue green measures already.	-2	1	-3	-1
15	I am willing to adopt climate adaptive measures.	2	3	1	0
16	I am aware of the municipality's expectations towards homeowners regarding the prevention of nuisance due to heavy rain, drought and/or heat.	-2	-2	-2	-2
17	I am responsible for water nuisance on my propery due to weather conditions.	-1	0	-2	2
18	I am willing to take climate adaptive measures to prevent nuisance for my neighbours due to heavy rain, drought and/or heat.	0	2	1	3
19	I want to look for my own information before I adopt blue	0	1	2	2

	green measures.				
20	The consequences of extreme weather are a conversation topic in my social environment.		0	-2	-2
21	Blue green labels, such as the energy labels, are a good idea.	0	0	-1	-1
22	If somebody in my neighbourhood starts an initiative I would like to join.	1	2	1	1
23	Adopting blue green measures increases the value of my property.	0	0	-1	-1
24	It is a good idea to fine homeowners who do not take blue green measures to prevent nuisance due to heavy rain.	-3	-3	0	-3
25	I am skilled thus I can adopt blue green measures myself.	-1	1	1	0
26	I know where to find the needed information to adopt blue green measures against extreme weather conditions myself.	-1	-1	-1	0

Table 7.12: Cribsheet of factor 1

#	**Highest Ranked Statements**	**Statement type**
1	The climate is changing.	
7	The municipality should do more to prevent nuisance by heavy rain, drought and/or heat.	D*
	Positive Statements Ranked Higher in factor 1 Array than in Other Factor Arrays	
20	The consequences of extreme weather are a conversation topic in my social environment.	D*
3	I am worried about the consequences of heat, drought and heavy rain for the area I live in.	D*
2	I experience nuisance by flooding, drought and/or heat stress in the direct proximity of my house.	
23	Adopting blue green measures increases the value of my property.	
	Negative Statements Ranked Lower in factor 1 Array than in Other Factor Arrays	
19	I want to look for my own information before I adopt blue green measures.	
18	I am willing to take climate adaptive measures to prevent nuisance for my neighbours due to heavy rain, drought and/or heat.	
26	I know where to find the needed information to adopt blue green measures against extreme weather conditions myself.	
13	I rather take climate adaptive measures in my garden than at my home.	
25	I am skilled thus I can adopt blue green measures myself.	D*
	regarding the prevention of nuisance due to heavy rain, drought and/or heat.	
	Lowest Ranked Statements	
12	Before I took part in this research I did not put thought into whether I can do something to prevent nuisance by extreme weather.	D*
24	It is a good idea to fine homeowners who do not take blue green measures to prevent nuisance due to heavy rain	

7.2.4. Factor narratives

In this subsection the narratives of the factors are presented. These are based upon the: consensus statements, distinguishing statements, factor arrays, constructed crib sheets, semi structured interviews performed after the Q-sorting and the composite Q-sorts of each factor which are included in Appendix H. The narratives are presented from a homeowner's perspective to emphasise that each factor is a fictive homeowner representing a group of homeowners. To improve the reliability of the narratives the factor loading on the statement is enclosed as follows (statement number, positive/negative loading on the statement). Additionally, quotes of interviewed homeowners are added if illustrative or complementary.

Factor 1: Major problem, but what is the solution?

I worry deeply about the effects of climate change (1, +3 & 2, +2). It is a frequent topic of conversation amongst friends and family (20, +2). I have thought about what can be done to limit climate change and the effects (12, -3). The terms mitigation and adaptation do not really ring a bell, "*I totally missed solar panels in your examples*". I am nevertheless very willing to adopt either mitigating or adaptive measures (15, +2).

I have not adopted SSCAM myself (14, -2). I do not feel it is my responsibility to act upon the consequences of climate change, but it is more a task of the municipality (7, +3 & 17, -1). Additionally, I am not too handy, so I wouldn't know how and where to start (25, -1). Space in my garden is not a concern (5, 0), but "*I worry that removing tiles to green my garden would turn my garden into a swamp after a multi-day rain event*". On top of that I think that these SSCAM also come with more maintenance which I am not fond of (4, +1). A last practical problem is how it will affect my use space; "do rain barrel attract mosquitoes and does the stagnant water pose health threats?"

A neighbourhood initiatives could work for me (22, +1), if there is time answer my multitude of questions regarding adopting SSCAM. I would also actually slightly prefer a green roof or a green facade over a green garden (13, -1), but I cannot do the construction and maintenance involved. Lastly, I want to emphasise that I do think SSCAM should be adopted on voluntary basis (8, -2). Therefore I am against fining or obliging homeowners (24, -3).

Factor 2: Together we make it better

It is very clear to me that the climate is changing (1, +3). I however do not see reason to worry yet (3, -2). I have not experienced major nuisance due to extreme weather yet fortunately (2, 0). I have adopted SSCAM in my garden already (14, 1), partially because I just like it (11, +2), partially "*to prevent heat in the summer*". I consider it a nice benefit that my garden is somewhat climate adaptive. I would not like it if I would cause nuisance for my neighbours, since "*the neighbours and neighbourhood can count on me. Whether it is to help a neighbour out with some sugar or to tackle climate change nuisance because the garden of the neighbour is flooded after every major rain event*" (18, +2). I thus strongly believe that problems can and should be solved collectively.

I would prefer to have a green roof or facade as new SSCAM (13, -1), since my garden space is already a bit limited (5, -1). More maintenance required for SSCAM is absolutely not a problem for me (4, -2). Additionally, I would describe myself as moderately skillful (25, 1), which also something that can be appealed for by my neighbours of course.

I am strongly in favour of neighbourhood initiatives to stimulate SSCAM (22, +2). I think SSCAM contributes to a more beautiful living environment, more SSCAM in the neighbourhood improves its aesthetics (11, +2). Participating in these initiatives should be open to each individual. Obligating and fining is contradictory to my point of view to achieve things together (8, -3 & 24, -3)). Both the municipality and I have a (shared) responsibility (17, 0). It would be good if the municipality and residents work together from beginning to end, "*a subsidy might persuade more people*" (9, +1).

Factor 4a: I don't know how I am part of a solution

Climate change is self-evident (1, +2). I am not so bothered by it in daily life. I am not worried (3, 0) and "*I*

also do not really think about it". With friends or family it is absolutely not a frequently discussed topic (20, -2). So far I have not experienced nuisance and I do not expect it to occur (2, -1). Therefore I also do not see the point of adopting measures myself. But if it would be necessary (or obliged) I want to preferably do my own research (19, 2). It is not clear yet were I would find this information (26, -1).

"*More green in cities is something I would like*", since it improves my living environment (11, +3). I think municipalities should contribute more to that (7, +1). The garden centre idea of showcasing green solutions in garden centres is also a good idea (10, +2). For me the options to adopt measures are very reduced by limited space available (5, -3), so if they want me to adopt measures it should be very small scale. Exhibiting SSCAM hopefully has an added benefit of convincing people that a garden can also look nice. "*I would for example be in favour of a ban on ugly fences to replace them with hedges*".

I think the municipality has more responsibility to take action in the case of climate change than homeowners (7, +1). If the municipality wants to get climate adaptive done, it should budget a lot of subsidy in my opinion (9, +3). I am neutral to obliging homeowners to adopt measures or fine them (8, 0 & 24, 0). This has the same explanation as why I am very much in favour of subsidising, namely the absence of perceived responsibility. "*If I don't perceive a responsibility probably others do not either. So if the municipality still wants to achieve something, they will have to rely on more persuasive policy instruments*". Not surprisingly, I have not adapted any SSCAM so far (14, -3), but I might (15, +1).

Factor 5: Act when needed

I have heard of climate change on the news. "*I definitely don't deny it*", but I have the feeling it is to some extent exaggerated (1, +1). I haven't experienced nuisance by climate change and the topic never arises in my social circle (2, -2 & 20, -2). I see no need to worry about it nor to adopt SSCAM (3, -1).

Since I have quite a large garden (5, +3), "*I would be able to act if I observe nuisances*". I am not inclined to adopt SSCAM (15, 0) due to the fact that I expect extra maintenance and costs involved (4, +2 & 6, 0). "*My property as it is satisfies me*", therefore I do not feel an intrinsic willingness to make alterations. If alterations would be necessary, I would prefer to look for my information however (19, +2). "*It is my property so I should be allowed to take care of it as I deem right*".

I think homeowners, me included, are themselves primarily responsible (17, +2). Additionally, I think that *your neighbourhood both in a physical as social sense is very important for the quality of living*. I am therefore active in the neighbourhood (22, 1). Privately I would also act if my neighbour would suffer from nuisances caused me (18, +3). I hope my neighbour does the same for me, but I think she/he would. Enforcing climate adaptation is something I would very much ill-advise (8, -3 & 24, -3). The municipality should take more measures in the first place (7, +1), but additionally also communicate its clear wishes to the neighbourhood as a whole (16, -2).

7.3. Factors compared

The next step is to compare how the above interpreted and four identified factors, referred to as factors from now onwards, are different or similar. The factors and their illustration are presented in Figure 9.1. Firstly, the demographic results will be presented, after which the factors are evaluated with the the five main features presented in the MPPACC on which the 10 categories to develop the Q-set are based on. The patterns described below are not necessarily significant patterns, they are distinguished to better understand the results and can potentially serve as hypotheses for future research.

7.3.1. Demographics

The demographic characteristics that have been asked for in this research are the city of residence, gender, age and education level. Patterns in the factors based upon these characteristics are provided if applicable.

Rotterdam versus Den Haag

The spread of participants loading on a factors 1,2 and 5 is evenly distributed over Rotterdam and Den Haag as depicted in Table 7.13. Factor 4a has however only been encountered in Rotterdam. Due to the low amount of participants loading on factor 4a, n = three, this could be chance. The result was not expected, due to the slightly more advanced climate adaptive policy of Rotterdam. However, homeowners in both Rotterdam and Den Haag have been found to be unaware of the expectations of the municipality Table 7.11. This finding emphasises that a group of residents exist in Rotterdam that are not aware of their potential contribution to climate adaptation as presented in factor 4a.

Table 7.13: Factor loading based upon city of residence

City	Factor 1	Factor 2	Factor 4a	Factor 5
Den Haag	2	4	0	3
Rotterdam	5	3	3	3

Sex

No pattern is observed in the factor loading based upon sex as can be observed in Table 7.14. It is however a interesting observation that the majority of participants is male, 76%.

Table 7.14: Factor loading based upon sex

Sex	Factor 1	Factor 2	Factor 4a	Factor 5
Male	6	5	2	5
Female	1	2	1	1

Age

Factor 4a appears to occur with middle aged or older people based upon Table 7.15. Since only three participants have loaded upon this factor, the support for this claim is limited.

Table 7.15: Factor loading based upon age

Age class	Factor 1	Factor 2	Factor 4a	Factor 5
18-30	0	0	0	2
31-40	2	2	0	1
41-55	4	1	1	0
55-67	1	1	1	3
67+	0	3	1	0

Education level

The education level characteristic firstly demonstrates that a wide variety of people has been reached. The only pattern that is observed here, is that factor 4a is loaded upon by participants for whom university of applied sciences is their highest education. The other education levels do not reveal a pattern

Table 7.16: Factor loading based upon level of education

Education level	Factor 1	Factor 2	Factor 4a	Factor 5
Primary school	0	0	0	0
Secondary school	2	1	0	0
Vocational college	0	2	0	2
University for applied sciences	3	1	3	2
University	2	3	0	2

7.3.2. MPPACC features

The factors are compared amongst each other based upon how they perceive the MPPACC features. The feature names have been modified to be more easily understandable and cohere more with the vocabulary of the participants. The features are presented below and the results are summarised in Table 7.17:

- Need (climate change risk appraisal); Are small scale climate adaptive measures urgently required?
- Responsibility (perceived adaptation efficacy); Who has the responsibility to act upon climate nuisance?
- Capability (perceived self-efficacy); Is the homeowner her/himself able to adopt SSCAM?
- Motivation (perceived adaptation costs); Is the motivation to adopt SSCAM intrinsic or extrinsic?
- Investment (adaptive capacity); What investment can be made in terms of costs in space, effort and financial aspect?

Avoidant maladaptation, which includes fatalism, denial and wishful thinking, is easily misinterpreted solely based upon the factor analysis of the Q-sorts. Interpretation requires careful inspection of the interviews conducted to obtain insight in this feature. Factor 4a might be prone to wishful thinking, however due to limited support this will not be included in the result.

Table 7.17: Comparison of the factors based upon the MPPACC features

MPPACC characteristics	Factor 1	Factor 2	Factor 4a	Factor 5
Need	High	High	Moderate	Low
Responsibility	Municipality	Together	Municipality	Self
Capability	Low	High	Neutral	Neutral
Motivation	Intrinsic	Intrinsic	Intrinsic	Extrinsic
Investment	Neutral	Low	High	High

7.4. Panel meetings

Two panel meetings were held of one hour each, one in which the panel consisted of participants and one with governmental officials. A brief overview is presented below of both meetings.

7.4.1. Panel meeting homeowners

In total five persons participated in this meeting. The factor narratives and suggestions for policy instruments were presented to five homeowners. Consequently, questions could be asked after which a discussion was started.

Three interesting questions posed were on the content:

1. Did you see a differentiation in the factors based upon age or any other demographic characteristic?

   This research has demonstrated no correlation between the demographic characteristics and the factors. The population size was also to small to make such a statement. Participant 5 added that he

expected older people to be more do-it-self. As he said it: “When I was young we simply did not have the money to get our house painted, my children who are in their thirties cannot even patch a tire.” Participant 1 shared a similar view and stated that the current generation has more of a welfare mentality.

2. What is the difference between perspective, factor and group?

   In principle they are the same. I have used them interchangeably. Factor refers the statistical method I have used, factor analysis, to obtain a reduced amount of representative perspectives for all participants. These factors thus represent a group of participants with similar viewpoints.

3. What SSCAM are thus available, because I am quite interested?

   I have not presented these since it would require a significant amount of time. I will email the SSCAM I have researched to everyone who wants.

Discussion

The discussion was led by the author using a few pre-drafted questions. Some interesting discussion points are provided below.

What did you think of the factors?

It was agreed upon that the factors were very recognisable. Person 1 highlighted that in his work as a project developer, these factors are indeed always present during the consultation meetings. They tend to influence each other and the outcome depends on which factor has a dominant and articulate spokesman. Generally, factor 1 and 4a are more observant, while the discussions arise from factor 2 and 5. People with view-points such as factor 1 and 4a do speak up on very practical issues. Person 2 said she had not seen the climate change denier. She had tried to arrange a green roof with her homeowners association, but one neighbour resisted and could not be persuaded since none of the arguments took hold. The persons present agreed that a climate change denier factor was missing. Person 5 argued this could be explained by the manner of inviting homeowners to participate with the research. Climate change deniers would be less interested to participate.

How well would the fostering instrument work in practise?

This question invoked mixed reactions. Person 1, 3 and 5 were in favour and thought the packages fitted the different factors well. They agreed that things should be as easily as possible, especially if homeowners feel some reluctance. Person 2 was not fond of the maintenance. After a discussion with the other homeowners she agreed that it might work, but she thought it strange. Person 4 took a different stance and explained that the first step should be communication. He was not aware of any of the public policies, which was resonated by the others. The communication campaign was therefore in his opinion far more important at this stage. The content of the fostering instrument looked reasonable to him when explicitly asked.

What do you think of the communication campaign?

The importance of clear communication was agreed upon unanimously. It was remarked that it should be the first instrument. No one of the panel was aware of the current policy regarding climate adaptation. The most important channels to use were determined to be from door to door, have ambassadors in the neighbourhoods and posters in the supermarkets and schools. Mouth to mouth advertisements is thought to work best. The local media are a bit outdated, older generations might watch this but for the younger generations this is not a good idea. Additionally, the suggestions was made to include professionals. In construction it makes a huge difference if a constructor is aware of the mitigation regulations and subsidies. In this way it is profitable and for them as well. Something similar is proposed by person 1 and 5. Many times a homeowners discusses a plan with a constructor or gardener, here the plans can still be altered or made more climate adaptive according to person 3, upon which the other persons agreed. Person 1 added that professionals can also provide neutral expertise which can help homeowners in deciding if and which SSCAM to choose.

This was agreed upon, person 2 however remarked that if the professionals have a financial interest it is not entirely neutral.

7.4.2. Panel meeting experts

In total eight experts attended in this meeting, Arthur Hagen and Jack Amesz from Den Haag could due to circumstances not participate. The factor narratives and suggestions for policy instruments were presented to the experts. Consequently, questions were asked which started some small discussions and provided insightful remarks. The posed question is firstly presented after which the summary of the discussion which followed is provided. To clarify each question and remark, they are enclosed in quotation marks and the initials of the person are provided before the sentence which is started with a colon.

1. EB: "Are you aware of the fact that the neighbourhoods Hillergsberg-Zuid, Rotterdam and Vruchtenbuurt, Den Haag might not be a good representation of Den Haag and Rotterdam?"

SM: "Both Hillergersberg-Zuid and Vruchtenbuurt are indeed not representative for Den Haag or Rotterdam. In this study I only focus on homeowners though, this group is also not representative for both cities. These neighbourhoods I think are both to fairly representative for homeowners in both cities. They are both middle income neighbourhoods, with a divers group of people living in them". AR: "How divers was your group and how did you evaluate that"? SM: "I asked homeowners to state their city of residence, age, sex, highest education, presence of front yard and size/existence of the backyard". AR: "Okay, and was it a divers group who participated"? SM: I believe so, the age spread was quite surprising from people my age who apparently could already buy a house, to roughly 75-year old people. The highest education also ranged from high school to university. In the nine interviews I conducted I obtained more information about political beliefs and values. I did not obtain this from the remaining 16 people I did not interview". AR: Thank you.

2. AR: How are you guaranteeing the continuity of such a (adaptive) project and how intensive is the relationship with the homeowners?

TW: "Might I add that it feels as if the process is from the municipality towards homeowners? In Rotterdam we are actually looking for ways how we can stimulate neighbourhood networks to get for citizens by citizens initiative, rather than a municipal initiative." SM: "The answer is I think a combination of both your remarks. Indeed the process is initiated by the municipality. As I have proven with my research, the awareness of adaptation is low and homeowners do not feel responsible nor capable. But the fact that the subject is initiated by the municipality does not make it a municipal affair. Homeowners should actively be included. To do so, the first step is to create the awareness, after which the relation should be build. This relation is quite intensive, but does not exist from municipal officials as stated local champions have an important role to play. The local champions help set-up the neighbourhood networks, which are consequently kept-up by residents with support of the municipality. No guarantee can be given, but the stronger the build relationship the more you guarantee the continuity of a project. Adaptive projects are finite however. TW: Setting up networks is I think a very good idea. Not only because it can ensure the continuity of a project, but also because it can for example increase the capability of individuals. Learning by talking to each other.

3. AM: How do you connect climate adaptation to other transition themes such as mitigation, mobility and so on?

SM: "That has not been the scope of this research. The networks created in neighbourhoods can of course also be used for the other transition themes. Additionally, I think that the adaptation transition can learn a lot from the mitigation transition. In the mitigation transition neighbourhood scales ensure lower costs of instalment. In Utrecht parts of the proposed fostering instruments are employed already. The construction is tendered by the municipality or residents' energy cooperatives". TW: "Yeah, I think based upon what you also said that the awareness regarding climate change is high. Therefore I also see a link with the fostering instrument". EB: "Do you think that a revenue model exists for adaptation such as for the energy transition"? SM: "Well adaptation is more an insurance I think. It will save damage costs later on. That is also why the municipality might also have a larger role to play. But it can be made more attractive financially by splitting

the sewer tax. This is widely used in Germany and Flanders as an incentive to promote rain water harvesting". EB: "Yeah, but for those few euros or even €50 per household, the administrative work will cost so much more. And how would you provide homeowners a discount"? SM: "In Germany it seems to work, so I will look into that. But this is actually a good point and something which we should think about".

4. DV: "What method did you use to reach homeowners and what was your response rate"?

SM: "I used two methods to reach homeowners. I contacted the neighbourhood associations and I went canvassing. The neighbourhood associations posted my message on their website and included it in their monthly publication. Four homeowners joined through this method. I don't know how many people have read it so, the response rate is unknown. The other method was canvassing, I approached roughly 150-170 homeowners in 6 days in the end. This has resulted in 21 homeowners who were willing to participate. So this is a response rate of more or less 15%". DV: "Oh, that is quite good. I noticed that canvassing indeed works the best". EW: "In the communication strategy I would diversify the communication channels. A newspaper might work for an older person, but younger generation do not read them". AR: "Flyers in elementary schools and supermarkets also work. Handing out flyers gives a guarantee people receive the message and is less demanding than canvassing. But I agree, canvassing works best".

8

Implications for policy instruments

In this chapter the policy analysis in chapter 4 and the factors and panel meetings presented in chapter 7 provide the base to develop more effective policy instruments to stimulate adoption of SSCAM among homeowners. Firstly, the use of a regulative policy instrument is evaluated. Consequently, a communication strategy is developed after which an 'enabling' policy instrument is presented.

8.1. Stick: back pocket instrument

Enforcing SSCAM is neither advised based upon the results of this research nor executable with current legislation for heat and drought. The Dutch municipality Laren demonstrates however that the run off from private property can be banned and punished by a fine (Gemeente Laren, 2016). Regulations are often associated with negative sanctions or other types of punishment as remarked by Bemelmans-Videc et al. (2011). This view was confirmed by the follow-up interviews where homeowners mentioned their disapproval of enforcing without being inquired about the matter yet. All factors are very uncharacteristic with enforcing except for factor 4a, which is the only factor who is neutral to enforcing. An interesting remark was given by one participant loading on factor 2: "*I am very much opposed to enforcing. It could however remain a back pocket idea which can serve as an instrument to get those few loonies aboard as well, but it really should be a last resort*". Den Haag and Rotterdam currently have non-binding adaptive policy in place, which is in line with the recommendation to have regulative policy instruments as a back pocket policy instrument when other policy instruments do not reach the desired objective. Additionally, clarification of the current responsibilities for climate adaptation is much needed and elaborated on in section 8.2 (Dekker et al., 2020).

8.2. Communication: Proposing a strategy

In this section a communication strategy is drafted. Firstly, the motivation for the communication strategy and its structure are provided. Consequently the communication strategy is developed which is comprising three steps. Each step is elaborated on individually.

8.2.1. Development of the communication strategy

Communication of risk is similar to an insurance: "*it is a fixed cost that can prevent larger damage*" (Fischhoff, 1995, p.143). This quote is very applicable for the objective of this study, since climate change poses a risk for large damages and even the loss of lives. The risk can be reduced by adopting SSCAM. Communication is the bridge that can cross the identified gaps in risk and adaptation appraisal of homeowners through objectives for effective risk communication (Fischhoff, 1995; Reed, 2008; Renn, 2008). Renn (2008) identifies the following objectives: 1) clarification - improve knowledge regarding the posed risk through a clear message to all recipients; 2) trust - establish a relationship between sender and recipient; 3) provide adaptive handles - improve the perceived adaptation and self-efficacy and 4) participation - include all relevant actors in the

decision making process. One participant illustrated the objective of this communication strategy poetically accurate: "*The municipality has a treasure in its hands. That treasure has to be kissed, not bombarded awake*". The communication strategy is thus motivated by the fact that few homeowners are aware of their expected role in climate adaptation. Surpassing the justness of this expectation, involving homeowners in the discussion regarding the need, responsibilities and capabilities is required to clarify their role which will accelerate SSCAM adoption (De Bruijn et al., 2008; Driessen et al., 2018; H. Mees, 2014)

The climate adaptation implementation agenda of the Dutch municipalities Amsterdam, Utrecht, Tilburg, Heereveen and Gouda have been examined for their communication strategies as inspiration. Gouda does not mention of a communication strategy. Den Haag and Heereveen included a communication strategy, but little elaboration is provided. Tilburg provides a limited communication strategy and has the only Uitvoeringsagenda where effect monitoring is included on the physical effects of the measures. Amsterdam does not have an implementation agenda yet, and no notion of Utrecht's implementation agenda was encountered. This illustrates the novelty of a communication strategy for the adaptation transition in Dutch municipalities.

Both the necessity and novelty for a communication strategy to promote adaptive behaviour and SSCAM a is established. The risk communication objectives of Renn (2008) address three of the distinguishing characteristics as presented in Table 7.17; need, responsibility and capability. The communication strategy is therefore structured into three steps which closely resemble the four objectives identified by Renn (2008). Each step influences one characteristic predominantly, the other characteristics are however to a lesser extent influenced as well:

1. Awareness (need) - Clarification of urgency climate adaptation and improve knowledge regarding the posed risks and climate adaptation through SSCAM

2. Dialogue (responsibility)- Establish a relationship

3. Participation in network (capability) - Inclusion of homeowners in the adaptive network

These steps aid homeowners in making an informed decision to adopt SSCAM or not and simultaneously reduce the perceived barriers.

The three communication steps are chronological and complement each other (Fischhoff, 1995). Each step is guided through the questions adapted from Fischhoff (1995) and Littlejohn and Foss (2017) presented below. An overview of the communication strategy is displayed in Figure 8.1

- Communication goal(s): What are the desired, measurable results of the communication?

- Target audience: Who are the intended actors to reach?

- Communication channel(s): What communication medium provides the needed communication?

- Evaluation: Has the communication goal(s) been achieved, should the roles of the actors be changed, is the target audience reached through the chosen communication media?

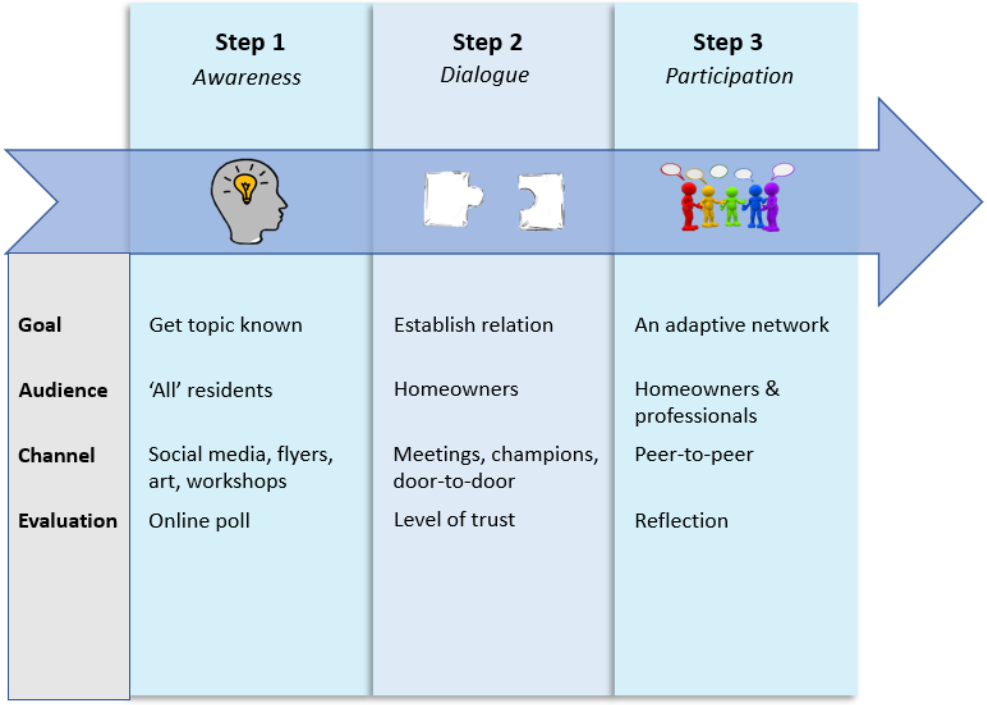


Figure 8.1: Schematic overview of the communication strategy

8.2.2. Step 1: Awareness

The first step should get climate adaptation and SSCAM known and manifest their importance. Homeowners were aware of climate change, but a mismatch exists on the need to become climate adaptive as perceived by homeowners and the municipalities Den Haag and Rotterdam (H. Mees, 2014; Uittenbroek et al., 2019). This can be explained by the lack of knowledge homeowners have regarding the effects of climate change for their own city or neighbourhood and SSCAM. Although climate stress tests have been conducted and are publicly available, the uncharacteristic score on statement 16 provided this uncommon knowledge amongst homeowners[1]. This step positively influences the risk appraisal for factors 4a and 5 by raising their awareness of the need for climate adaptation. Factor 1 and 2 are thought to have passed the risk appraisal, this step can additionally positively influence the capability by improving their awareness of SSCAM (Grothmann & Patt, 2005).

The intended audience is 'all' residents of a municipality since other actors than homeowners should also be aware of adaption to start a adaptation transition (Loorbach, 2010). To reach all residents a wide variety of local communication channels should be used, including the social media of the municipality and informative flyers in schools, supermarkets, sport clubs and in the mailbox(Hendriks, 2018; Littlejohn & Foss, 2017; Tvinnereim et al., 2017) & (panel meeting experts). This should be complemented with neighbourhood specific information motivated by the interest all factors express in neighbourhood initiatives. Open workshops are additionally recommended due to the unanimous positive loading on demonstrations. Some workshop suggestions are provided, which are based on already performed examples in Dutch municipalities. Firstly, disconnecting courses under supervision of rain water coaches are proposed which increases the capability, secondly a garden fair such as TuinIdee in the municipality Den Bosch in collaboration with the waterboard can be organised. Lastly, the 'Climate Mates' in Delft is an initiative which involves citizens, organisations and companies to aid homeowners to adopt SSCAM by providing knowledge and helping with the implementation of SSCAM through workshops. Passive communication can complement the above communication with the exhibition of climate adaptive projects/art to receive attention is proposed at frequently visited

[1] Statement 16: I am aware of the municipality's expectations regarding the prevention of nuisance due to heavy rain, drought and/or heat.

places such as a central station, shopping districts and garden centres. Inspiration can be obtained from the municipality Utrecht, where a 12 metre high plastic whale was exhibited to raise awareness for plastic pollution. Rotterdam has already put such an climate adaptive exhibition in place through the Water Square, which received (inter)national attention. In Delft, part of the University Campus is a living lab where climate adaptive innovations can be tested and beheld. Lastly, the waterboard Delfland is setting up an cooperation with garden centres to showcase SSCAM for in the garden. Evaluation can be performed by comparing the outcomes of an online pre- and post-survey (Attems et al., 2020), such as conducted by van der Grient et al. (2019).

8.2.3. Step 2: Dialogue

The goal of the second step is to create trust and clarify the responsibilities between the involved parties through dialogue. This step is similar to the risk dialogues in the DPRA, but more comprehensive. The DPRA risk dialogue aims to increase the awareness and discuss proposed adaptive measures (Rijksoverheid, 2018). This step distinguishes itself by emphasising the establishment of responsibilities and a relation through trust between homeowners and the municipality, which are both essential for effective policy and communication (Driessen et al., 2018; Fischhoff, 1995; Littlejohn & Foss, 2017; H. Mees, 2014; Renn, 2008) & (panel meeting homeowners). Both factor 1 and 4a express a lack of responsibility and seems to unintentionally express trust in the municipality through their very characteristic score on statement 7[2]. Oppositely, factor 5 does not express this by being uncharacteristic. Furthermore public policy on adaptation is unknown amongst homeowners as all factors loaded uncharacteristic, -2, on statement 16[3], which reduces the effectiveness of the policy in place (Driessen et al., 2018; Gilissen, 2013; H. Mees, 2014). Especially factor 4a and 1 are thought to be positively influenced by increasing their perceived responsibility.

A dialogue should be initiated with homeowners. The responsibilities and trust can be established through two-way communication between the municipality and homeowners (Attems et al., 2020; Fischhoff, 1995; H. L. Mees et al., 2019). Each factor is expected to have a preferred topic to connect upon. Factor 1 requires information, the ability to ask informative questions regarding the pros and cons of different SSCAM and additionally will feel more motivated by emphasising the importance of individual behaviour. Factor 2 will also be interested in the SSCAM, but also in the social aspect of adopting SSCAM together with neighbours. Factor 4a is not yet interested in the topic and better involved by addressing the aesthetic benefits of SSCAM for the neighbourhood and their own property. Lastly, factor 5 is very involved with is own living environment and that of its close neighbours, which can open the dialogue with them. Direct communication is thus recommended, below direct communication options and examples are provided (Attems et al., 2020; Rogers, 2010) & (panel meeting homeowners & experts):

- Meetings: This is an effective channel to enable two way communication (Renn, 2008; Uittenbroek et al., 2019). A neutral moderator to lead the meetings will improve the trust process by setting a less hierarchical scene (Fischhoff, 1995; Renn, 2008; Uittenbroek et al., 2019). In Arnhem climate cafes serve as informal information meetings, which reduce the barrier for homeowners to participate and speak up (panel meeting homeowners & experts). This channel is thought effective for factor 1 and 2.
- Door-to-door campaigns: this is a time-consuming but effective channel to establish a relationship (panel meeting experts). This research performed a satisfactory door-to-door approach to reach participants. The established relationship enabled follow-up interviews with nine participants and a panel meeting with five. This channel is thought effective for factor 4a.
- Local champions: Messages received from local 'champions' are better received than from the municipality (Attems et al., 2020; Hendriks, 2018) % (panel meeting homeowners). 'Champions' are enthusiastic and driven homeowners who initiate change (Attems et al., 2020; Rogers, 2010), which can be asked to become 'adaptation ambassadors' (panel meeting experts). In Utrecht 'energy ambassadors'

[2] Statement 7: The municipality should do more to prevent nuisance by heavy rain, drought and/or heat

[3] Statement 16: I am aware of the municipality's expectations regarding the prevention of nuisance due to heavy rain, drought and/or heat.

are employed to stimulate the energy transition (Gemeente Utrecht, 2015). This channel is thought effective for factor 5.

Evaluation of this step can be done by inquiring homeowners about their level of trust and the perceived responsibility before and after this step .

8.2.4. Step 3: Participation in adaptive network

The municipality should facilitate the set-up of adaptive networks which increases the individual capability by connecting it with the capability of known and more progressive individuals (Rogers, 2010) & (panel meeting experts). An added value is the expected mouth-to-mouth communication regarding SSCAM amongst homeowners and other network participants (Rogers, 2010) & (panel meeting experts). This step is strongly urged by the fact that the capability of factor 1, 4a and 5 does not equal the identified capability for homeowners in chapter 5. The network scale should be confined to a small scale such as the neighbourhood or even smaller for homeowners to be able to associate with the problems and solutions and maintain a group feeling in which they feel represented (Huckfeldt, 1979) & (panel meeting experts). An example of a successful network is provided by Rotterdam in the construction of the Rooftop park. Residents of the adjacent neighbourhood were strongly represented, heard and advised, which led to interest and firm participation amongst the residents (Uittenbroek et al., 2019). This example also demonstrates that the municipality should ensure continuity and proper participation of the network (Arnstein, 1969). In Tiel, on the contrary, residents were initially stimulated to participate in the design of a water square which was part of an urban renewal project (Uittenbroek et al., 2019). However, during the implementation phase of the project residents were not actively included anymore to speed up the project which caused a negative sentiment amongst the residents (Uittenbroek et al., 2019).

The target audience of this step is homeowners and professionals such as constructors, gardeners and SSCAM experts to obtain a greater economic and carrying capacity (Loorbach, 2010) & (panel meeting homeowners & experts). Homeowners are naturally included since voluntary adoption of SSCAM is envisioned. The network increases the individual capability of homeowners by connecting it with the capability of known and more progressive individuals (Rogers, 2010) & (panel meeting experts). Professionals also have an important role in the adoption of SSCAM. Gardeners and constructors are in direct contact with the 'customer', the homeowner and can therefore advise homeowners on climate adaptive alternatives (panel meeting homeowners). SSCAM experts can provide impartial advise for homeowners on what SSCAM to adopt (panel meeting homeowners).

The best communication channel to spread innovations, SSCAM is in this case thus considered an innovation, is peer-to-peer (Rogers, 2010) & (panel meeting experts). An adaptive network can effectively facilitate peer-to-peer communication for SSCAM (panel meetings). The factors are not expected to become involved equally in such a network. Factor 2 was already identified as a champion and is therefore the starting point to set-up a citizen network (panel meetings). Factor 1 is expected to be interested to participate through informative network meetings with professionals. Their capability can largely increased by informing about concrete SSCAM applicable and emphasising the positive impact of individual measures. As in step 2 an external moderator is recommended to lead these meetings and set the agenda with the input provided from participants to prevent agenda pushing from one powerful actor (H. Mees, 2014; Reed, 2008). Factor 4a is expected to participate in a later stage than factor 1 and 2. Homeowners which have adopted SSCAM already increase the interest to participate in an adaptive network through peer-to-peer communication. The capability of factor 4a can be positively influenced by both garden designs of gardeners active in the network and homeowners with SSCAM. Factor 5 is strongly oriented on its direct living environment and not expected to become actively involved unless his close environment starts adopting SSCAM. This highlights the importance of the citizen network for this factor as well. An additional approach is to inform factor 5 about the investments needed when no SSCAM are adopted. Lastly, adaptive updates in the neighbourhood should be provided through occasional flyers in the mailbox and the municipal and neighbourhood website and social media to all neighbourhood residents (panel meeting experts).

A participation process can be time consuming (Attems et al., 2020; Fischhoff, 1995; Reed, 2008). Nevertheless it is important to continue the process to maintain the relationship since trust, the baseline for communication as stated in step 2, is easily shattered. Tiel is one example where the trust was broken, another example is the project 'Waterproof Kockengen' by the municipality Kockengen (Uittenbroek et al., 2019). A sounding board group, comprising of 20 representatives of residents, farmers and a nature conservation group was installed. The group could provide feedback on the plans, their feedback was however not binding since the group held no legal or financial power (Uittenbroek et al., 2019). This caused the residents to feel neglected and turn to the media to have their voices heard (Uittenbroek et al., 2019). This emphasises the importance that homeowners are not only listened to but also have influence through an equal power field (Reed, 2008). This was underlined by one municipal official who stated to be careful not to make the policy too much from the municipality towards homeowners and is line with the raised concern regarding the continuity of such projects **??**. The level of involvement should thus lead to citizen power as illustrated by Arnstein (1969, p.219):"*if consulting them is not combined with other modes of participation, this (tokenism) rung of the ladder is still a sham since it offers no assurance that citizen concerns and ideas will be taken into account*". This also illustrates the importance of evaluation of this last step. Firstly, the strengths of the network should be identified by all parties involved which are amongst others homeowners, neighbourhood associations, gardeners, contractors and involved municipality officials. Additionally, the points of improvement from all these parties are valuable to incorporate in future network projects.

8.3. Carrot: enabling instrument

This section continues upon the communication strategy. The communication strategy aided to identify the role of homeowners in climate adaptation by raising awareness for the need of SSCAM, discussing the responsibilities and creating a network to improve the capability. In this section firstly the reason why solely subsidising is not recommended is explained. Next, the 'tailored enabling instrument' is proposed which addresses the barriers of the factors and as such aids homeowners in fulfilling their identified role.

8.3.1. Subsidy

All factors are mildly in favour of the statement that a subsidy for SSCAM is required, except for factor 4a. Subsidies "*remove a barrier*" as mentioned by one homeowner. Interestingly the expense of SSCAM is not perceived a major barrier, only factor 5 perceives a mild barrier in the financial costs for SSCAM. The other factors either felt mildly uncharacteristic or neutral towards the expenses. Factor 4a strikingly loads highest on the statement that a subsidy is required, mildly uncharacteristic on the costs and lowest on the statement if SSCAM have been taken. Solely subsidising is thus not expected to achieve major results since it does not reduce the other perceived barriers.

8.3.2. Tailored enabling instrument

An enabling instrument is proposed to effectively reduce the identified barriers to adopt SSCAM. The enabling instrument therefore includes four 'components'; subsidy, information, construction and maintenance. It has become evident that factors 1 and 5 perceive maintenance as a barrier. Additionally, only homeowners in factor 2 characterise themselves as skilful, the other factors perceive a low capability. The construction of SSCAM effectively alleviates this barrier. All factors were in favour of demonstrations of climate adaptive measures in garden centres and no factor knew where to find the needed information regarding the adoption of SSCAM. This implicates information regarding the possible SSCAM and how the SSCAM function is favoured by all factors. Lastly, subsidy is included since all factors are mildly in favour of subsidy.

The factors demonstrate no one size fits all instrument can be formulated. Customisation is key. The enabling instrument is therefore tailored, meaning that it is to some extent customised to the homeowners' perspective. Three 'packages' are shown in Table 8.1, which address the barriers that have been identified in all four factors. The three proposed package options can be fitted to the needs/barriers of each factor.

Table 8.1: Unburden instruments with three different packages

Package	Subsidy	Information	Construction	Maintenance
1	X	X		
2	X	X	X	
3	X	X	X	X

Subsidy

Subsidy refers to the money each registered applicant receives for a package. All packages include subsidy since it is favoured by all factors. In line with reducing barriers, it is advised to arrange the subsidy for each applicant. This limits the financial costs barrier effectively without inducing another cost barrier such as effort.

Information

Information is concerned with what vegetation and materials to use, a climate adaptive garden design and do it yourself building guide. Information ought to be included in every package just as the subsidy. This is indicated by the positively perceived statement 10[4] and the negative load upon the statements 26[5] and 14[6].

Firstly, information regarding what vegetation to use for climate adaptive purpose and how to maintain it is highly important. The latter is illustrated by the following citation of one participant: "*We have a green garden because my wife loves gardening. Me, I am able to let a cactus die*". This is provided in the form of information flyers and demonstrations in garden centres such as already done by Tuinbranche. Secondly, climate adaptive garden designs or locations where climate adaptive garden designs can be drafted are included. Intratuin Pijnacker and Lochum already provide such a (temporary) service. Consequently, which materials to use and where to purchase them is easily provided and saves trouble for the applicant. Lastly, only homeowners loading on factor 2 consider themselves skilful. Information regarding the instalment of vegetation and material is provided and should be graspable for everyone. This concept is widely applied for furniture already by a Swedish furniture store and something similar should be opted for.

Construction

The construction option entails the building of the SSCAM on the homeowner's property. Construction is facilitated in both package 2 and 3 and is expected to aid factors 1, 4a and 5. All three factors are uncharacteristic with adopting SSCAM, factor 1 and 5 do not regard themselves skillful, and factor 4a and 5 have a respectively neutral and low willingness to adopt SSCAM.

To facilitate the construction component, public partnerships with gardeners, garden centres and construction markets are encouraged. In this way the process can be conducted effectively, efficiently and stimulate local companies. Effectively because the companies involved can be selected for their knowledge regarding the construction of climate adaptive measures. Implementation on a larger scale make it more efficient. Local companies can be chosen to cooperate with, which stimulates the local economy. The municipality can work with a trade mark for companies that have been screened to guarantee proper service. Another way to facilitate the construction is to tender a deal with companies to make the participating gardens climate adaptive. Inspiration can be drawn from the energy transition policy such as drawn by the municipality Utrecht in 'Energy plan Utrecht'. The municipality Utrecht cooperates with homeowners and energy, construction and financial companies to install energy saving and renewable energy producing products. The construction itself is thus not performed by the municipality.

[4] statement 10: Exhibiting examples of blue green measures at garden centres is a good idea.

[5] statement 26: I know where to find the needed information to adopt blue green measures against extreme weather conditions myself.

[6] statement 14: I have adopted many blue green measures already.

Maintenance

Maintenance adds a basic level of care for the SSCAM to ensure functioning over time (Woods et al., 2015). This option is specifically focused upon factor 5, which perceives maintenance as major barrier. A trade-off is to be made since the financial costs of including maintenance will significantly affect the price of this package. Rotterdam is already working with neighbourhood gardeners for the public domain. This service can be extended to private domain maintenance. Another option is to encourage partnerships with gardeners. In this way the maintenance is not conducted by the municipality. Lastly, the established neighbourhood networks in section 8.2 can connect homeowners with neighbours who do not own a garden or want to work in more gardens. Something similar was set-up in Dresden, Germany, where an urban gardening network is established in cooperation with the municipality which connects different garden projects and volunteers with each other (Kabisch et al., 2017). In Genk, Belgium, a very successful non-profit organisation was set-up to stimulate and support urban farming initiatives. Volunteers help maintain communal vegetable gardens and vegetable gardens for the elderly. This initiative has now spread through other parts of Flanders (Kabisch et al., 2017). In the latter two options the maintenance is not conducted by the municipality.

Cost coverage

These packages do introduce a question: who will pay for these different packages? One can straightforwardly set a price for package 1 and increase the price if additional options are chosen, the homeowner then pays for the extra service received. Intuitively this might seem fair. The argument can however be made that homeowners provide a service to the municipality to adopt SSCAM. The municipality then 'leases' gardens in which SSCAM are adopted, the garden itself however remains property of the homeowner. The argument for the lease is strengthened by the fact that climate adaptive measures adopted in the public domain have been paid with collective resources as well while residents do not benefit equally. A different approach is to let the homeowners pay and provide a reward through a sewer tax discount. The sewer tax covers the discharge of waste water and run-off (Verenging van Nederlandse Gemeenten, 2018). Municipalities are allowed to separate the tax for the two fluxes and set two different rates (Verenging van Nederlandse Gemeenten, 2018). Disconnected houses and garden therefore do not pay for the run-off tax. This separate sewer tax system has already been put in place in the Dutch municipality Son en Breugel in 2019. Other options are to install a sewer tax dependent on the total impervious area on the property which includes the house, as such green roofs are stimulated as well (Verenging van Nederlandse Gemeenten, 2018). This taxation is widely used in German municipalities (Meesters & Bor, 2016). Another option is to relate the charges for urban (sewage)water management and water to the quantity of drinking water consumed as done in Hamburg, Germany (Schuetze, 2013). The last option would be preferred by municipal officials of Den Haag and Rotterdam since it is more easily accounted for (panel meeting experts).

9

Discussion

The findings of this study suggest that the decision-making characteristics involved to adopt SSCAM by homeowners are varied. This was assessed with an online Q and a literature study in three decision-making theories, a policy analysis of Den Haag and Rotterdam, an literature study in SSCAM and reinforced with interviews with experts and homeowners. Four factors which represent four similar homeowners' perspectives were identified providing key knowledge to understand the role homeowners can have in adaptation. Firstly, he factors are firstly discussed. Then the study limitations and their implications on the results of this research are evaluated. Suggestions for future research are made throughout the chapter.

9.1. Factors and theory

In this section firstly the usefulness of MPPACC for this research is reviewed. Consequently, a link between the adopter types of the (DIT) and the four factors is established. Lastly, the proposed policy instruments are discussed.

9.1.1. Heterogeneity of homeowners

The adaptive policies of Den Haag and Rotterdam mention involving relevant stakeholders and recognise homeowners as such. This research has explored the diversity of one stakeholder, homeowners and identified four factors. Five characteristics these factors: need, responsibility, capability, motivation and investment as provided in Table 7.17. These five characteristics were adapted from the MPPACC categories which were the successfully employed to structure the Q-set as provided in chapter 6. The climate change and risk perception categories of the MPPACC were combined into need. Social influence was removed, since all factors perceived it positively. The factors identified this research are as presented in chapter 7:

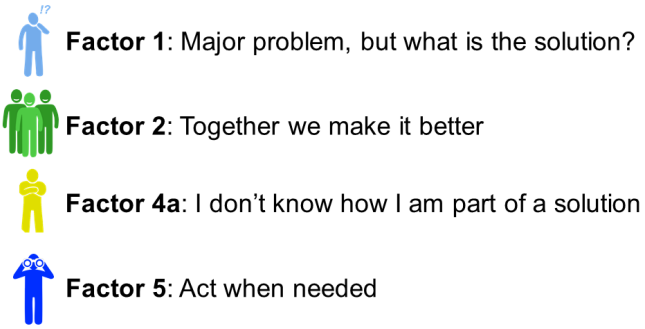


Figure 9.1: Overview of the factors

Besides successfully distinguishing the different factors, this research also demonstrated, in correspondence

with the MPPACC, that awareness of climate change is not sufficient to adopt SSCAM (Grothmann & Patt, 2005). This research showed a high homeowners' awareness of climate change; all factors acknowledged to be aware of climate change. However, only factor 2 has adopted SSCAM. Factor 1 was thought to have passed the risk appraisal and as such has reached the adaptation appraisal. This is demonstrated by the extensive thought put into climate adaptation and willingness to adopt SSCAM. Factor 4a and 5 on the other hand have not passed the risk appraisal which is demonstrated by little worry or experienced nuisance, not considering SSCAM and not having adopted SSCAM. Factor 4a additionally does not perceives the responsibility to adopt SSCAM, while Factor 5 is to some extent skeptical of the consequences of climate change.

The MPPACC can be improved by including a positive influence of the adaption incentives towards adaption appraisal. This study proposed the communication strategy to positively influence the responsibility and capability of homeowners through respectively dialogue and an adaptive network (Bostrom et al., 2013; Fischhoff, 1995; Renn, 2008; Snel et al., 2019). Additionally, the enabling instrument is recommended. This is an incentive aimed at effectively increasing the capability and motivation while decreasing the investment in terms of financial costs. The enabling instrument positively influences the motivation by reducing the perceived effort and costs, both determining influences in the adoption of solar panels (Jager, 2006; Vasseur & Kemp, 2015). Lastly, the investment constraints for mitigation measures are mostly found in the financial costs (Jager, 2006; Vasseur & Kemp, 2015). The subsidies included in the enabling instrument effectively reduce the financial costs and therefore deemed effective. A positive influence from adaptation incentives to adaptation appraisal should thus be added to the MPPACC.

9.1.2. Diffusion of Innovation Theory

The factors showed similarities with the adopter types of the DIT. In this section firstly the DIT itself is introduced, after which the similarities between the adopter types presented in the DIT and the factors are shown. Then the added value of the link between the factors and the adopter types of the DIT is demonstrated. Lastly, the scientific contribution of the established link between the adopter types and the factors and recommendations for future research are contemplated.

The DIT explains the uptake process of innovations, i.e. novel technologies, ideas or behaviour, in a society (Rogers, 2010). DIT is a widely used and tested theory which provides three key points (Rogers, 2010):

1. The innovation traits that provide successful spread

2. The importance of social networks and peer-peer feedback

3. A comprehensive understanding regarding the needs of different adopter types in society to adopt an innovation

The DIT distinguishes five adopter types; Innovators, Early Adopters, Early Majority, Later Majority and Laggards which can be subdivided into Laggards and Persistent Skeptics (Rogers, 2010). Society can be broken down into these five DIT adopter types as presented inFigure 9.2. As such the DIT provides a quantitative aspect to the qualitative interpretation of the factors. A description of the six adopter types is provided in Table 9.1

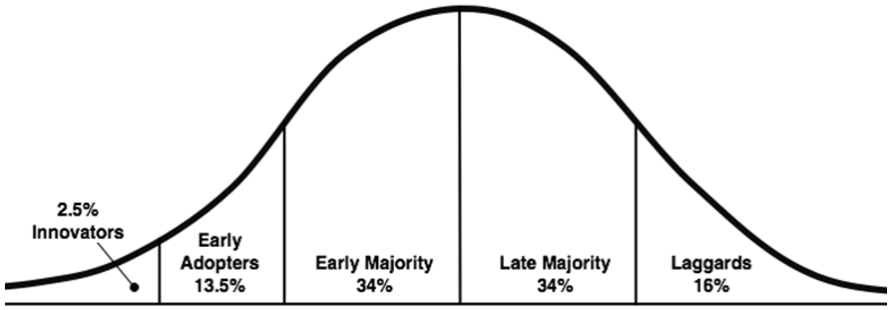


Figure 9.2: The bell shaped distribution of adopter types (Rogers, 2010)

Table 9.1: The six adopter types of the DIT with a description of each type.

Adopter type	Description
Innovators	Pioneer: Very high willingness to take risks and invest resources to adopt a new action, high social status and financial status, have a strong network which includes other innovators and the scientific field and are fond of new ideas.
Early Adopters	Influencer: High intrinsic willingness to take risks and invest resources to adopt a , new action highest social status and financially and educationally above average. This group is regarded most essential in successful spread of an innovation.
Early Majority	Pragmatist: High/Neutral willingness to take risks and invest resources to adopt a new action, acquainted to early adopters which stimulate or demotivate them to adopt an innovation.
Late Majority	Mainstream: Extrinsic willingness to take risks and invest resources to adopt a new action, follow an innovation when it has become mainstream.
Laggards/Persistent Skeptic	(Very) Conservative: Very extrinsic willingness to take risks and invest resources to adopt a new action, little financial liquidity and mostly in contact with the late majority and other laggards.

Similarities can be observed between the description of the adopter types and the narratives of the factors presented in subsection 7.2.4. The adopter types are evaluated based upon their willingness to adopt innovations and their attitude towards risk (O'Neill, 2004). This characteristic was called motivation in this research and was researched for the factors as well. Additionally, the attitude towards risk as indicated for adopter types was identified in the factors as the characteristic need. The motivation and need of the factors are presented in Table 7.17. The specified 'social status' of the adopter types could not be linked to the factors, since this was not researched. The financial status of the factors was not intently researched, but uncovered as a by-product of the interviews. It should be noted that only nine homeowners were interviewed of which only one homeowners had loaded on factor 4a. A strong link between the adopter types and factors was found based on the motivation and need as demonstrated in Figure 9.3. The financial status of verifies this established link.

The DIT not only provides a comprehensive understanding of the factors themselves. The DIT describes how to involve the factors by emphasising the importance of social networks and peer-peer feedback (Rogers, 2010). The importance of social networks and peer-peer feedback was also underlined in the panel meeting with experts and homeowners as well. Lastly, the DIT and Arnstein's ladder of participation are linked (Arnstein, 1969; O'Neill, 2004; Rogers, 2010). The link with Arnstein's ladder of participation informs when to involve the different factors (Arnstein, 1969; O'Neill, 2004; Rogers, 2010). In Figure 9.3 the different levels of

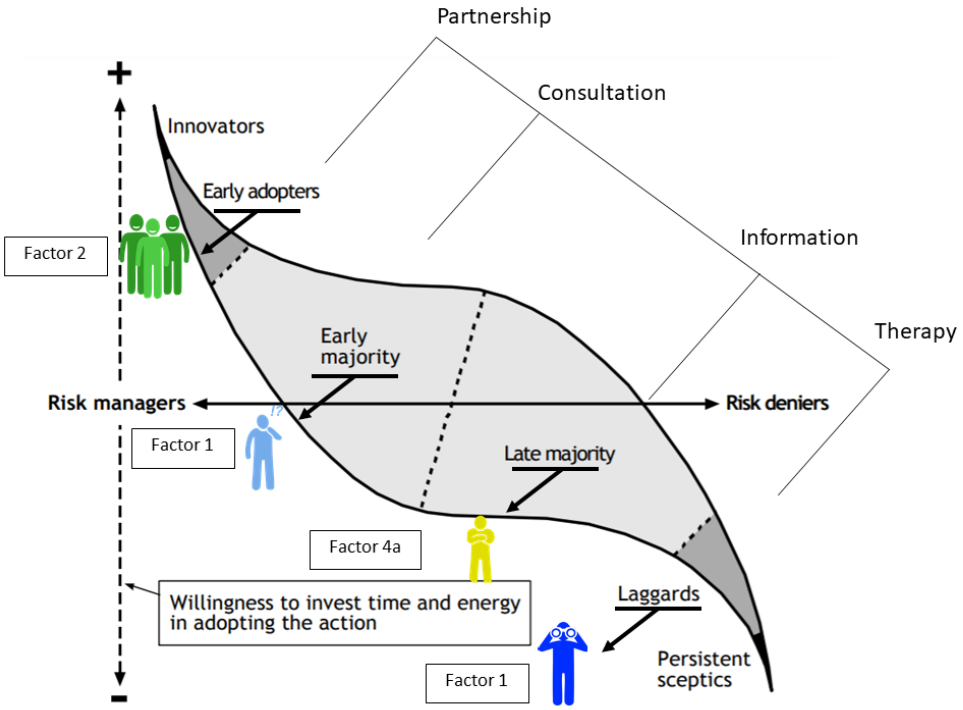


Figure 9.3: The citizen's participation ladder and diffusion vortex of innovations with homeowner's factors, adapted from (Arnstein, 1969; O'Neill, 2004)

participation are included for each factor.

This study has provided an interesting novel scientific contribution by linking homeowners' perspectives on adopting SSCAM with the adopter types of the DIT. This link provides the following three added values: a more comprehensive understanding 1) of the factors themselves, 2) how to involve the factors and 3) when to involve the factors. In Google Scholar two researches have been encountered which linked the theme climate adaptation with the DIT, however neither researches researched private adoption of adaptive measures. One research linked DIT to a risk communication model for natural hazards (O'Neill, 2004). The second study used DIT to identify barriers to participation in carbon sequestration for non-industrial private forest landowners in the southern United States (Khanal et al., 2019). Future research should statistically confirm the established link with a larger population of homeowners. Additionally, the DIT is valuable since it provides a scientifically based approach which identifies how far the spread of SSCAM is, what adopter types to focus on and thus what policy instruments to use. In this study few of the participants knew the term adaptation, but most participants were aware of an example such as green roofs. The spread of the innovation is therefore thought to be with the early adapters, meaning the step to early majority should be facilitated. The proposed policy instruments which are discussed below in subsection 9.1.3 are expected to do that. Linking homeowners to the DIT is thus valuable information for adaptive policy making and consequently stimulating diffusion of the 'innovation' SSCAM under homeowners.

9.1.3. Policy instruments

The adaptive policy of Rotterdam is better established than the policy of Den Haag as evaluated in chapter 4 and Rotterdam is recognised as a front runner in adapting to climate change (H. Mees, 2014). Nevertheless, Factor 4a was only present in Rotterdam and was not likely to adopt SSCAM. No clear pattern was observed in the other factors as provided in section 7.3. Although Rotterdam has a more adaptive policy in place than Den Haag, it has not been observed effective in stimulating homeowners to adopt SSCAM in this research. The reasons can be a lack of awareness regarding adaptation and the fact that Rotterdam has only conducted small scale pilots to specifically stimulate homeowners. Den Haag did not have specific policy in place to

actively engage homeowners. The proposed policy instruments are therefore expected to be an addition for both Rotterdam and Den Haag.

This study has demonstrated that mono-functional policy instruments are not effective in stimulating homeowners to adopt SSCAM since other barriers can still be present as also argued by Bemelmans-Videc et al. (2011). Subsidies are mildly favoured by three factors and highly favoured by factor 4a. The financial costs were however not a perceived barrier for factor 4a. Factor 5 did perceive financial costs as a barrier, but did not favour subsidies strongly. This research demonstrated two policy instruments that complement each other to stimulate SSCAM adoption by homeowners; an enabling instrument and a communication strategy. The communication strategy is composed of three steps each addressing a subsequent objective. The objectives are: clarification of climate risks, establishing a dialogue and inclusion in decision-making processes. The enabling instrument recognises the variety of perspectives present in homeowners and effectively reduces the barriers perceived. It can be tailored to address the factors' barriers .

The proposed policy instruments contribute scientifically, since they expand the concept of economic and informative policy instruments formulated in Bemelmans-Videc et al. (2011). In chapter 4 the informative policy instrument was already rephrased to communicative policy instrument. Communication can (and should) include a two way stream of information, while informing is an one way stream. Additionally, the concept economic policy instrument is recommended to be understood broader, including financial aid but also 'services'. The barriers perceived by homeowners are not solely focused on financial constraints, but were in this study more often found to be related to time, maintenance or capability which can be addressed with services as provided in the enabling instrument. This understanding of the economic and informative policy instruments is thought to aid municipalities in formulating adaptive policy. Both policy instruments can be optimised in future research through evaluation of their comprehensiveness of identified barriers and effectiveness to reduce these barriers.

It should be noted that climate adaptation is part of a overarching transition and is therefore not isolated (Loorbach, 2010). Implementing the proposed policy instruments can have unforeseen positive or negative influences on the other transition themes such as the mitigation transition by improving the neighbourhood networks which are not accounted for in this research (panel meeting experts).

9.2. Study limitations and their implications

In this section the steps of Q as presented in section 2.4 are revisited and evaluated. The introduced limitations are identified and their impact on the results are discussed. Both in the concourse and the Q-sort step no significant influences that could have been prevented are expected. Triangulation was used to limit researcher bias in the concourse (Watts & Stenner, 2012). The response bias (mainly influenced by the social desirability bias) could skew the Q-sorting. This bias was limited by emphasising the interest in the opinion of the homeowners, or as phrased by the author "anything goes". Future research ideas are suggested to address the identified limitations. Lastly, the generalisation of results is discussed.

9.2.1. Q-set: development & terminology

The development of the Q-set is a trial and error process (Brown, 1980). No benchmark to verify the Q-set exists, most studies therefore draw upon existing theories applicable for the research objective (Eden et al., 2005). In this study MPPACC was useful in structuring the Q-set and additionally made it possible to develop a Q-set which was not skewed towards a certain category. MPPACC was complemented with insights from semi-structured interviews with homeowners to prevent biases in the Q-set (Watts & Stenner, 2012).

Terminology used in the statements of the Q-set can be ambiguous (Eden et al., 2005; Watts & Stenner, 2012), which is illustrated with one example from this research. Statement 19 [1] was reported to be not clear by seven participants. The confusion occurred despite the Q-set was reviewed for clarity and distinctness by experts and homeowners. It is not obvious whether Statement 19 did not have differentiating role in establishing the

[1] Statement 21: Blue green labels, such as the energy labels, are a good idea

factors. It is not obvious whether the cause is an unclear statement and as such all factors loaded neutral, or because all homeowners perceived the statement neutral.

In future research it would be interesting to study the definition of climate adaptation, sustainability and resilience. Definitions can differ per person based upon the narratives, values and learning processes surrounding a concept (McEvoy et al., 2013). This can amongst others result in misinterpreted or negatively perceived terminology by citizens (Harcourt et al., 2019). Q would be a well equipped method to establish understanding of the different concept definitions homeowners and other actors identified by the DPRA have (Eden et al., 2005; Watts & Stenner, 2012).

9.2.2. P-set: participation & missing factor & scope

An intake conversation is recommended to be be able to judge the P-set's diversity (Brown, 1980). An intake conversation was however considered too offsetting to incentive homeowners to participate, which would in turn reduce the P-set's diversity. Therefore an invitation conversation was prepared to establish willingness to participate and retrieve information regarding home ownership and contact details. Some homeowners were nevertheless still not interested in participating in 'this sort' of research, referring to climate change in general. The emphasis of the invitation was consequently shifted towards to topic of improving the livelihood through adding blue and green measures. This was expected to increase the amount of homeowners that were interested and as such improve the P-set's diversity.

Although the P-set of this study was diverse, it was incomplete. At least one perspective was not represented in this study, the climate change denier (van der Grient et al., 2019). This is thought to be caused by fact that this demographic did not want to participate with this research. In the Netherlands 8% of the population does not believe in climate change (van der Grient et al., 2019). The expectation is that climate change deniers are the equivalent of persistent skeptics as identified in the DIT. In that case, this group of people will probably not be reached with the proposed policy instruments, the expectancy is however that enforcing for them would also be undesirable.

The scope of this research was limited to homeowners, in the province South-Holland however 39% of the total housing stock is social housing which is mostly predominantly owned by housing corporations (Provincie Zuid-Holland, 2016). Housing corporation can thus have a significant impact on making a city climate adaptive, which was also investigated for Rotterdam (Buro Bergh, 2018). Recently, the four biggest housing corporations of Rotterdam have signed a letter of intent to make Rotterdam climate proof (Rotterdams Weerwoord, 2021). Q is a suitable method to evaluate the reasons for a housing corporation to either commit or not commit to adopt climate adaptive measures for their housing stock. This research has proven it is possible to evaluate the barriers and stimuli for groups of individuals using Q. Additionally, H. Mees (2014) and Castanos (2020) have shown Q's suitability to group different layers of a organisation such as a municipality and companies.

9.2.3. Q-sort: online

This study validated the use of Q through an online study. Most Q studies are performed face-to-face (Zabala et al., 2018). Reluctance to perform online Q studies is caused by the assumed disadvantage of not being physically present during the Q-sort and the less obvious post Q-sort interview (Watts & Stenner, 2012). This online Q introduced many benefits for the participants and researcher, while the minor issues that arose could easily be resolved.

The online Q study design took up extra time due to additional preparations such as an online Q-sorting tool selection and modification of the website. The website posed problems for two participants, who could not continue after step 2. The cause has not been revealed, but in both cases the participant orally dictated their preferences via Zoom while the screen of the researcher was shared. The advantages of travel time, the independence for homeowners to conduct the Q-sort and the time saved by having the Q-sorts online, ready to be analysed outweighed the above mentioned drawbacks. Lastly, the majority of participants indicated that they enjoyed their participation. Even though a Q-sort is considered more demanding than a survey, it

provides participants with insights in their own thinking. Additionally, the design of a Q-sort, laying a puzzle, was enjoyed and perceived as a game.

9.2.4. Q analysis: factor analysis dispute

There seems to be a scientific dispute regarding the choice of either CFA or PCA for factor extraction in Q studies (Watts & Stenner, 2012; Zabala & Pascual, 2016). PCA is the most widely used factor extraction method (Zabala et al., 2018), it is however not considered a factor extraction method applicable for Q by some scientists (Watts & Stenner, 2012; Zabala & Pascual, 2016). CFA is the 'old-fashioned' factor extraction method introduced with Q-method itself in 1935 and consequently further developed (Brown, 1980; Stephenson, 1935, 1953; Watts & Stenner, 2012).

The composite Q-sorts of the PCA and the differences between the PCA and CFA are depicted in Appendix I. The explained variance of 55% presented in section 7.1 was obtained using the CFA and is scientifically relevant (Zabala et al., 2018). The same data set was also analysed with PCA, which increased the explained variance to 64% as demonstrated in Appendix I. This increase is attributed to the fact that PCA is a method that maximises the explained variance of each consecutive factor (Brown, 1980; Watts & Stenner, 2012). The composite Q-sorts of the PCA and the differences between the PCA and CFA are depicted in Appendix I. Future research should therefore aim to settle the ongoing scientific dispute or provide clear guidelines on when to use CFA and PCA to prevent confusion.

9.2.5. Generalisation of results

The factors identified in this research are applicable to homeowners from middle to higher middle socio-economic class living in middle large cities in the Netherlands, because these would be comparable with the study areas. Q does however not provide a statistical result for the whole population. A subsequent survey study is needed to generalise the obtained results. Such a study can additionally identify the percentages of homeowners loading on one of the factors using a larger population than used in this study. The DIT adopter types have a bell shaped distribution in a population as presented in Table 9.1. As such it can either quantitatively confirm or deny the qualitatively established link between the factors and DIT adopter types of this research

10

Conclusion & recommendations

The purpose of this study was to identify how private homeowners can be stimulated to adopt SSCAM on private property by the Dutch municipalities. Hereto a variety of private homeowners has been researched using Q-methodology, which provided homeowners with a voice to share their perspectives. Four perspective groups, called factors, were identified amongst homeowners: Four perspectives amongst homeowners were identified, implying no one-size-fits-all solution exists to stimulate adoption of SSCAM: 1) Major problem, but what is the solution?!, 2) Together we make it better!, 3) I don't know how I am part of a solution and 4) Act when it is needed.which perceive the need, responsibility, capability, motivation and investment regarding the adoption of SSCAM differently. This implies no one-size-fits-all solution exists. On the other hand homeowners do agree upon: (1) not being in favour of enforcing the adoption of SSCAM, (2) unawareness of the municipality's expectations regarding climate adaptation and (3) enthusiasm for neighbourhood initiatives.

It can firstly be noted that enforcing climate adaptation should be a last resort policy instrument. Next, communication regarding the role of homeowners in climate adaptation is much needed, therefore a three-step communication strategy was developed. The first step informs residents about climate risks and SSCAM. In the second step a dialogue between homeowners and the municipality is proposed to establish a relation and clarify responsibilities. The last step invites homeowners and professionals to participate in local adaptive networks which increases the individual capability by connecting them to professions or homeowners who have already adopted SSCAM. Consequently, a customisable enabling instrument is advised, which focuses on implementing 'garden SSCAM' and 'material SSCAM' based upon the established functionality and applicability criteria. The enabling instrument can be tailored to the different needs and barriers identified amongst the four homeowners typologies with three packages. All three packages include information and subsidy and can be extended with construction and maintenance options. The instrument focuses on increasing the capability and decreasing the investment of homeowners. The two policy instruments demonstrate that Dutch municipalities need to align their objectives with the different perspectives present amongst homeowners and pro-actively engage with homeowners for effective adaptive policy. The drafted communication strategy and customisable unburdening instrument are recommended tools to do so.

10.1. Recommendations

Over the course of this research the author stumbled upon some interesting topics and discussions of which a few are presented below. Firstly, a discussion regarding the discourse of the climate theme heat is presented, after which a re-evaluation of the concept participation is argued for. Lastly, the missing link with the design of climate adaptive gardens is elaborated on.

10.1.1. Discourse regarding heat

It appears that the public discourse leaves heat as a responsibility for the individual (H. Mees, 2014). Heat is a relatively new phenomenon in the Netherlands (KNMI, 2020; Mulder KF, 2009; Runhaar et al., 2012). In 2007 the national heat action plan was put in place to facilitate quick collaboration between the national institute for public health, RIVM, and organisations, health care professionals and volunteers to coordinate measures with no role is included for the municipalities (Hagens & van Bruggen, 2015). In chapter 4 it was already concluded that no specific legislation and thus responsibilities are put in place for municipalities, limiting their role (Hegger et al., 2017; H. Mees, 2014). Both the initiative and costs to prevent negative effects of heat are on the account of homeowners (H. Mees, 2014). Individual heat reducing measures are however less effective and can even invoke opposite effects (Döpp et al., 2011; Kluck et al., 2020; Runhaar et al., 2012). More specific research on the responsibility and effectiveness of heat adaptation on individual level in combination with the public domain is urgently needed (Mulder KF, 2009). This is due to the fact that both the amount of heat waves and the amount of vulnerable people due to an aging population are expected to increase in the Netherlands (Rijksoverheid, 2014).

10.1.2. Participation in adaptation

Citizen participation, one of the three objectives presented in section 8.2, can easily lead to 'window dressing', i.e. citizen consultation which is not followed by other modes of citizen power, in order to legitimise policy (Arnstein, 1969). In Dutch citizen's initiatives this problem is also lurking since unclarities on the level of homeowner's involvement exists in decision-making (Driessen et al., 2018; Hegger et al., 2017; H. L. Mees et al., 2019; Uittenbroek et al., 2019). Citizen participation is a categorical concept for citizen involvement (Arnstein, 1969). Participation with relevant stakeholders is emphasised and encouraged in the DPRA. However, nor the DPRA nor the policies of Den Haag and Rotterdam specifically mention of the involvement category for important stakeholders such as homeowners. Meanwhile, the role of the Dutch municipalities has remained regulative and steering in Dutch citizens' adaptation initiatives, inhibiting citizen participation (Arnstein, 1969; Fischhoff, 1995; H. L. Mees et al., 2019). A cause is the lack of "*flexibility and support of their own municipal organisation to facilitate such (citizens') initiatives*" (H. L. Mees et al., 2019, p.206). More research into case studies of citizen participation, such as H. L. Mees et al. (2019), should be conducted to critically assess the municipality's role in decision-making and establish standardised reflection guidelines to assess citizen's initiatives.

10.1.3. Design of climate adaptive garden

Climate adaptive garden designs have not been encountered in scientific literature. Research from civil and environmental engineering seems more focused on the influence and optimisation of one measure, while the landscape architecture and urbanism disciplines appear to assess adaptation on larger scale than gardens (Derkzen, 2017; Kleerekoper, 2016; Kluck et al., 2020). It seems that the integration of the different 'scales' for climate adaptation has not been combined for gardens. In grey literature abundant information can be found on climate adaptive gardens. This literature is however not critical on the requirements of a SSCAM. The effectiveness of a SSCAM is however dependent on local and physical variables (Pötz, 2012; Voskamp & Van de Ven, 2015). Additionally, the factors identified in this study should be kept in mind for the design. Different perspectives of homeowners result in different perceived barriers, values and aesthetic preferences. Comparable to policy, no one size fits all garden design is applicable. The private garden scale thus appears to be missing in scientific literature and would be a valuable contribution in stimulating homeowners to become climate adaptive.

Bibliography

Ajzen, I. et al. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179–211.

Ajzen, I. (2011). The theory of planned behaviour: Reactions and reflections.

Akhtar-Danesh, N. et al. (2017). A comparison between major factor extraction and factor rotation techniques in q-methodology. *Open Journal of Applied Sciences*, *7*(04), 147.

Alves, A., Vojinovic, Z., Kapelan, Z., Sanchez, A., & Gersonius, B. (2020). Exploring trade-offs among the multiple benefits of green-blue-grey infrastructure for urban flood mitigation. *Science of the Total Environment*, *703*, 134980.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of planners*, *35*(4), 216–224.

Attems, M.-S., Thaler, T., Snel, K. A., Davids, P., Hartmann, T., & Fuchs, S. (2020). The influence of tailored risk communication on individual adaptive behaviour. *International journal of disaster risk reduction*, *49*, 101618.

Baart, T. (2021). Bridging the gap between different perspectives on climate change adaptation. *Master thesis*.

Bacchi, C. (2009). Analysing policy.

Beard, V. A., Mahendra, A., & Westphal, M. I. (2016). Towards a more equal city: Framing the challenges and opportunities. *GROWTH*, *2015*, 2030.

Bemelmans-Videc, M.-L., Rist, R. C., & Vedung, E. O. (2011). Carrots, sticks, and sermons: Policy instruments and their evaluation. *1*.

Bichard, E., & Kazmierczak, A. (2012). Are homeowners willing to adapt to and mitigate the effects of climate change? *Climatic Change*, *112*(3), 633–654.

Bosch Slabbers and Deltares and SWECO and Witteveen+Bos and KNMI. (n.d.). Climate App [Accessed: 2020-13-11]. https://climateapp.nl/

Bostrom, A., Böhm, G., & O'Connor, R. E. (2013). Targeting and tailoring climate change communications. *Wiley Interdisciplinary Reviews: Climate Change*, *4*(5), 447–455.

Brolsma, R., Buma, J., Van Meerten, H., Dionisio, M., & Elbers, J. (2012). Effect van droogte op stedelijk gebied. *Kennis voor klimaat*.

Brown, S. R. (1980). Political subjectivity: Applications of q methodology in political science.

Brown, S. R. (1993). A primer on q methodology. *Operant subjectivity*, *16*(3/4), 91–138.

Buro Bergh. (2018). Rotterdam: Samen passen we ons aan! *Gemeente Rotterdam*.

Cambridge English dictionary [Accessed: 2020-18-11]. (n.d.). https://dictionary.cambridge.org/dictionary/english

Castanos, E. (2020). Mainstreaming private climate adaptation: An exploration of business perspectives. *Master thesis*.

CBS. (2019). Kerncijfers wijken en buurten 2019 [Accessed: 2020-03-12]. https://www.cbs.nl/nl-nl/maatwerk/2019/31/kerncijfers-wijken-en-buurten-2019

Crane, A., & Livesey, S. M. (2003). Are you talking to me? stakeholder communication and the risks and rewards of dialogue. *Stakeholder communication and the risks and rewards of dialogue*.

Daniel, K. (2017). Thinking, fast and slow. *Farrar, Straus and Giroux*.

De Bruijn, J., de Bruijn, H., & ten Heuvelhof, E. (2008). Management in networks: On multi-actor decision making.

Dekker, G., Wullems, B., & Chan, P. (2020). Verantwoordelijkheden bij risico's van extreem weer in een veranderend klimaat. *Ambient*.

Derkzen, M. (2017). Changing roles of urban green space: Spatial and temporal dynamics.

Döpp, S., Klok, L., Jacobs, C., Kleerekoper, L., & Uittenbroek, C. (2011). Kennismontage hitte en klimaat in de stad. *TNO publication*.

Driessen, P. P., Hegger, D. L., Kundzewicz, Z. W., Van Rijswick, H. F., Crabbé, A., Larrue, C., Matczak, P., Pettersson, M., Priest, S., Suykens, C., et al. (2018). Governance strategies for improving flood resilience in the face of climate change. *Water*, *10*(11), 1595.

Eden, S., Donaldson, A., & Walker, G. (2005). Structuring subjectivities? using q methodology in human geography. *Area*, *37*(4), 413–422.

European Commission. (2014). Adaptation to climate change [Accessed: 2020-16-09]. https://www.eea.europa.eu/policy-documents/dg-clima-adaptation-to-climate-change#:~:text=Adaptation%5C%20means%5C%20anticipating%5C%20the%5C%20adverse,and%5C%20lives%5C%20in%5C%20the%5C%20future

Fischhoff, B. (1995). Risk perception and communication unplugged: Twenty years of process 1. *Risk analysis*, *15*(2), 137–145.

Gemeente Den Haag. (2012). Uitvoeringsplan klimaatbestendig den haag; groen denken, groen doen.

Gemeente Den Haag. (2014). Vertrouwen op haagse kracht, coalitie akkoord 2014-2018.

Gemeente Den Haag. (2015a). Gemeentelijk rioleringsplan den haag 2016-2020; goed riool, duurzaam en klimaatbestendig.

Gemeente Den Haag. (2015b). Toekomstbestendig haags water! visie op het voorkomen van wateroverlast.

Gemeente Den Haag. (2016a). Actieplan burgerparticipatie 2016-2020.

Gemeente Den Haag. (2016b). Agenda ruimte voor de stad.

Gemeente Den Haag. (2019). Den haag resilience strategy.

Gemeente Laren. (2016). Verordening op de afvoer van hemelwater laren [Accessed: 2020-21-10]. *Decentrale overheid*. http://decentrale.regelgeving.overheid.nl/cvdr/xhtmloutput/Actueel/Laren/CVDR487195.html

Gemeente Rotterdam. (2013a). Handboek openbare ruimte rotterdamse stijl.

Gemeente Rotterdam. (2013b). Herijking van waterplan 2. *In collaboration with: Hoogheemraadschap van Schieland en de Krimpenerwaard, Waterschap Hollandse Delta en Hoogheemraadschap van Delfland*.

Gemeente Rotterdam. (2013c). Rotterdamse adaptatiestrategie.

Gemeente Rotterdam. (2015). Gemeentelijk rioleringsplan, planperiode 2016-2020 [Accessed: 2020-22-10]. https://www.aanpakagniesebuurt.nl/content/uploads/2019/10/Gemeentelijk_rioleringsplan-2016-2020.pdf

Gemeente Rotterdam. (2017). Rotterdam resilience strategy, ready for the 21st century.

Gemeente Utrecht. (2015). Utrecht: Energiek middelpunt van het land energieplan utrecht.

Gerechtshof Arnhem-Leeuwarden. (2011). Kort geding: Buurman handelt ism art. 5:38 bw door tegen de natuurlijke afwatering op zijn erg blokkades op te werpen [Accessed: 2020-23-10]. https://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:GHARL:2013:BZ9810

Gerechtshof Den Haag. (2011). Gemeente dordrecht niet aansprakelijk voor schade aan huizen door paalrot; schade door gebrekkige opstal (riolering) [Accessed: 2020-21-10]. https://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:GHSGR:2011:BP7513

Gilissen, H. (2013). Adaptatie aan klimaatverandering in het nederlandse waterbeheer: Verantwoordelijkheden en aansprakelijkheid. *Kluwer*.

Gilissen, H., van Kempen, J., Groothuijse, F., & van Rijswick, H. (2019). Droogte in de delta–het nieuwe normaal?: Naar meer eigen verantwoordelijkheid voor de landbouw. *Tijdschrift voor Agrarisch Recht*, *2019*(11), 697–708.

Glanz, K., Rimer, B. K., & Viswanath, K. (2015). Health behavior: Theory, research, and practice. *John Wiley & Sons*.

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global environmental change*, *15*(3), 199–213.

Hagens, W., & van Bruggen, M. (2015). Nationaal hitteplan: Versie 2015. *Rijksinstituut voor Volksgezondheid en Milieu RIVM*.

Harcourt, R., de Bruin, W. B., Dessai, S., & Taylor, A. (2019). Investing in a good pair of wellies: How do non-experts interpret the expert terminology of climate change impacts and adaptation? *Climatic change*, *155*(2), 257–272.

Havekes, H., & de Putter, P. (2016). Overheid niet zomaar aansprakelijk voor schade door overlast. *Water governance*, 6–13.

Hegger, D. L., Mees, H. L., Driessen, P. P., & Runhaar, H. A. (2017). The roles of residents in climate adaptation: A systematic review in the case of the netherlands. *Environmental Policy and Governance*, *27*(4), 336–350.

Hendriks, M. (2018). *Inwonersparticipatie in wijk west: Beweegredenen om deel te nemen* (Master's thesis).

Huckfeldt, R. R. (1979). Political participation and the neighborhood social context. *American Journal of Political Science*, 579–592.

IGRA. (2009). International Green Roof Association on Types of Green Roofs [Accessed: 2020-13-11]. http://www.igra-world.com/green-roof-types/index.html

IPCC. (2007). Climate change the physical science basis; working group 1, science, intergovernmental panel on climate change. *AGUFM*, *2007*, U43D–01.

Jager, W. (2006). Stimulating the diffusion of photovoltaic systems: A behavioural perspective. *Energy Policy*, *34*(14), 1935–1943.

Jeffrey, P., & Seaton, R. (2004). A conceptual model of 'receptivity'applied to the design and deployment of water policy mechanisms. *Environmental Sciences*, *1*(3), 277–300.

Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017). Nature-based solutions to climate change adaptation in urban areas: Linkages between science, policy and practice.

Khanal, P. N., Grebner, D. L., Straka, T. J., & Adams, D. C. (2019). Obstacles to participation in carbon sequestration for nonindustrial private forest landowners in the southern united states: A diffusion of innovations perspective. *Forest Policy and Economics*, *100*, 95–101.

Kleerekoper, L. (2016). Urban climate design. improving thermal comfort in dutch neighbourhood typologies. *PhD, Delft University of Technology*.

Kluck, J., Klok, L., Solcerová, A., Kleerekoper, L., Wilschut, L., Jacobs, C., Loeve, R., Daniels, E., & Dankers, R. (2020). De hittebestendige stad: Een koele kijk op de inrichting van de buitenruimte. *Hogeschool van Amsterdam*.

KNMI. (2014). Knmi klimaatscenario's [Accessed: 2020-16-09]. https://www.knmi.nl/kennis-en-datacentrum/achtergrond/waarnemingen-klimaatveranderingen

KNMI. (2020). Warmtegetallen sinds 1901 in de bilt [Accessed: 2020-25-03]. https://www.knmi.nl/nederland-nu/klimatologie/lijsten/warmtegetallen

Krijnen, K. (2020). Increasing the resilience of urban areas to extreme precipitation: Are the residents ready?: The receptivity for effective rainproof measures on private terrain in the neighbourhood de baarsjes, amsterdam.

Littlejohn, S. W., & Foss, K. A. (2017). Theories of human communication, eleventh edition. *Waveland press*.

Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. *Governance*, *23*(1), 161–183.

Manso, M., & Castro-Gomes, J. (2015). Green wall systems: A review of their characteristics. *Renewable and sustainable energy reviews*, *41*, 863–871.

McEvoy, D., Fünfgeld, H., & Bosomworth, K. (2013). Resilience and climate change adaptation: The importance of framing. *Planning Practice & Research*, *28*(3), 280–293.

Mees, H. (2014). Responsible climate change adaptation: Exploring, analysing and evaluating public and private responsibilities for urban adaptation to climate change. *PhD, Utrecht University*.

Mees, H. L., Uittenbroek, C. J., Hegger, D. L., & Driessen, P. P. (2019). From citizen participation to government participation: An exploration of the roles of local governments in community initiatives for climate change adaptation in the netherlands. *Environmental Policy and Governance*, *29*(3), 198–208.

Meesters, C., & Bor, A. (2016). Hemelwater belasten of belonen, impactproject differentiatie belastingen voor klimaatadaptieve gebouwen. *Commissioned by: Stimuleringsprogramma Ruimtelijke Adaptatie*.

Mishra, A. K., & Singh, V. P. (2010). A review of drought concepts. *Journal of hydrology*, *391*(1-2), 202–216.

Mora, C., Dousset, B., Caldwell, I. R., Powell, F. E., Geronimo, R. C., Bielecki, C. R., Counsell, C. W., Dietrich, B. S., Johnston, E. T., Louis, L. V., et al. (2017). Global risk of deadly heat. *Nature climate change*, *7*(7), 501–506.

Mulder KF, S.-R. B., Enserink B. (2009). The neglected effects of climate change, paper presented at the 15th international sustainable development research conference, july 5–8. *Utrecht University*.

NASA. (2020). Global Land-Ocean temperature index [Accessed: 2020-16-09]. https://climate.nasa.gov/vital-signs/global-temperature/

Norman, P., Boer, H., & Seydel, E. R. (2005). Protection motivation theory. *Predicting health behaviour*, *81*, 126.

OECD. (2014). Water governance in the netherlands: Fit for the future?

Omroep West. (2018). Huiseigenaren vaak zelf verantwoordelijk bij wateroverlast [Accessed: 2021-03-22]. https://www.omroepwest.nl/nieuws/3630778/Huiseigenaren-vaak-zelf-verantwoordelijk-bij-wateroverlast

O'Neill, P. (2004). Developing a risk communication model to encourage community safety from natural hazards.

Parool. (2020). 1 miljoen huizen dreigen te verzakken: Verzekeraar betaalt niks uit [Accessed: 2020-03-12]. https://www.parool.nl/nederland/1-miljoen-huizen-dreigen-te-verzakken-verzekeraar-betaalt-niks-uit~ba5354f8/

Pickett, S. T., Cadenasso, M. L., & Grove, J. M. (2004). Resilient cities: Meaning, models, and metaphor for integrating the ecological, socio-economic, and planning realms. *Landscape and urban planning*, *69*(4), 369–384.

Pötz, H. (2012). Urban green-blue grids, manual for resilient cities. *Alterier GroenBlauw*.

Provincie Zuid-Holland. (2016). Staat van zuid-holland; doelgroep en staat van sociaal [Accessed: 2020-22-03]. https://staatvan.zuid-holland.nl/portfolio_page/doelgroep-en-voorraad-sociaal/

Raadgever, G., Mostert, E., & Van De Giesen, N. (2008). Identification of stakeholder perspectives on future flood management in the rhine basin using q methodology. *Hydrology & Earth System Sciences*, *12*(4).

Rechtbank Gelderland. (1997). Uitspraak schade en aansprakelijkheid [Accessed: 2020-21-10]. https://www.riool.net/documents/20182/540630/RIONEDStartpagina%5C_-%5C_Schade%5C_en%5C_aansprakelijkheid(1).pdf

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological conservation*, *141*(10), 2417–2431.

Renn, O. (2008). Risk governance: Coping with uncertainty in a complex world - earthscan risk in society series. *Routledge*.

Rietkerk, M., Hommes, S., Mastop, J., Dirven, L., & Schyns, P. (2016). Klimaatbestendige tuinen— stap doorgronden: Gedragsanalyse. *Deltares publication*.

Rijksoverheid. (2014). Klimaatbestendige stad; klimaat en de stad. *Consortium Kennis voor klimaat*.

Rijksoverheid. (2018). *Deltaprogramma 2018*. Ministerie van Economische zaken andMinisterie van Infrastructuur en Milieu.

Rogers, E. M. (2010). Diffusion of innovations.

Rotterdams Weerwoord. (2018). Wie zijn wij [Accessed: 2020-22-10]. https://rotterdamsweerwoord.nl/wie-zijn-wij/

Rotterdams Weerwoord. (2021). Intentieverklaring klimaatadaptatie [Accessed: 2020-22-10]. https://rotterdamsweerwo
nl/weerberichten/intentieverklaring/

Runhaar, H., Mees, H., Wardekker, A., van der Sluijs, J., & Driessen, P. P. (2012). Adaptation to climate change-related risks in dutch urban areas: Stimuli and barriers. *Regional Environmental Change*, *12*(4), 777–790.

Schuetze, T. (2013). Rainwater harvesting and management–policy and regulations in germany. *Water Science and Technology: Water Supply*, *13*(2), 376–385.

Shafique, M., Kim, R., & Rafiq, M. (2018). Green roof benefits, opportunities and challenges–a review. *Renewable and Sustainable Energy Reviews*, *90*, 757–773.

Sluijter, R., Plieger, M., van Oldenborgh, G. J., Beersma, J., & de Vries, H. (2018). De droogte van 2018: Een analyse op basis van het potentiële neerslagtekort. *KNMI*.

Snel, K. A., Witte, P. A., Hartmann, T., & Geertman, S. C. (2019). More than a one-size-fits-all approach–tailoring flood risk communication to plural residents' perspectives. *Water International*, *44*(5), 554–570.

Spurling, N. J., McMeekin, A., Southerton, D., Shove, E. A., & Welch, D. (2013). Interventions in practice: Reframing policy approaches to consumer behaviour. *University of Manchester, Sustainable Practices Research Group*.

Stadsgewest Haaglanden. (2014). Met het oog op de toekomst, regionale klimaatadaptatie strategie haaglanden. *In collaboration with the municipalities; Wassenaar, Leidschendam-Voorburg, Den Haag, Zoetermeer, Rijswijk, Pijnacker-Nootdorp, Delft, Midden-Delfland, Westland and waterboards Delfland and Rijnland*.

Stephenson, W. (1935). Technique of factor analysis. *Nature*, *136*(3434), 297–297.

Stephenson, W. (1953). The study of behavior; q-technique and its methodology. *University of Chicago Press*.

STOWA. (2018a). Deltafact; droogte en hitte in de stad [Accessed: 2020-15-10]. *Stichting toegepast onderzoek waterbeheer (STOWA) Deltafacts*. https://www.stowa.nl/deltafacts/zoetwatervoorziening/aanpassen-aan-klimaatverandering/droogte-en-hitte-de-stad

STOWA. (2018b). Deltafact; robuustheid [Accessed: 2020-15-10]. *Stichting toegepast onderzoek waterbeheer (STOWA) Deltafacts*. https://www.stowa.nl/deltafacts/waterveiligheid/innovatieve-dijkconcepten/robuustheid

Tan, J., Zheng, Y., Tang, X., Guo, C., Li, L., Song, G., Zhen, X., Yuan, D., Kalkstein, A. J., Li, F., et al. (2010). The urban heat island and its impact on heat waves and human health in shanghai. *International journal of biometeorology*, *54*(1), 75–84.

Taylor, A. L., Dessai, S., & de Bruin, W. B. (2014). Public perception of climate risk and adaptation in the uk: A review of the literature. *Climate Risk Management*, *4*, 1–16.

Theeuwes, N., Solcerová, A., & Steeneveld, G. (2013). Modeling the influence of open water surfaces on the summertime temperature and thermal comfort in the city. *Journal of Geophysical Research: Atmospheres*, *118*(16), 8881–8896.

Tvinnereim, E., Fløttum, K., Gjerstad, Ø., Johannesson, M. P., & Nordø, Å. D. (2017). Citizens' preferences for tackling climate change. quantitative and qualitative analyses of their freely formulated solutions. *Global Environmental Change*, *46*, 34–41.

Uittenbroek, C. J., Mees, H. L., Hegger, D. L., & Driessen, P. P. (2019). The design of public participation: Who participates, when and how? insights in climate adaptation planning from the netherlands. *Journal of Environmental Planning and Management*, *62*(14), 2529–2547.

UN. (n.d.). United Nations Environment programme [Accessed: 2020-17-09]. www.unenvironment.org/explore-topics/climate-change/what-we-do/

Van den Born, G., Kragt, F., Henkens, D., Rijken, B., Van Bemmel, B., Van der Sluis, S., Polman, N., Bos, E. J., Kuhlman, T., Kwakernaak, C., et al. (2016). Dalende bodems, stijgende kosten: Mogelijke maatregelen tegen veenbodemdaling in het landelijk en stedelijk gebied: Beleidsstudie.

van der Grient, R., Kamphuis, A., & de Vos, M. (2019). Publieksmonitor klimaat en energie 2019. *Commissioned by Ministerie van Economische Zaken en Klimaat*.

Van Exel, J., & De Graaf, G. (2005). Q methodology: A sneak preview.

Vasseur, V., & Kemp, R. (2015). The adoption of pv in the netherlands: A statistical analysis of adoption factors. *Renewable and sustainable energy reviews*, *41*, 483–494.

Verenging van Nederlandse Gemeenten. (2018). Rioolheffing als instrument om duurzaamheidsdoelen te realiseren. [Accessed: 2021-04-14]. https://vng.nl/sites/default/files/rioolheffing-als-instrument_20180911.pdf

Vinther, B. M., Buchardt, S. L., Clausen, H. B., Dahl-Jensen, D., Johnsen, S. J., Fisher, D., Koerner, R., Raynaud, D., Lipenkov, V., & Andersen, K. K. (2009). Holocene thinning of the greenland ice sheet. *Nature*, *461*(7262), 385–388.

Voskamp, I. M., & Van de Ven, F. H. (2015). Planning support system for climate adaptation: Composing effective sets of blue-green measures to reduce urban vulnerability to extreme weather events. *Building and Environment*, *83*, 159–167.

Wamsler, C., & Brink, E. (2015). The role of individual adaptive practice for sustainable adaptation. *International Journal of Disaster Resilience in the Built Environment*, *6*(1), 6–29.

Watts, S., & Stenner, P. (2012). Doing q methodological research: Theory, method & interpretation. *Sage*.

Weinstein, N. D. (1989). Effects of personal experience on self-protective behavior. *Psychological bulletin*, *105*(1), 31.

White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour: The role of descriptive, injunctive, and in-group norms. *British journal of social psychology*, *48*(1), 135–158.

Wihlborg, M., Sörensen, J., & Olsson, J. A. (2019). Assessment of barriers and drivers for implementation of blue-green solutions in swedish municipalities. *Journal of environmental management*, *233*, 706–718.

Woods, B., Wilson, S., Udale-Clarke, H., Illman, S., Scott, T., Ashley, R., & Kellagher, R. (2015). The suds manual; ciria: London, uk.

Zabala, A., & Pascual, U. (2016). Bootstrapping q methodology to improve the understanding of human perspectives. *PloS one*, *11*(2), e0148087.

Zabala, A., Sandbrook, C., & Mukherjee, N. (2018). When and how to use q methodology to understand perspectives in conservation research. *Conservation Biology*, *32*(5), 1185–1194.

A

Choice of study areas

A.1. City

The following criteria have been identified to choose suitable municipalities:

- Difference in climate policy
- Comparable in total inhabitants
- Similar cultural diversity among inhabitants
- Comparable soil type
- Comparable expected climate nuisance
- Accessibility and contact

The first obvious and far most important criterion is that the two cities should have different climate policies concerning the level of involvement of private homeowners. This ensures to some degree that potential differences in perspectives can be attributed to policy measures.

Municipalities need to be comparable in inhabitants since the main interest of this research is how the role of private homeowners can be increased. Small municipalities might have different obstacles, than larger municipalities. To ensure that the results of this research can be used, the following groups of municipalities are identified: large (>250.000), middle large (250.000-100.000), middle (100.000-50.000) and small (<50.000).

Perspective is largely influenced by certain beliefs somebody holds true. Beliefs can vary significantly among different cultures. Beliefs can over time change due to influence of different beliefs. The objective of this research is to identify perspectives of private homeowners in order to increase their role, it is not the objective to research the cultural differences in taking climate adaptive measure. However, cultural background might also influence the perspective a private homeowner has regarding the role one envisions in adopting climate adaptive measure. Similar cultural diversity amongst the municipalities is therefore deemed relevant as a criteria.

Comparable soil types allows for similar nuisances experienced due to climate change. Additionally, similar climate adaptive measures can be taken. To provide an example, a house build on high sand grounds is not affected as much by fluctuating ground water level as a house build on peat. The peat house has wooden poles to support the construction and is therefore vulnerable to rotten poles if ground water levels fluctuate.

Lastly, to be able to conduct a social research in a municipality it is important one has access to a research population which can greatly be improved with contacts within the municipality.

Taking these criteria into account a list of municipalities was assembled and assessed. Rotterdam and Den Haag are the two municipalities chosen. It should be noted that the selection process is still subjective even though selection criteria have been used.

A.2. Neighbourhoods

Since it is not possible and necessary to cover the whole of Rotterdam and Den Haag a choice of neighbourhoods was made. A neighbourhood where little public terrain is available to perform climate adaptive measures is opted for. In these neighbourhoods exists a higher necessity to stimulate residents to adopt climate adaptive measures. In the Netherlands roughly 10 neighbourhood typologies can be distinguished (Kleerkoper, 2016). Especially the typologies Vooroorlogse bouwblok and Volkwijk are vulnerable since generally little public space is available and even more problematic is that most houses do not have a front garden. Since the target group is private home owners the choice is made to look for two 'comparable' neighbourhoods with a Vooroorlogse bouwblok typology. The reason is that the Volkwijk typology neighbourhoods in Rotterdam and Den Haag are roughly 50% privately owned and 50% rented CBS, 2019. The Vooroorlogse bouwblok neighbourhoods are roughly 60-65% privately owned CBS, 2019.

The Klimaateffect atlas is used to determine which areas suffer similar nuisance of water, drought and heat (https://www.klimaateffectatlas.nl/nl/). Water nuisance is in Den Haag mostly observed in Scheveningen. The same nuisance could not be matched to a neighbourhood in Rotterdam is was therefore not chosen. In Den Haag generally more areas with severe water nuisance were observed. In Rotterdam the neighbourhoods Blijdorp, Hillesluis and Hillegersberg Zuid showed more water nuisance than the other Vooroorlogse bouwblok neighbourhoods. Hillesluis had to be eliminated since this neighbourhoods only had 25% privately owned houses CBS, 2019. Next, the heat maps were observed to further reduce to two comparable neighbourhoods. Blijdorp had less heat stress than Hillegersberg Zuid. Therefore Hillegersberg Zuid was chosen as the neighbourhood in Rotterdam.

It is assumed that the socio-economic conditions influence to time and money available to consider adopting climate adaptive measures. Taking Q-sorts from two different socio-economic neighbourhoods could therefore very well result only this difference in relative time and money available rather than a wide collection of perceptions. The average house value (WOZ), average income, housing density and homeowners are considered. After an analysis Hillegersberg Zuid and Vruchtenbuurt were found to be comparable Table A.1

Criteria	Hillergsberg Zuid	Vruchtenbuurt
WOZ	€ 265.00	€ 299.00
Average annual income	€ 31.80	€ 31.70
Housing density	3.985	5.008
Percentage homeowners	68%	75%

Table A.1: Socio-economic factors neighbourhoods CBS, 2019

The biggest drawback of the chosen neighbourhoods is the fact that both neighbourhoods are equally non-representative for the city they are situated in based upon its cultural diversity. Both Rotterdam and Den Haag are very multi-cultural with around 50% of its residents non-native Dutch CBS, 2019. In both Hillegersberg Zuid and Vruchtenbuurt this percentage is considerably lower with 25% CBS, 2019. Additionally, the percentage homeowners in both Den Haag en Rotterdam is respectively 40% and 35%, which is condiderably lower than in the researched neigbourhoods CBS, 2019.

B

Blue green measures

In this appendix the background information is provided from the measures depicted in Table 5.2. The measure's information is supplied per category of measure; materials (grey), vegetation (green) and water (blue).

B.1. Category: Materials

Material's properties can target drought, heat and flooding in several ways. Examples are provided below according to two identified properties of materials; reflectivity and infiltration.

Reflectivity; coating

Increasing the reflective property of building materials within the urban area can have a substantial effect on decreasing the heat stress in a city. One of the most influential measures to prevent heat in buildings is to increase the albedo of the roof and/or the facade of a building (Döpp et al., 2011; Pötz, 2012). An increase of the city albedo from 25% to 40% has been simulated to reduce the city's air temperature by 1-4 degrees. Additionally, the cooling wattage of the building can be reduced till 60% with this measure (Döpp et al., 2011).

In the Netherlands white or beige roof tiles can be applied instead of the conventional black, grey or red tiles (Döpp et al., 2011). Flat roofs can be coated white or beige to reduce the heat stress. Likewise, the conventional clay bricks can be painted a lighter shade. It should however be noted that increasing the reflectivity of a material invokes more heat stress for another building. This potential problem is greater with bricks since solar radiation is reflected into the urban living space (Pötz, 2012).

The measures are generic and require no to little space. They do involve additional costs, but the maintenance would not be affected significantly.

Infiltration property; porous pavement

Materials that enable infiltration are called porous and can reduce heat and flooding (Pötz, 2012). The focus will be on porous pavement, since a porous roof would create other negative effects. Two types of porous pavements exist: 1) water passes around the pavement elements (e.g. bricks) 2) water passes through it (Voskamp & Van de Ven, 2015).

When water passes around the pavements elements, the elements themselves are not porous. The space between the pavement element enable infiltration. This space can get clogged due to debris in the runoff, reducing the effect of the measure. Porous elements in the pavements are able to absorb the water and store it within the material. Therefore porous elements can alleviate heat stress by evaporation. Drought is reduced by both porous pavements since water is stored in the groundwater. This requires a fluctuating groundwater level which in most parts of the Netherlands is restricted. Additionally, a permeable soil is required for

infiltration. Peat soils in the West of the Netherlands pose difficulties.

The measures are generic. There functioning is however affected by the permeability of the soil and whether groundwater table is permitted to fluctuate. The effort is expressed both in costs for construction and maintenance. Little space is required since most gardens in the Netherlands are already roughly 60% paved.

Infiltration property; infiltration crates

Infiltration crates are designed to buffer rain water. They are manufactured from very porous material, 96% of the crate's volume can store water (Pötz, 2012). The crates are installed underground and wrapped in geotextile to prevent the build up of debris in the crates which reduce the crate's water storage volume.

The infiltration crates increase the water storage. Additionally, the crate's bottom is open so rainwater can infiltrate into the groundwater and the crate can store a new rain event (Pötz, 2012). A side benefit is that this can help prevent drought induced subsidence (Pötz, 2012). The requirement for proper functioning of infiltration crates is thus a permeable soil. Due to the underground installation, no above ground space is needed. The underground installation does require the excavation of the garden to at least 0.5 meter (Pötz, 2012). The excavation costs and costs of the crates themselves manifest a substantial financial effort.

The infiltration crates are generic, require no space but do require effort. The functionality of the infiltration crates is limited on water nuisance since only storage and infiltration are provided. Additionally, permeable soils are required to guarantee proper functioning of the measure.

B.2. Category: Vegetation

Vegetation applies to the whole range of trees, shrubberies and grass and the location it is able to grow.

Green roofs

Green roof are roofs planted with vegetation/plants in growth medium such as soil (Pötz, 2012; Shafique et al., 2018). They provide multiple benefits such as attenuation of stormwater runoff, cooling by transpiration and increased isolation (Bosch Slabbers and Deltares and SWECO and Witteveen+Bos and KNMI, n.d.; Döpp et al., 2011; Pötz, 2012; Shafique et al., 2018). Co-benefits involve increased biodiversity, aesthetic value and enhancement of stormwater quality (Bosch Slabbers and Deltares and SWECO and Witteveen+Bos and KNMI, n.d.; Pötz, 2012; Shafique et al., 2018).

Three types of green roofs can be identified, intensive, semi-intensive and extensive green roofs. The difference is made clear in figure Figure B.1. A intensive green roof can support more a biodiverse roof life, whereas a extensive roof mainly support mosses and herbs (Shafique et al., 2018). Semi-intensive green roofs will not be evaluated directly, but both its benefits and disadvantages are assumed to be in between the intensive and extensive greens.

All three types of green roof provide the stated benefits, however the choice in green roof influences the degree of benefit provided. Intensive green roofs attenuate and store up to 88% of the stormwater and provide more cooling since its vegetation is able to transpire more water. Additionally, the thermal resistance of a building, e.g. the temperature difference between the two faces of the green roof, is improved by a thick layer of soil and the improved bearing structure of the roof (Shafique et al., 2018). This provides cooler temperatures in summer and warmer temperatures in winter. Extensive green roofs perform the same function, but are able to attenuate and store up to 55% of the stormwater, provide little cooling since the vegetation is very drought resistant which means little water is transpired (lost). Lastly a thinner layer of soil provides less isolation, however this effect is minor (Shafique et al., 2018).

The applicability of green roofs can not be considered generic in the Dutch context. Both intensive and extensive green roofs can be applied on roofs that have an angle 10 degrees (IGRA, 2009). Extensive green roofs can be applied on on 35 degrees angled roof (IGRA, 2009). The effort depends on the roof chosen, intensive roofs have high construction and relatively higher maintenance costs (Pötz, 2012). Extensive green

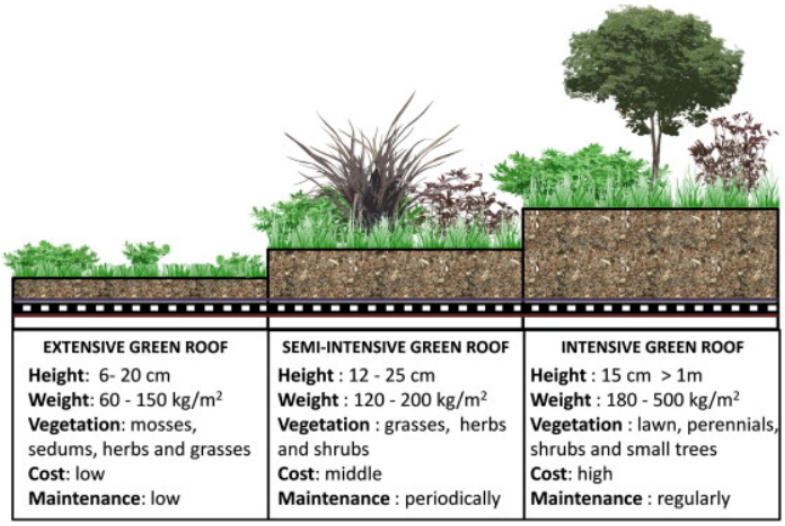


Figure B.1: Green roofs types (IGRA, 2009)

roofs have significantly lower construction cost and low maintenance costs (Pötz, 2012). No to little space is needed, even when rooftop terrace is present a green roof can still be applied (Pötz, 2012).

Green walls

Green walls are an external wall or support structure affixed to the external wall covered by vegetation (Manso & Castro-Gomes, 2015; Pötz, 2012). They provide multiple benefits such as cooling by transpiration, increased isolation and attenuation of stormwater runoff(Manso & Castro-Gomes, 2015; Pötz, 2012). Co-benefits involve increased biodiversity and aesthetic value (Manso & Castro-Gomes, 2015; Pötz, 2012). Green walls can have a great potential in urban areas considering the can be double the ground footprint of buildings (Manso & Castro-Gomes, 2015).

Two types of green walls can be identified, the green facade and the living wall (Manso & Castro-Gomes, 2015). The green facade is a green wall covered by climbing or hanging plants that is self-reliant. The living wall is a green wall covered by vegetation that is fixed in a soil attached to a external wall or support structure.

Both green walls boosts the same benefits(Manso & Castro-Gomes, 2015; Pötz, 2012). A comparison in the degree of observed benefits can be made with the green roofs. The green facade is comparable with the extensive green roof, whereas the the living wall is comparable with the intensive green roof.

The applicability of green walls can be considered generic as long a a house has a external wall. The effort depends on the wall chosen. A green facade does not require much effort, however it takes a longer time before a wall is covered and maintenance is recommend which can become difficult (Manso & Castro-Gomes, 2015). Depending on the manner of application, direct or on a support structure, the green wall requires no to little space (Pötz, 2012).

Green garden

Greening gardens by homeowners have a major effect in mitigating the effects of drought, heat stress and flooding (Bosch Slabbers and Deltares and SWECO and Witteveen+Bos and KNMI, n.d.; Pötz, 2012; Rietkerk et al., 2016; Rijksoverheid, 2014). Benefits of green gardens are attenuation and storage of stormwater runoff, cooling by transpiration, cooling by shade decreasing drought sensitivity of the soil (Bosch Slabbers and Deltares and SWECO and Witteveen+Bos and KNMI, n.d.; Döpp et al., 2011; Pötz, 2012; Shafique et al., 2018). Co-benefits are increased biodiversity, aesthetic value and enhancement of stormwater quality.

The degree of benefit obtained from a green garden depends on the vegetation chosen. Mosses and suc-

culents have a shallow root system, therefore less infiltration is expected to occur. Additionally, succulents provide little cooling due to limited evaporation. Trees on the other hand will facilitate both higher rates of infiltration and more cooling, directly by providing shade and indirectly by high evaporation rates. A humus rich soil, the nutrient rich substrate plants grow in, is able to withhold more water thus reducing droughts from occurring.

Green gardens are generic considering that 90% of the homeowners has a garden (Rietkerk et al., 2016). Most people however have a mixed garden, 20-35% have a green garden and 15-30% have a grey garden (Rietkerk et al., 2016). A grey garden is a garden covered with 75% impermeable material, a green garden is 75% green and a mixed garden refers to other gardens(Rietkerk et al., 2016). Currently, a greying trend is observed in gardens (Rietkerk et al., 2016). The effort highly depends on the vegetation chosen. Adding a cactus to one's garden requires the purchase and the planting, but after this very little maintenance is needed. On the other hand, a flower garden requires a relative high level of maintenance.

B.3. Category: Water

This subsection contain the measures that focus on water and measures that could not be attributed to vegetation or materials will also be provided below.

Water roof

A water roof is designed to buffer a certain amount of precipitation on the roof by situating the drain at a higher than normal level (Pötz, 2012). Depending on the drain height chosen a significant portion of the precipitation can be stored upon a water roof. After a rain storm the water roof is to be drained to create sufficient storage capacity for the next rainfall. Water roofs can additionally alleviate heat stress. This is however highly dependent on the operation of the water roof during summer. Water on the roof provides cooling by evaporation, if the water is drained however the flat roof contributes to the heat stress (Pötz, 2012).

Water roofs require a flat roof which can support a greater loading than regular roofs (Pötz, 2012). Both requisites are not generic for the Dutch private housing context. The effort of based upon costs for construction and maintenance is high (Pötz, 2012). Maintaining its water buffering function can be automatised, in case of manual maintenance of the water buffering function the effort is increased. Lastly, no to little space is required when a flat roof is present.

Rain garden

A rain garden is a buffering and infiltration system. It provides multiple benefits such buffering and attenuation of stormwater runoff, cooling by transpiration and decreasing drought sensitivity of the soil (Pötz, 2012). Co-benefits involve increased biodiversity and aesthetic value (Pötz, 2012).

The normally dry vegetated depression area fills up during a rainstorm after which the infiltrated water percolates into the groundwater (Pötz, 2012). The top layer consists of enhanced soil with plants. A second highly permeable layer, often packed in geotextile, is added to increase infiltration. In the public domain a stormwater drainpipe is situated below the second layer which is connected to the emergency overflow of the rain garden. For rain gardens on private property this safeguard and the drainpipe could be relieved, since overflow would cause minor nuisance relative to the status quo. A schematic overview of a rain garden is presented in Figure B.2.

A rain garden is a generic measure. The cost are mainly in the construction of the rain garden. Maintenance is required due to the vegetation in the rain garden. The vegetation chosen does highly effect the maintenance needed. Nuisance by mosquito's and/or odor can occur. Lastly, space is required. Roughly 10% of the connected area is required to buffer the stormwater if designed well (Pötz, 2012).

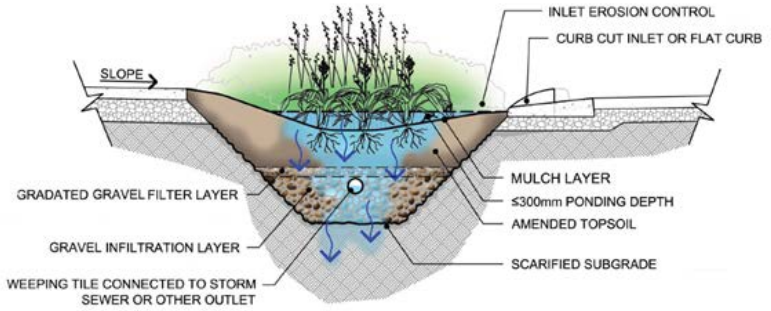


Figure B.2: Rain garden (Pötz, 2012)

Infiltration strip

An infiltration strip is a smaller and shallower rain garden. An infiltration strip can host a lesser variety of vegetation (Pötz, 2012). Infiltration strips provide multiple benefits such attenuation of stormwater runoff, cooling by transpiration and decreasing drought sensitivity of the soil (Pötz, 2012). Co-benefits involve increased biodiversity and aesthetic value (Pötz, 2012).

An infiltration strip is a generic measure. The effort is mainly in the construction of the infiltration strip, which are lower than for the rain garden, maintenance highly depends on the vegetation chosen to inhabit the infiltration strip (Pötz, 2012). Nuisance by mosquito's and/or odor can occur. Lastly, little space is required. Most designs show a rectangular shaped infiltration strip. This can be a convenient shape since it can easily be placed on the property's boundary.

Water pond

A water pond is a depression filled with water. A water pond provides buffering of stormwater runoff (Pötz, 2012). The cooling effect of a water pond is disputed (Döpp et al., 2011; Theeuwes et al., 2013). Evaporation of water lowers the temperature since this phase change requires energy, however the increased humidity dampens the experienced thermal comfort (Theeuwes et al., 2013). Furthermore, a higher water than air temperature increases the temperature (Theeuwes et al., 2013). This mostly happens at night or in autumn.

A water pond is a generic measure to take, which after construction requires little maintenance. Construction can be outsourced but just as well be done by the homeowners. A water pond requires space to fulfill its buffering function. Nuisance by mosquito's can occur. In addition, a larger volume of water provides a longer period of where the cooling effect is dominant.

Rain barrel

The rain barrel is a water tank used to collect and store rain water runoff, typically directed by the gutters from the rooftop. It's main function is storing water. Additionally, this stored water can be used to reduce the water usage of a household during summer and help alleviate drought in the garden.

The rain barrel is a generic measure. After purchase, little effort is required. Lastly, very little space is needed to set up a rain barrel.

C

Policy supplementary material

Firstly, a summary of the policy documents of Den Haag and Rotterdam is provided. Consequently, an evaluation of these documents is provided guided by Loorbach's framework. Lastly, adaptive legislation is elaborated.

C.1. Den Haag

In this section firstly a summary of the policy documents of Den haag is provided after which the evaluation of the policy based upon Loorbach's framework for transition policy is discussed.

C.1.1. Summary policy documents

The climate adaptive policy of Den Haag is extensive and divided in different plans, strategies and implementation programs which are summarised and evaluated below.

Vertrouwen op "Haagse kracht" Coaltitie akkoord

The coalition agreement of city council highlights the policy choices made. These are general guidelines that need separate policy documents to give substance to them, nevertheless it sets the course and demonstrates the vision Firstly, an area-oriented approach is opted. The city of Den Haag consists of districts with their own district office. Safety and livelihood scans are to be conducted. The districts which require extra effort obtain a special 'priority' status. Additionally, all districts obtain more influence and budget to improve their district. The responsibilities are decentralised within the municipality itself. This is specifically thought to improve communication, increase trust and create a sense of ownership amongst the residents. Themes such as sustainability and climate adaptation are included in this.

Besides opting a more decentralised approach the public space will be renovated. Den Haag wants to lead by example by renovating squares, increase the amount of green in the neighbourhoods and connect green areas with one another. Besides increasing the livelihood of the city, it is thought to increase the appreciation for green.

Lastly, Den Haag wants to be a climate neutral city by 2040. Climate neutral is defined as carbon neutral. To achieve this, initiatives from citizens are stimulated. The slogan "*think and act sustainable*" is intended to stimulate such initiatives. This slogan also provides the opportunity to include adaptation into the initiatives.

Regional climate strategy

The region Haaglanden, consisting of nine municipalities and two water boards have drafted a regional climate strategy together. The region has a very high economic value, a high population density and green area. The region has the ambition to become a climate adaptive internationally renowned area by 2050. The area

can roughly be divided into three distinct land uses: greenhouse horticulture, urban, and pasture. These areas are more prone to certain climate risks than others. Connecting the ambitions and different governmental bodies with each other will provide chances to eradicate problems occurring in these areas. The current climate strategy highlights the expected climate risks and potential solutions. Next, common ground is sought between the different parties to enable linking opportunities in 'Water tables'. These are frequently occurring meetings between all the involved parties to discuss how cooperation can be implemented on a regional scale.

Resilience strategy Den Haag

The Resilience strategy Den Haag identifies shocks and stresses for the city. Extreme weather is considered a shock and climate change a stress. Consequently five opportunities are presented to improve Den Haag's resilience which are formulated as followed:

- A connected city for everyone: strong communities
- A new economy: economic and technological developments inspire innovations.
- Adapt to a changing climate: the best initiatives for climate adaptation contribute to the quality of Den Haag no matter the weather conditions
- Increase risk awareness and prepare for risks: well-informed citizens are better prepared for risks and better able to aid others
- Cooperate both within and outside the city: the complex challenges faced by the city require public-private partnerships

To achieve these chances, concrete initiatives are presented which are dived into four 'scales' as depicted in Figure C.1. Scale 1 represents safe, empowered people. Interestingly, only one initiative in this scale focuses on climate change "*Climate adaptation and resilience in children's education*" (Gemeente Den Haag, 2019, p.36). Most climate adaptation and resilience initiatives are located in the second and third scale, "*liveable and cohesive neighbourhoods*" and "*strong and just city*" (Gemeente Den Haag, 2019, p.36).

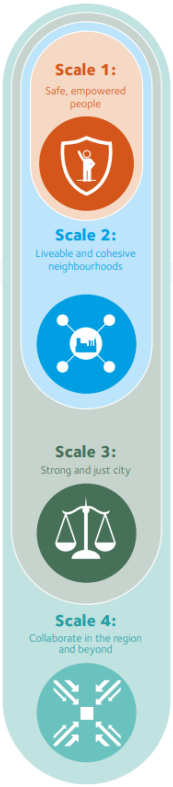


Figure C.1: The scales of resilience (Gemeente Den Haag, 2019)

Municipal sewer plan

The municipal sewer plan incorporates the three duties of care for the municipality.

- Waste water; Collection and transportation of waste water. The possibilities to produce biogas from the municipal waste water is currently under research by the waterboard with the support of Den Haag
- Rainwater; Prevention of water nuisance by effective collection, transportation and processing of rainwater. Den Haag has started to build a separate sewer system since 1970. It is recognised that the sewer system alone does not suffice to cope with rain storms.
- Groundwater; Prevention or limitation of structurally negative consequences by a too high/low groundwater level. Den Haag is increasing its groundwater monitoring system where and when groundwater problems exist. Consequently, if deemed necessary changes in the public space can be made

Citizens and entrepreneurs are regarded as a essential partners to be able to fulfill the tasks stated in the municipal sewer plan. Additionally the responsibilities property home owners have are highlighted.

This plan is the first municipal sewer plan to address both sustainability and climate change. It does so since sewer system are not a flexible infrastructure, therefore a need exists to predict the dimensions needed for the sewer system.

Uitvoeringsplan klimaatbestendig Den Haag

The tasks for this plan are the following:

- The city becomes climate robust. Climate robust is defined taken the "*public health, infrastructure, build environment and the public space*" into account (Gemeente Den Haag, 2012, p.5)
- Measures are adopted by public, private and other institutional sectors where possible
- The residents of Den Haag become aware of climate change by providing this theme with publicity
- Den Haag will position itself as the international city of Peace and Law on the themes of climate change and sustainability.

The strategic base to achieve this is firstly to generate integral solutions and win win opportunities. One such opportunity is to increase the attractiveness of the city while addressing climate change. Another is to engage social-economic aspects too. Secondly, the city has to be prepared for calamities. This increases the resilience. Additionally green area in and around the city get a more diversified development plan. Currently they provide mainly to increase the livelihood and as recreation area. These areas should however be further developed to create a water storing and cooling capacity for the city. Lastly, inhabitants need to be involved by creating awareness regarding climate change and adaptive solutions through public-friendly activities.

Toekomst bestendig Haags water

Toekomst bestendig Haags water is a strategy document of Den Haag in cooperation with water board Delfland specifically focused on the ambition to: "have a well functioning and future-proof water system that can cope with climate change and urbanisation while contributing to an attractive and liveable city".

Current some bottlenecks have been observed in the urban water system and are elaborated upon. Three pillars are identified in this strategy to resolve these bottlenecks:

1. The stand still principle. The water system keeps function as it is and can cope with water nuisance and drought regardless of spatial planning practices
2. Synergy. This concept refers to seizing opportunities, working together with relevant stakeholders and most of all combine these.
3. Knowledge generation. Den Haag focuses on research and innovative projects.

The achievement progress of the ambitions is annually documented. Additionally, administrative meetings are held at regular intervals. This aids flexible steering in order to achieve the ambitions. After completion of the duration an evaluation is held.

Ruimte voor de Stad

In the agenda 'space for the city' four transition challenges for the city are inventoried. These are a new economy, a resilient economy, smart city development and governance. To provide insights in opportunities in area development and strengthen spatial structures within the city five assignments have been drafted to provide coherence while incorporating the transition challenges. The 5 assignments are the following (Gemeente Den Haag, 2016b, p.5):

- *Space for the outdoor space*
- *Space for urban living*
- *Space for (new) economy and tourism*

- *Space for sustainable mobility*
- *Space for energy transitions and climate adaptation*

Indirectly, space for the outdoor space incorporates climate adaptation in the public domain by facilitating more green corridors, city parks and restoring the water system with canals in Den Haag. Climate adaptation is however directly mentioned and regarded in combination with the energy transition, mitigation. Residents are 'challenged' to make propositions.

Actieplan burgerparticipatie

Actieplan burgerparticipatie contains the vision of Den Haag concerning citizens participation: "live together, choose together, act together". This is provided guidelines en concrete measures to facilitate, as such giving an impulse to citizens participation. The following six action are proposed:

Action 1: "*Strengthen the front line and the connection between the front line and policy*"(p.14). Municipal officials work in the streets on neighbourhood scale, they are the link between the current state of affairs and the municipality. They cooperate with other organisations such as the police, social workers, health workers etcetera.

Action 2: "*Improve influence of residents on social and physical livelihood in the neighbourhood*"(p.16). A budget is allocated to neighbourhood funds which can be used by residents to increase the control residents have on the livelihood in their neighbourhood.

Action 3: "*Connect demand and supply of residents in the neighbourhood*"(p.17). The municipality facilitates participation-pitches in which ideas and initiatives are presented by residents for residents.

Action 4: "*Stimulating and facilitating residents' self-organisation*"(p.17). Residents are challenged to take over activities normally conducted or put out to tender by the municipality. Additionally, societal cooperatives are stimulated and supported.

Action 5: "*Increase accessibility and the reach of the municipality*"(p.18). Online platforms and online communication tools are set up to increase accessibility and reach of the municipality with residents.

Action 6: "*Setting up a network to experiment and learn*"(p.19). Residents, (social) entrepreneurs, municipal officials and front liners are connected to learn from each other. Additionally, experiments are started and the results shared.

C.1.2. Evaluation climate adaptive policy

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Den Haag aspires to become a climate neutral city by 2040. This refers specifically to a net zero emission of carbon dioxide. No specific date is observed for Den Haag to become climate adaptive or climate robust. In the resilience strategy the end year of all policy documents is 2040 at latest. The assumption is therefore that Den Haag aims to become climate adaptive in 2040 as well. A special position is created to achieve resilience in Den Haag, since one year it has a chief resilience officer.

Throughout the different policy documents different strategic goals are provided; some with a deadline whereas others without. De Haagse Kracht coalition agreement has a steering role. It shows a decentralising trend of responsibilities, on the other hand it ascribes the municipality as a role model for climate adaptation. The Den Haag resilience strategy is an extensive document integrating climate adaptation with other stresses and shocks relevant. Stresses are slowly building up nuisances such as subsidence, shocks are abrupt nuisances such as pluvial floods. No deadlines are provided in the resilience strategy. The regional climate strategy helps to structure the climate risks Den Haag is facing in line with its surrounding area. Both strategies show a change in both the horizontal as vertical layering of governmental bodies. Toekomst bestendig Haags water sets the course to resolve different already observed water nuisances. The municipal sewerplan sets the course and agenda for the next 5 years for the urban sewersystem. The municipal sewer plan both creates

and implements a vision and can therefore be seen as strategic and tactical. Lastly the Uitvoeringsplan klimaatbestendig includes the tasks that should become implemented specifically focused on climate adaptation.

Besides policy documents setting strategic goals, partnerships have been created. Den Haag is part of the same partnerships as Rotterdam.

On local scale Den Haag provides its strategic goals with substance with programs and action plans. Ruimte voor de stad provides criteria that need to be met in new developments in the city. Climate adaptation is one of these criteria, as such new development plans cannot be approved unless is proven to be climate adaptive. Groen voor de stad sets the course for the design of the public space. It specifically highlights to incorporate green, increase accessibility and maintenance. The municipality regards itself as a role model in this plan. Lastly, the Actieplan burgerparticipatie is a plan to strengthen participation between the municipality and the residents. Although, this plan does not mention climate adaptation.

To observe the progress and effectiveness of policy, reflection of the policy is needed (Loorbach, 2010). In the gemeentelijk rioleringplan this reflection is formulated. Every five years a new gemeentelijk rioleringplan has to be created. Therefore the achievements of the previous plans are evaluated. The other policy documents do however not contain reflection.

In Den Haag the focus appears to remain on the municipality to take climate adaptive measures. This is conformed during a conversation with a governmental official of Den Haag. Den Haag wants to provide a good example as a role model and unburden residents in taking climate adaptive measures. As such Den Haag is both an active participator and passively present as a facilitator through its ambition to unburden residents in adopting climate adaptive measures.

C.2. Rotterdam

In this section firstly a summary of the policy documents of Rotterdam is provided after which the evaluation of the policy based upon Loorbach's framework for transition policy is discussed.

C.2.1. Summary policy documents

The climate adaptive policy of Rotterdam is extensive and divided in different plans, strategies and implementation programs of which the summary and evaluation is provided below:

Waterplan herijking 2 The Waterplan is a technical plan that states how the city of Rotterdam will cope with extreme rainfall. The objective of the Waterplan herijking 2 is to solve the different water issues experienced in Rotterdam while simultaneously contribute to a attractive and climate resilient city. To accomplish this wide objective five specific objectives have been formulated:

- Attractive city: A more attractive city with improved living conditions and a stronger economy is opted for which addresses the experienced water issues in co-operation with relevant stakeholders.
- Protection: Safeguard Rotterdam now and in the future against fluvial and coastal flooding for inner and outer dike areas.
- Clean water: The waters of Rotterdam are to be clean with thriving vegetation.
- Sewer system: Guarantee a well functioning sewer system
- Together: The municipality will realise the above mentioned objectives in collaboration with the three water boards operating in Rotterdam, businesses, research institutes and residents.

Three strategies have been employed by Rotterdam to achieve these five objectives. Firstly, 1) the norm approach is released, since the norms became an objective in itself surpassing the actual problem at hand. Therefore projects are assessed on their effect instead. This approach provides more opportunity to experiment and is thought to promote the living conditions as intended. Next, 2) co-operation with other municipal

plan focused on improving the living conditions or increasing green area in the city is sought to make water management an integral part of policy. Lastly, 3) active participation of residents or other stakeholder is opted for. The municipality recognises itself as the facilitator of this task.

Rotterdams Adaptation strategy

The Rotterdam Adaptation strategy demonstrates how Rotterdam will adapt to climate change and discusses the consequences for the city. The first goal formulated is to create a climate proof city. To do so C02 emissions are to be reduced by 50% and the whole Rotterdam area is climate proof by 2025. Climate proof is defined as: "*is minimally disrupted by and maximally benefits from climate change both then and throughout the following decades*" (Gemeente Rotterdam, 2013c, p. 22). Therefore, Rotterdam requires spatial development projects to account for long term effects of climate change and urbanisation while room is also left for uncertainties. To structure these ambitions the following primary objectives are formulated:

- Rotterdam and its residents are safeguarded from fluvial and coastal flooding.
- Rotterdam and its residents can cope with both a shortage and surplus of rainfall.
- The consequences of climate change are known by the residents of Rotterdam. Additionally, the responsibilities and adaptive measures are clearly communicated to the residents.
- A comfortable and attractive living environment to live and work is envisioned through adaptation.
- Adaptation is used to internationally strengthen the image of Rotterdam and improve the economy.

The basic strategy is to have a robust system and add adaptation, work together with stakeholders and link to other projects on the 4 themes; ecology, economy, environment and society.

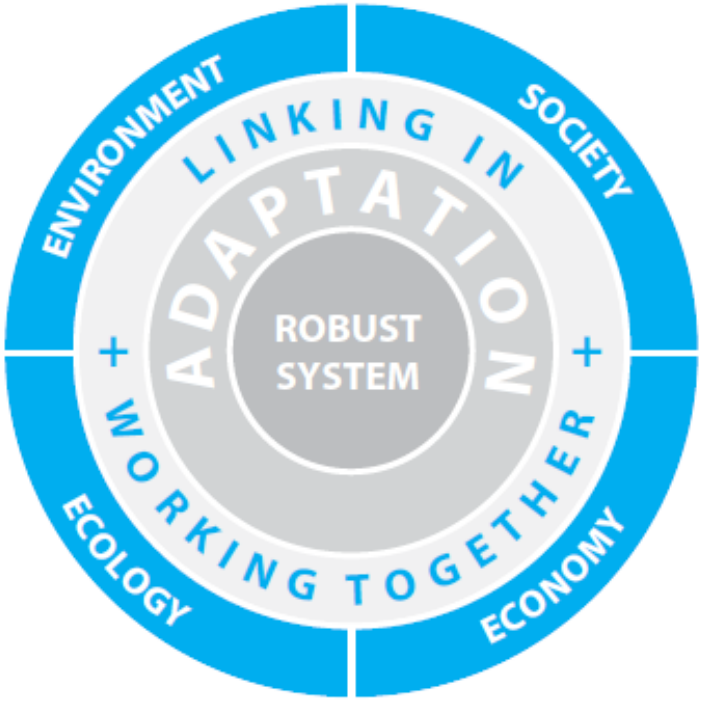

Figure C.2: Rotterdamse Adaptatie stratgie visualisation (Gemeente Rotterdam, 2013c)

Implementation is area specific. For homeowners information and action perspectives regarding protection against river water, excessive rainfall, droughts and periods of high temperatures is provided. Dialogues are used to work towards the joint responsibility of public and private property owners for the collection of excess rainfall.

Rotterdam resilience strategy

This policy document integrates climate adaptation with other goals such as: zero emission energy, infrastructure, cyber-security and branding of Rotterdam as an economic and innovative hub. This strategy is meant to anchor resilience thinking more structurally in new ideas and implementing them. Consequently, more cohesion between programs of different sectors are sought.

The notions of urban resilience and the resilient city have gained considerable attention and interest over recent years, not only in relation to environmental management but also in terms of urban planning. The notion of urban resilience is not just confined to academic discourses – it is increasingly prevalent in urban policy documents. This paper examines awareness and understanding of urban resilience in the planning policy arena in Rotterdam, The Netherlands, where planning has a long history of managing water. Specific attention in the paper is paid to the issue of climate change and how planning processes in the city consider or deal with the risks that it presents. The ways in which the city assesses and prepares for these risks or threats form the two main areas of analysis. The paper concludes that evidence of resilient thinking can be found at all levels of decision-making, ranging from the transnational to local levels. However, the notion of resilience is still quite fuzzy and its significance can vary substantially between policy officials and between policy documents, sometimes even within the same administration.

Municipal sewer plan

The municipal sewer plan describes how the municipality will perform its water related tasks, these tasks are elaborated in the legislation section. Four targets have been formulated by the Rotterdam municipality to perform its water related tasks:

1. Through effective collection and transportation of municipal waste water the environment, waters and public health of Rotterdam are protected.
2. Water nuisance is prevented by collecting rainwater and diverting the run-off out of the city though the urban drainage system.
3. The groundwater level is controlled by taking measures in the public space to limit damages caused by a too high/low groundwater level
4. Raise awareness amongst residents and businesses in Rotterdam regarding the positive influence they can have on the urban water system through communication.

The municipal sewer plan describes a passive role for the municipality and the responsible water boards. An active role is set out for its inhabitants. This is also observed in the four above mentioned goals, the last three directly involve the inhabitants of Rotterdam. Prevention of water nuisance is to be achieved partly by disconnecting surface area from the sewer system in which homeowners are a significant stakeholder. Limiting damage by a too high/low groundwater level is coordinated in close contact with homeowners since they bear responsibility to resolve foundation issues themselves. The last goal literally implies a role for homeowners, the municipality has to communicate this role clearly and wholly.

Rotterdams Weerwoord

Homeowners are extensively mentioned as initiator, partner, executor and responsible agent in the Rotterdam climate adaptive policy. The municipality has a passive role in the climate adaptive process, but with a pro-active role in maintaining a robust water system such as dikes and sewers. These two ascribed roles might lead to a tension field where the roles become blurred. To tackle this, the municipality has a pro-active role as communicator and facilitator of projects.

Rotterdams Weerwoord aids in the execution of this pro-active role. Its goals is to make Rotterdam climate resilient in the private domain. Two strategies are employed: cooperation throughout the whole urban area and utilising changes in the physical domain of the city. This is consequently realised in four spatial domains, one being the inhabitants of Rotterdam. It set out a plan to let the inhabitants actively participate. Lastly, it

is entangled in other programs it has common ground with. As such, synergies are opted for with others programs.

Rotterdamse stijl

Guidelines to design the public space are enclosed in the Rotterdamse stijl. The philosophy behind the Rotterdamse stijl is to provide a sustainable and comfortable living environment. The public domain is therefore designed using city wide recurring design. The Rotterdamse Stijl additionally provide examples how climate adaptation can be integrated in the landscape. This is thought to positively increase awareness and capability of individuals.

C.2.2. Evaluation climate adaptive policy

Rotterdam is to be climate proof in 2025, this entails a carbon dioxide reduction of 50% compared by 1990 and the whole area of jurisdiction ought to be climate adaptive. (Gemeente Rotterdam, 2013c). By introducing a special function, tasked to coordinate, initiate and inspire, Rotterdam aims to become more resilient. Together with the head climate adaptation, the responsibility is borne to achieve a climate proof city.

Throughout the different policy documents the different strategic goals are provided with a deadline. In the Waterplan herijking2 the course for five years is set to resolve different water nuisances while simultaneously contribute to a attractive and climate resilient city. The Rotterdam adaptation strategy describes the strategy to become climate proof in 2025, this document does not contain activities to monitor progress. The same applies for the Rotterdam resilience strategy, the objective of this document is however to integrate climate adaptation with other goals such as: zero emission energy, infrastructure, cyber-security and branding of Rotterdam as an economic and innovative hub. The municipal sewerplan sets the course and agenda for the next five years to create a robust urban water system. The municipal sewer plan both creates and implements a vision and can therefore be seen as strategic and tactical. The strategic process of becoming climate adaptive is however not displayed in an easy overview such as an adaptation agenda.

In addition to policy documents setting strategic goals, partnerships have been created. Rotterdam is part of the 100 resilient cities set-up by the Rockefeller Foundation to help more cities build resilience to the physical, social, and economic challenges that are a growing part of the 21st century. Cities in the 100RC network have been provided with the resources necessary to develop a 'roadmap' to resilience along four main pathways; financial, expertise support, access to solution and a global network of member cities to learn from each other. Additionally, Rotterdam is in the C40, a network of the world's megacities committed to addressing climate change. Rotterdam is also part of the City Deal. City Deal is an agreement between 17 public and 17 (semi)private partners and the Rijksoverheid to achieve a break-through in climate adaptation in the Netherlands. Lastly, Rotterdam is active in operatie Steenbreek. This is a foundation set-up to remove impervious area in cities.

On local scale Rotterdam provides its strategic goals with substance with programs and guidelines Rotterdamse stijl provides guidelines for public space planning and landscape architecture to provide a collective theme in Rotterdam, while simultaneously improving the climate adaptive capacity. This is to be incorporated when the public space is under construction even though it would unrelated such as for example opening up the street to replace electricity cables. Rotterdams weerwoord is the program to execute the Rotterdam adaptation strategy. It sets out to actively involve inhabitants as partners in climate adaptation. It also monitors the small scale experiments and pilot projects executed in Rotterdam. The reasoning behind this is to promote innovation and stimulate innovations to grow. Innovation is however not only provided in the spatial or technical aspect. Rotterdam is the only city in the Netherlands with a chief resilience officer. Institutional innovation is regarded important to achieve a transition just as much as spatial or technical innovation (Loorbach, 2010). The chief resilience officer is positioned to facilitate both the institutional change as spatial change.

To observe the progress and effectiveness of policy, reflection of the policy is needed (Loorbach, 2010). In the implementation of policy such as the municipal sewer plan and Rotterdams weerwoord this is formulated.

Also the Waterplan provides reflection and by evaluating the outputs of the previous Waterplan. It does not become clear how the Rotterdam resilience strategy will be reflected.

Lastly, the focus is shifted to role of homeowners in the Rotterdam policy documents. homeowners are extensively mentioned as initiator, partner, executor and responsible agent in the Rotterdam climate adaptive policy. The municipality has a passive role in the climate adaptive process, which seems best described as motivator and facilitator. Maintaining the sewerage and drainage system in order to create a robust water system is however still the responsibility of the municipality. A reasoning is not provided, but two explanations are possible. The governmental water management tradition is too strong in this particular sector, so even though private-public partnerships are increasingly welcomed, this sector remains untouched. Another explanation is that too much is thought to be at stake, therefore the municipality does not dare to leave it too governance. The first explanation would show that institutional change is still a ongoing process. The second would show that the municipality does envision a limit to their own policy.

C.3. Legislation

This chapter provides the framework in which climate adaptive policy has to be drafted. The Netherlands has a Klimaatwet which is dedicated to achieve the goals set in the Paris Agreement. Adaptation is not included in this law, a substantial body of direct and indirect foundation for adaptation can be found in legislation. The municipality has a general duty of care for habitable land and a improvement for the living environment (Gemeentewet, art. 21). This is regarded as a legally binding motivation to take climate adaptive measures. Since 2018 the DPRA is in effect. The DPRA is a legally binding contract embedded in the Deltabeslissing with an annual update presented to the Tweede Kamer by the Deltacommissioner and Minister of Water. The DPRA can be considered as the 'birthplace of adaptive policy', it sets the course to take policy without giving substance to it. In the DPRA a decentralised approach is opted, which provides freedom to some extent on the 'how'. The provided discretion leaves adaptation policy to some extent open to municipalities (Gilissen, 2013). National legislation however provides the decentralised approaches with boundaries which are explored next. Firstly, 'general principles of proper governance' (Algemene beginselen behoorlijk bestuur) applicant to all governmental activity are listed. Subsequently, the legislation applicable to the three climate themes is presented.

- Principle of diligence (zorgvuldigheidsbeginsel, Algemene wet bestuursrecht (Awb), artikel 3.2 .
- Prohibition of bias (verbod van vooringenomenheid, artikel 2.4 Awb
- Prohibition of arbitrariness (verbod op willekeur, artikel 3.3 Awb
- Principle of proportionality (evenredigheidsbeginsel, artikel 3.4 Awb
- Principle of motivation (motiveringsbeginsel, artikel 3.46 Awb

The three climate themes flooding, drought and heat are separately discussed below. In the evaluation of legislation the newly announced Omgevingswet will not be taken into account.

Flooding

Pluvial flooding is caused by a lack of infiltration, storage and drainage capacity to cope with the rainfall as discussed in section 5.1. Although not apparent yet, this multi-facet causation of the problem can make the situation from a legal perspective quite challenging. Due to the fact that the Netherlands has often experienced nuisance by flooding, a substantial body of literature and jurisprudence is available.

Rainwater

Firstly, art. 3.5 of the Waterwet states the municipality has a duty of care regarding rainwater, if this cannot be reasonably required from the owner of the property. This provides two insights. The public space is owned by the municipality, therefore the municipality is required to take reasonable measures to prevent run-off. Secondly, homeowners have the primary responsibility to take care of the rainwater on their own property

if reasonable. Only when it is not reasonable for homeowners to cope with the rainwater, the duty of care applies for the municipality.

The duty of care is given substance in a municipal sewer plan (GRP) (Wet Milieubeheer, art. 4.22). The GRP states which measures will be taken by the municipality to cope with rainwater and which measures have to be taken by homeowners. The sewer system is one measure taken by the municipality to reasonably prevent run-off from the public domain. Reasonable is translated into a non-binding building norm for the sewer system to cope with rains events that happen once every two years. This is provided further guidance by the verdict of the Court of Arnhem which has determined that a road should at least withstand rain events happening every two to three years (Havekes & de Putter, 2016).

If however during a rain storm, run-off from a property causes damage downstream, who is then liable? A owner of the downstream property is required to tolerate run-off from upstream following the natural course (Burgerlijk wetboek, art. 5.38 & 5.39). The upstream property owner should take reasonable measures as stated in the Waterwet art. 3.5. The downstream property owner should also take reasonable measures and tolerate run-off following the natural course. This changes if the natural course is adapted. The owner of a property is not allowed to cause nuisance if the natural course of run-off is adapted in its course, capacity or quantity (Burgerlijk wetboek, art. 5.39). Examples of adaptations are raising of grounds, applying impermeable surfaces and influencing the course of run-off by construction of a road (Gerechtshof Arnhem-Leeuwarden, 2011; Gilissen, 2013). In such cases a upstream property owner can thus be found liable.

Groundwater Homeowners have a variety of measures they can take to prevent run-off: infiltration, storage and/or drainage. Increasing popularity within governmental institutions has been found for green gardens (Rietkerk et al., 2016). Here a link is created between rain water which is infiltrated and storage which is provided in the unsaturated zone. The unsaturated zone and groundwater in urban areas have a less well defined managing government body, sometimes causing a problem of causality (Gilissen, 2013). Extractions and infiltration are firstly discussed since these can significantly affect groundwater levels. Afterwards the groundwater level regulation and duty of care regarding groundwater are discussed.

Provinces are authorised to grant permits for industrial groundwater extractions, e.g. + 150.000 m3 per year (Waterwet, art. 6.4). Water boards can include permits in their Keur for smaller abstractions, but are not obligated to do so (Waterschapswet art. 59 & art. 78). Generally small abstractions/infiltrations do not need a permit (Gilissen, 2013).

A Pijl is a set water level for surface and groundwater bodies determined by the managing governmental body (Waterwet, art. 5.2). The Pijl is to be maintained as much as possible (Waterwet, art. 5.2). The municipality has a duty of care to prevent structural nuisances in the groundwater level by taking measures in the public space if this is not the resonsibility of the managing government body (Waterwet, art. 3.6). Interestingly, the municipality is not a managing government body as indicated in Waterwet art. 1.1. In the case of groundwater the municipality is thus not responsible nor tasked to take measures to influence the groundwater level (Gilissen, 2013). Nevertheless, the municipality can be found liable if the duty of care is neglected according to 'wrong behaviour' (Burgerlijk wetboek, art. 6.162). The behaviour of the municipality must therefore be 1) the cause of 2) the damage suffered and must be 3) unlawful 4) against the disadvantaged and be 5) imputed to the perpetrator. An example could for instance be a broken sewer. The municipality is responsible for the robust sewer system (Wet Milieubeheer). A broken sewer can affect the groundwater level, causing damage which is unlawful by the Wet Milieubeheer. Water boards can also be found liable for not maintaining the groundwater based upon the Burgerlijk wetboek, they have an additional burden of proof of innocence since they are a managiging government body (Burgerlijk wetboek 6.174). It should however be noted that the above applies to structural changes and duty of care for the public space. Primarily, homeowners are themselves responsible to avoid damage and nuisance to their property based upon the current circumstances and reasonably accounted changes (Gerechtshof 's-Gravenhage, 2011).

This is also illustrated by a quote from the Director of Rioned, the Dutch umbrella foundation for urban water management: "When the roof is leaking, homeowners think is obvious that they have to fix this. Strangely, this

does not apply for the bottom of the house. Then people do not have the feeling that they should protect their property." (Omroep West, 2018). This holds true unless the municipal sewer plan, in which the municipal duties of care regarding waste water, rainwater and groundwater are specified, puts full responsibility upon the municipality (Wet Milieubeheer, art. 4.8).

Drought

Drought is a relatively new phenomenon in Dutch water management. It could even be argued that is a phenomenon created by the Dutch water management tradition (Gilissen et al., 2019). Two consequences of drought on homeowners could be relevant: drinking water provision and low groundwater levels.

Drinking water

Drinking water provision is provided legal status in the Drinkwater wet. Drinking water companies are responsible to provide safe drinking water and maintain the distribution network. During a water scarcity the Verdringingsreeks is put into (Waterwet, art. 2.9). The Verdringingsreeks provides guidance which sectors and functions have priority over others sectors and functions.

The highest priority is given to safety and irreversible damage. The second category includes drinking water categories. So far no drought brought the Verdringingsreeks to exclude drinking water to prioritise category one. The Verdringingsreeks hereby shows that even drinking water provision is not an exclusive and absolute responsibility for one party.

Groundwater

Groundwater has already been discussed and but has not been regarded from a drought perspective. Long lasting drought can cause the groundwater to drop. In the West of the Netherlands most houses have been built upon wooden poles, which become exposed. This causes oxidisation and can consequently lead to damage to the house due to subsidence of the foundation (Brolsma et al., 2012).

The Pijl of the groundwater should be maintained as much as possible. A prolonged drought can be regarded as case of force majeure just as a intense rain storm. This would lift the responsibility the operating government body has. The municipality has a duty of care to prevent structural hindrance by taking measures in the public space. In this case structural needs a second thought. Due to climate change, dry summers are expected to become more common (KNMI, 2014). This could be interpreted as a requirement towards municipalities to take actions to avoid hindrance. If this holds true, maintaining a Pijl by the operating government body as much as possible would probably also require them to act.

On the other hand, homeowners as already concluded have a responsibility to protect their property against damage. No jurisprudence regarding a low groundwater level related to drought has been found. Jurisprudence has been found regarding damage to foundation poles due to a low groundwater level. The municipality of Dordrecht was found to be not liable to the damage caused by a low groundwater level by a leaking sewer pipe. Although a leaking sewer pipe was was the cause, the municipality still fulfilled its tasks. The case, based upon Burgerlijk wetboek art. 6.174, was therefore found not sufficiently founded. This verdict shows that homeowners have a substantial own responsibility in safeguarding their property. This might lead to substantial investments in proper foundation poles for 1 million houses in the Netherlands. The insurance association has however already stated, this can not be claimed with the insurer (Parool, 2020).

Drought is thus a relatively phenomenon in the Netherlands, therefore little jurisprudence and legal research is available. It appears homeowners are primarily responsible to protect themselves and their property against damage induced by drought and are also liable to the damage caused. The municipality is however not free of responsibility since they have a duty of care to prevent structural hindrance.

Heat stress

Just as drought, heat stress does not have a firm basis in Dutch jurisprudence or legal research. No specific law or article has been found that sets (open) norms to prevent or reduce heat stress, except the Gemeentewet,

art. 21. This states that the municipality has a general duty of care for habitable land and a improvement for the living environment. The municipality can provide further guidance by including heat stress reduction in their development plan (Wet Ruimtelijk ordening (Wro), art. 1.1.2b). A development plan is used for the purpose of good spatial planning (Wro, art. 3.1.1). Good can be regarded as a container concept, severe experienced heat stress in residential area would therefore not be regarded good. The development plan a tool for the municipality follow up on the duty of care. In practice homeowners have a responsibility to take adequate measures to reduce heat stress as has become evident during the past heat waves in the Netherlands. Public discourse leaves most of the responsibilities and initiative to the private citizen. It is left to the private homeowner to prevent or counteract negative effects of heat waves in their own house, including implementation and costs. However, liability e.g. the cost of health damage that occurs in spite of possible measures the private person lies with the health care insurer after the own risk of the person has been spent.

D

Exploratory interview

The goal of the exploratory interviews was to identify as many factors as possible that affect the decision making of private homeowners in adopting climate adaptive measures. This is in turn needed to draft statements for the Q-sort.

The interviews have been conducted in Dutch with in total six home owners living in Delft, Nijmegen, Rotterdam and Den Haag. The interview presented below in Figure D.1 has been modified based upon input from the interviewees.

Onderzoekend interview huiseigenaren

Doel

Zoveel mogelijk factoren identificeren die invloed hebben om het gedrag van huiseigenaren om klimaat adaptieve maatregelen te nemen.

Subdoel

Q statements maken

Intro deur

Beste meneer/mevrouw,

Mijn naam is Stijn Muntjewerff. Ik ben een student van de Technische Universiteit Delft en schrijf nu mijn master scriptie. Mijn scriptie gaat over hoe huiseigenaren aankijken tegen het nemen van blauw-groene maatregelen. Dit zijn maatregelen die een positief effect hebben op menselijke gezondheid, biodiversiteit, het omgaan met extreme weeromstandigheden zoals harde regen of hitte. Ik ben geïnteresseerd wat huiseigenaren hier nou zelf van vinden.

Bent u een huurder of huiseigenaar?

Huurder: Helaas komt u niet in aanmerking om mee te doen met mijn onderzoek.
Huiseigenaar; Zou ik u een aantal vragen mogen stellen als u daar tijd voor heeft? Het duurt ongeveer 15 minuten tot een half uurtje.

Intro binnen

Ik heb een aantal vragen opgesteld die ik u graag zou willen stellen, maar voel u vooral vrij om te dingen toe te voegen die in uw hoofd schieten. Het gesprek is geheel anoniem. Voor mij is het belangrijkste dat u zegt hoe u erover denkt of wat u beïnvloedt.

Heeft u nog vragen aan mij, voordat ik u vragen zal stellen?

Vragen

1. Maakt u zich er wel eens zorgen over overlast door hitte, droogte of regen?
2. Wat voor maatregelen zou u kunnen nemen tegen wateroverlast, hitte en droogte op uw eigendom?
3. Heeft u wel eens van blauw-groene maatregelen gehoord? (indien niet, uitleg)
4. Wat voor maatregelen zou u kunnen nemen op uw eigendom?
5. Wat zijn voor u factoren die uw keuze beïnvloeden om maatregelen te nemen tegen overlast door regen, hitte en droogte te voorkomen?
6. Wat zijn voor u factoren die uw keuze beïnvloeden om geen maatregelen te nemen tegen overlast door regen, hitte en droogte te voorkomen?
7. Wat zou u stimuleren om maatregelen die overlast door regen, hitte en droogte voorkomen te nemen?
8. Zou informatie over het risico dat uw huis loopt uw keuze beïnvloeden?
9. Heeft u het idee dat u/uw huis risico loopt overlast door regen, hitte en droogte?
10. Verwacht u dat klimaatverandering invloed heeft op het risico dat uw huis loopt en waarom?
11. Vindt u dat uw zelf verantwoordelijk bent om overlast door regen, hitte en droogte te voorkomen en waarom?
12. Verwacht u dat maatregelen die u zou kunnen treffen, overlast verminderen?
13. Bent u wel eens betrokken geweest bij buurtinitiatieven om de buurt schoner/groener etc te maken?
14. Als u de gemeente direct zou mogen benaderen, wat zou u dan zeggen als het gaat over aanpassingen maken om hitte droogte en wateroverlast in de stad te verminderen?

Figure D.1: Exploratory interview private homeowner

E

Statements database

Alle the drafted statements of the concourse are provided in Table E.1

Category	Statements
Climate change	
1	Klimaat verandering doet bij mij geen belletje rinkelen
2	Ik vind klimaatverandering een groot probleem
3	Ik vind klimaatverandering grote onzin
4	Wateroverlast, droogte en hittestress komen door hoe onze steden zijn ingericht
5	Door klimaatverandering is er een toename van wateroverlast, droogte en hittestress
6	In Nederland is klimaat adaptatie niet nodig
7	Door extremer weer is er een toename van droge en hete perioden en wateroverlast door regenbuien
8	Er is genoeg informatie voorhanden om de effecten van klimaatverandering in Nederland te voorspellen
9	Het klimaat verandert
Risk perception	
10	Ik ervaar wateroverlast, droogte en/of hittestress in de directe omgeving van mijn huis
11	Ik ben op de hoogte van het risico of mijn huis gaat verzakken
12	Tijdens de zomer had ik last van de hitte
13	Een heftige regenbui kan voor waterschade zorgen aan mijn huis en/of tuin
14	Ik maak me zorgen over de gevolgen van (extreem weer,) zoals hitte, droogte of hevige regen waar ik woon
15	Ik ben op de hoogte de klimaatstresstest die in mijn gemeente is uitgevoerd
16	Overlast door water, droogte en/of hitte zijn toegenomen
17	Ik neem alleen maatregelen tegen extreem weer als ik overlast ervaar
Self assumed capability	
18	Ik kan zelf wat doen tegen hitte, droogte en wateroverlast
19	Groene blauwe maatregelen kunnen overlast als gevolg van regen, droogte en/of hitte verminderen
20	Ik weet welke blauw groene maatregelen ik kan nemen om overlast van regen, droogte en/of hitte te verminderen
21	Het aanpassen van bijvoorbeeld mijn tuin heeft effect op overlast van regen,

	droogte en/of hitte
22	Mijn bijdrage met groen blauwe maatregelen is verwaarloosbaar klein
Adaptation capacity	
23	Ik ben handig dus ik kan zelf blauw groene maatregelen nemen
24	Ik wil niet te veel onderhoud aan mijn huis en/of tuin
25	Ik denk dat mijn huis en/of tuin geschikt is om blauw groene maatregelen voor e nemen
26	Ik heb voldoende ruimte om blauw groene maatregelen uit te voeren
Adaptation costs	
27	Ik denk dat blauw groene maatregelen erg duur zijn
28	Het is beter om te inversteren in preventieve maatregelen dan te wachten op schade
29	Ik heb voldoende kennis over hoe ik blauw groene maatregelen moet aanleggen op mijn eigendom
30	De kosten van een investering in blauw groene maatregelen wint zich terug
31	Ik vind het te veel moeite om mijn eigendom aan te passen
32	De tijd die het kost om me bezig te houden met het nemen van blauw groene maatregelen kan ik beter besteden
33	Blauw groene maatregelen ten koste gaat van mijn tuin en/of huis
Responsibility	
34	Het is de verantwoordelijkheid van de gemeente om de risico's door regen, droogte of hitte te communiceren
35	De gemeente is verantwoordelijk voor het voorkomen van overlast door wateroverlast
36	De gemeente is verantwoordelijk voor het voorkomen van overlast door droogte
37	De gemeente is verantwoordelijk voor het voorkomen van overlast door hitte
38	Ik ben verantwoordelijk om overlast door regen, droogte of hitte voor de stad te verminderen door maatregelen te treffen op mijn eigendom
39	Geen regenwater laten afvloeien
40	Het nemen van maatregelen om overlast door regen, droogte of hitte te verminderen is een gedeelde verantwoordelijkheid van burgers, overheden en bedrijven
41	Ik betaal belasting aan de gemeente en waterschappen dus zij moeten overlast door regen, droogte of hitte voorkomen
42	Ik ben zelf verantwoordelijk voor overlast door extreme weersomstandigheden in eigen huis en tuin
43	Ik ben bereid om mijn eigen huis en tuin aan te passen om mijn omgeving geen overlast door extreme weersomstandigheden te bezorgen
44	De gemeente moet meer doen tegen overlast door regen, droogte of hitte
Legislative	
45	Ik ben zelf verantwoordelijk voor wateroverlast of -onderlast door weersomstandigheden op eigen terrein.
46	De gemeente is wettelijk verplicht om te voorkomen dat ik overlast door regen, droogte en/of hitte ervaar
47	De gemeente zou de burger moeten verplichten om blauw groene maatregelen te nemen
48	Ik weet wat de gemeente van mij als huiseigenaar verwacht als het gaat om het voorkomen van overlast door regen, droogte en hitte.
Policy ideas	
49	Het verminderen van overlast door regen, droogte en/hitte verdient aandacht

50	Er is voldoende informatie voorhanden om blauw groene maatregelen te nemen
51	Er moet een subsidie regeling komen voor blauw groene maatregelen
52	De gemeente mag het nemen van blauw groene maatregelen verplichten op het eigen terrein
53	Het is een goed idee om bij tuincentra voorbeelden te laten zien van blauw groene maatregelen
54	De materialen die nodig zijn voor het nemen van blauw groene maatregelen goedkoper maken bij bouwmarkten is een goed idee
55	Een korting op de rioolheffing zou mij stimuleren groen blauwe maatregelen te nemen
56	Een risico dialoog met de gemeente vind ik nuttig om op de hoogte te geraken hoe mijn huis en/of tuin risico loopt op overlast regen, droogte en/hitte
57	Ik weet waar ik de benodige informatie kan vinden om zelf maatregelen tegen overlast door extreem weer te nemen
58	Ik vind een blauw-groen label voor huizen, vergelijkbaar met energielabels, een goed idee.
59	Boetes voor eigenaren die geen maatregelen nemen om overlast door regen te voorkomen vind ik een goed idee.
Social influence	
60	Ik ben bereid om groen blauwe maatregelen te nemen wanneer mijn buren dit ook doen
61	Gezelligheidsaspect
62	De gevolgen van extreem weer zijn een gespreksonderwerp in mijn sociale kringen.
63	Ik ben bereid op mijn eigendom aanpassingen te doen om te voorkomen dat mijn buren overlast door regen, droogte en hitte ervaren.
Miscalleneous	
64	Het nemen van blauw groene maatregelen verbetert mijn leefomgeving
65	Ik hecht estetische waarde aan blauw groene maatregelen
66	Ik wil liever blauw groene maatregelen in mijn tuin nemen dan aan mijn huis.
67	Ik ben bereid blauw groene maatregelen te nemen
68	Ik heb al veel blauw groene maatregelen genomen
69	Ik wil mijn eigen onderzoek kunnen doen voordat ik blauw groene maatregelen neem
70	Voordat ik aan dit onderzoek deelnam, had ik nog niet nagedacht over de vraag of ik iets tegen overlast van extremer weer zou kunnen doen
71	Het nemen van blauw groene maatregelen verhoogt de waarde van mijn huis

Table E.1: Statements database

F

Invitation letter research

Help mee, verbeter uw leefomgeving!

Beste mevrouw, meneer,

Mijn naam is Stijn Muntjewerff. Ik ben een master student watermanagement aan de Technische Universiteit Delft en ik ben op dit moment bezig met mijn afstudeeronderzoek. Afgelopen week ben ik bij u aan de deur geweest om u te vragen of u mijn online survey wilt invullen voor mijn afstudeeronderzoek.

Ik onderzoek hoe steden zich kunnen voorbereiden op extreme weersomstandigheden, zoals extreme hitte, droogte en wateroverlast. Mogelijke maatregelen die hiervoor genomen kunnen worden om overlast te verminderen worden blauw-groene maatregelen genoemd. Denk hierbij aan een:

- Vijvertje
- Geveltuin
- Groen dak
- Regenton
- Zonnewering
- Meer planten en bloemen in de tuin

In de bijlage zitten 4 afbeeldingen met voorbeelden van blauw-groene maatregelen.

Dit onderzoek kijkt naar hoe u als huiseigenaar tegenover blauw-groene maatregelen staat. Uw mening staat centraal in het verbeteren van het beleid omtrent omgaan met extreme weersomstandigheden. De uitkomsten van dit onderzoek zullen daarom gebruikt worden om advies te geven op het beleid van uw gemeente omtrent omgaan met extreme weersomstandigheden en daarmee uw leefomgeving te verbeteren. Uw gegevens zullen ten alle tijden anoniem blijven.

Praktisch

Voor mijn onderzoek is het noodzakelijk dat u in een koopwoning woont. Meedoen aan het onderzoek duurt in totaal ongeveer 30-45 minuten. En ziet er als volgt uit:

- Een videobel gesprek (~10 minuten)
  Kennismaking, korte uitleg over blauw-groene maatregelen op privaat terrein en beantwoording van eventuele vragen.
- Het onderzoek (~10-20 minuten)
  U rangschikt uitspraken van heel oneens naar heel eens. Ik heb een website gemaakt om dit op afstand te kunnen doen. Uw gegevens zullen anoniem verwerkt worden.
- Nabespreking (~10-15 minuten)
  Ik stel u een aantal vragen over hoe u het onderzoek heeft ingevuld.

U zou mij heel erg helpen met uw deelname. Stuur mij een mailtje als u interesse hebt om mee te doen naar het volgende mailadres: srmuntjewerff@gmail.com

Alvast hartelijk bedankt en ik hoop u snel te spreken!

Vriendelijke groet, Stijn

G

Online Q-sort procedure

The semi-structured interviews conducted with homeowners to establish the concourse also revealed that the distinction between mitigation and adaptation to be ill defined for most homeowners. Therefore an explanation and examples of SSCAM in the form of photos were included in the instruction email sent to homeowners participating in this research. In the instruction email the link to the online Q-sort website was provided. The website guided the participant through the study using the steps provided below.

Welcome page

Thank you for your participation to my research. The progress will be tracked at the bottom of the web page.

Introduction

This study examines how homeowners regard the adoption of blue-green measures. These are measures that reduce the vulnerability of nuisance by extreme weather conditions. Examples are enclosed in the invitation letter to provide you with a better understanding. Your answers will be processed anonymously. The results will be used to advice upon improvements in municipal policy regarding coping with extreme weather conditions.

Step 1 of 5

Sort the statements over three categories; disagree, neutral, agree. Do this by dragging the statements. The statements are numbered from 1 till 26 and are presented to you in a random order, so don't be alarmed if you start with for example number 19. If you want to reread the instruction, click Help!

Step 2 of 5

Arrange the statements in the table displayed. The amount of blocks in the table represent the amount of statements that can be placed. Drag the statements to the desired location. This step can be challenging, but it is very important for the research. Sort the statements from disagree most, -3, to agree most, +3. It is possible that you (dis)agree with more statements than block options provided. Try to make a choice with which statements you (dis)agree most.

Step 3 of 5

The sorting is done! Check if you are satisfied with the result.

Step 4 of 5

Please provide a short explanation why you (dis)agree most with the statements arranged under -3 and +3.

Step 5 of 5

You are almost finished, please answer these general questions.

The following general questions were asked in step 5 of the procedure, every question could be answered with the option "I would rather not give an answer".

- What is your sex?
- What is your age category?
- What is your highest received education?
- Do you have a front garden?
- What is the size of your back garden?
- What is your city of residence?
- Would you want to aid this research further with a follow-up interview?
- Do you have any remarks or questions?

H

Supplementary material factor interpretation

In this appendix the supplementary material used to interpret the factors as profiles is provided. Firstly, the unrotated correlation matrix is presented in Figure H.1. The factor loadings are subsequently illustrated. Then the factor arrays and a statement's Z-score and ranking the for all four factors are presented. Consequently, the factor's crib sheets are depicted. Lastly, the composite Q-sorts of each factor are provided.

H.1. Correlation matrix

Participant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	100	27	-20	40	39	26	31	54	34	61	27	36	3	43	0	50	44	57	47	36	30	20	66	31	34
2	27	100	-1	17	53	29	20	0	10	29	7	31	20	33	-34	11	40	13	26	41	-1	34	19	13	81
3	-20	-1	100	50	34	26	57	10	40	19	49	41	17	44	6	20	20	10	29	34	54	21	4	24	13
4	40	17	50	100	51	47	63	30	64	43	63	46	41	66	27	29	34	54	43	59	39	16	40	46	37
5	39	53	34	51	100	59	51	23	39	36	41	36	46	64	19	31	27	30	67	43	27	37	30	49	54
6	26	29	26	47	59	100	43	9	24	30	54	13	46	53	11	24	10	19	27	33	24	6	24	23	27
7	31	20	57	63	51	43	100	30	37	27	47	33	24	47	4	36	20	31	34	70	37	4	27	43	23
8	54	0	10	30	23	9	30	100	31	57	21	31	-9	37	20	43	19	37	26	36	29	7	44	37	7
9	34	10	40	64	39	24	37	31	100	50	39	54	30	40	21	39	34	61	46	41	47	40	34	19	36
10	61	29	19	43	36	30	27	57	50	100	51	40	17	51	10	57	64	69	44	60	29	39	57	29	49
11	27	7	49	63	41	54	47	21	39	51	100	24	46	60	26	51	54	43	53	53	44	11	34	47	29
12	36	31	41	46	36	13	33	31	54	40	24	100	-6	34	14	20	29	40	17	37	53	17	33	-1	36
13	3	20	17	41	46	46	24	-9	30	17	46	-6	100	46	41	16	21	30	33	41	11	0	34	24	27
14	43	33	44	66	64	53	47	37	40	51	60	34	46	100	10	34	30	37	51	56	60	36	41	47	50
15	0	-34	6	27	19	11	4	20	21	10	26	14	41	10	100	-6	-7	10	16	6	4	-39	14	17	-33
16	50	11	20	29	31	24	36	43	39	57	51	20	16	34	-6	100	34	54	60	47	20	39	76	51	27
17	44	40	20	34	27	10	20	19	34	64	54	29	21	30	-7	34	100	36	47	44	33	33	37	30	50
18	57	13	10	54	30	19	31	37	61	69	43	40	30	37	10	54	36	100	39	49	13	16	54	13	33
19	47	26	29	43	67	27	34	26	46	44	53	17	33	51	16	60	47	39	100	33	27	39	50	70	33
20	36	41	34	59	43	33	70	36	41	60	53	37	41	56	6	47	44	49	33	100	34	26	53	40	53
21	30	-1	54	39	27	24	37	29	47	29	44	53	11	60	4	20	33	13	27	34	100	34	27	19	24
22	20	34	21	16	37	6	4	7	40	39	11	17	0	36	-39	39	33	16	39	26	34	100	24	36	69
23	66	19	4	40	30	24	27	44	34	57	34	33	34	41	14	76	37	54	50	53	27	24	100	49	27
24	31	13	24	46	49	23	43	37	19	29	47	-1	24	47	17	51	30	13	70	40	19	36	49	100	23
25	34	81	13	37	54	27	23	7	36	49	29	36	27	50	-33	27	50	33	33	53	24	69	27	23	100

Figure H.1: The correlation matrix. A print screen of the table was taken since the table could not be fitted

H.2. Unrotated factor matrix

The unrotated factor matrix is displayed in Table H.1. As stated in section 7.1 factors 3, 6 and 7 do not have two Q-sorts significantly loading upon them. Therefore these are excluded from further interpretation. Factor 1, 2, 4 and 5 do have at least two Q-sorts significantly loading upon them. The significance is calculated with formula 3.3 presented in subsection 2.4.5 and should be 0.392 or higher.

No. participant	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.5924	0.3789	0.1141	0.0395	-0.2057	-0.1155	0.3219
2	0.3689	0.248	0.0467	0.4859	0.4586	0.2113	0.1929
3	0.431	-0.3984	0.1248	-0.3356	0.3436	-0.1985	-0.3282
4	0.7667	-0.2376	0.0416	-0.2393	0.061	0.1236	0.0815
5	0.7213	-0.2276	0.038	0.3342	0.1743	-0.0038	0.2052
6	0.4936	-0.3453	0.0913	0.1203	0.0592	0.126	0.1699
7	0.6108	-0.2411	0.0427	-0.1799	0.1653	-0.0761	0.1441
8	0.4521	0.157	0.0184	-0.2045	-0.2176	-0.2868	0.1809
9	0.6642	0.0295	0.0007	-0.3092	0.0564	0.0148	-0.0708
10	0.7457	0.4408	0.1597	-0.1145	-0.1773	0.1395	-0.0519
11	0.7136	-0.3199	0.0776	-0.0355	-0.1835	0.179	-0.2874
12	0.5107	0.1523	0.0173	-0.4084	0.3273	-0.0611	0.0959
13	0.431	-0.3451	0.0912	0.1365	-0.048	0.5081	0.05
14	0.7879	-0.2435	0.0439	0.0585	0.1182	-0.045	0.0402
15	0.1111	-0.3724	0.1076	-0.2555	-0.4093	0.1062	0.1935
16	0.6282	0.2137	0.0344	0.0574	-0.3363	-0.247	-0.074
17	0.5676	0.2336	0.0413	0.0092	-0.0498	0.1419	-0.3548
18	0.6152	0.3203	0.0796	-0.2114	-0.1815	0.1983	0.0883
19	0.6982	-0.069	0.0033	0.3263	-0.2556	-0.1944	-0.1693
20	0.7512	0.0423	0.0015	-0.0768	0.052	0.1131	0.0859
21	0.5181	-0.064	0.0028	-0.2004	0.2299	-0.3073	-0.0786
22	0.4036	0.2561	0.0499	0.3131	0.2986	-0.18	-0.502
23	0.6555	0.2495	0.0473	0.0774	-0.3851	-0.1272	0.1918
24	0.5622	-0.1873	0.0253	0.2731	-0.2467	-0.32	-0.0302
25	0.5859	0.3254	0.0823	0.3646	0.5166	0.2426	-0.0851

Table H.1: Unrotated factor matrix, the green cells have a significant loading on a factor

H.3. Factor loading

The varimax rotation of the unrotated factor matrix results in the factor loadings presented below. It is interesting to note that factor 4 has one Q-sort loading negatively upon the factor. This signifies it is bipolar factor and is therefore splitted in factor 4a and 4b.

No. participant	Factor 1	Factor 2	Factor 4a	Factor 5
1	0.6939	0.1472	0.1982	0.0832
2	0.0805	0.1881	0.7751	0.0547
3	-0.0907	0.2752	-0.0319	0.703
4	0.3335	0.4517	-0.0102	0.6255
5	0.1803	0.6735	0.3839	0.2851
6	0.0618	0.5483	0.0801	0.2761
7	0.1755	0.3763	0.052	0.5636
8	0.5072	0.0925	-0.0797	0.2131
9	0.4354	0.1862	0.0369	0.5589

10	0.8332	0.1147	0.1937	0.2628
11	0.3536	0.6248	-0.1024	0.3558
12	0.29	-0.0781	0.1729	0.6618
13	0.0759	0.5427	0.0039	0.1779
14	0.276	0.5993	0.1996	0.4728
15	0.0988	0.2686	-0.5463	0.0902
16	0.6763	0.3031	0.0599	0.0563
17	0.5123	0.1774	0.2135	0.2029
18	0.6905	0.0699	0.051	0.2836
19	0.4754	0.6365	0.1609	0.019
20	0.4687	0.3384	0.1934	0.4458
21	0.1893	0.1848	0.136	0.5255
22	0.21	0.1506	0.5841	0.0995
23	0.7373	0.315	0.0617	0.0237
24	0.3267	0.6127	0.0519	0.0159
25	0.2479	0.1898	0.831	0.2568

Table H.2: The factor loadings on each factor; green is positively, red is negatively and grey is not significantly loading upon a factor.

The explained variance of each factor in order of appearance in the table above is; 18%, 15%, 10% and 13%.

H.4. Factor array

In table Table H.3 the factor arrays of all four researched factors are presented.

Item number and wording		**Factor arrays**			
#		*F1*	*F2*	*F4a*	*F5*
1	The climate is changing.	3	3	2	1
2	I experience nuisance by flooding, drought and/or heat stress in	0	0	-1	-2
	the direct proximity of my house.				
3	I am worried about the consequences of heat,	2	-2	0	-1
	drought and heavy rain for the area I live in.				
4	I do not want to much maintenance on my home and/or garden.	1	-2	0	2
	and/or garden.				
5	I have sufficient space to take blue green measures.	0	-1	-3	3
6	I think that blue green measures are rather expensive.	-1	-1	-1	0
7	The municipality should do more to prevent nuisance by heavy	3	0	1	1
	rain, drought and/or heat.				
8	The municipality should oblige the adoption of blue green	-2	-3	0	-3
	measures on private property.				
9	A subsidy should be installed for blue green measures.	1	1	3	1
10	Exhibiting examples of blue green measures at garden centres	1	1	2	1
	is a good idea.				
11	Adopting blue green measures improves my living environment.	1	2	3	0
12	Before I took part in this research I did not put thought into	-3	-1	0	-1
	whether I can do something to prevent nuisance by extreme weather.				
13	I rather take climate adaptive measures in my garden than at	-1	-1	0	0
	my home.				
14	I have adopted many blue green measures already.	-2	1	-3	-1

15	I am willing to adopt climate adaptive measures.	2	3	1	0
16	I am aware of the municipality's expectations towards homeowners	-2	-2	-2	-2
	regarding the prevention of nuisance due to heavy rain, drought and/or heat.				
17	I am responsible for water nuisance on my propery due to	-1	0	-2	2
	weather conditions.				
18	I am willing to take climate adaptive measures to prevent nuisance for my	0	2	1	3
	neighbours due to heavy rain, drought and/or heat.				
19	I want to look for my own information before I adopt blue	0	1	2	2
	green measures.				
20	The consequences of extreme weather are a conversation topic in		0	-2	-2
	my social environment.				
21	Blue green labels, such as the energy labels, are a good idea.	0	0	-1	-1
22	If somebody in my neighbourhood starts an initiative I would like to join.	1	2	1	1
23	Adopting blue green measures increases the value of my property.	0	0	-1	-1
24	It is a good idea to fine homeowners who do not take blue green measures	-3	-3	0	-3
	to prevent nuisance due to heavy rain.				
25	I am skilled thus I can adopt blue green measures myself.	-1	1	1	0
26	I know where to find the needed information to adopt blue green measures	-1	-1	-1	0
	against extreme weather conditions myself.				

Table H.3: Factor array of all four factors

H.5. Factor ranking based upon Z-score

No. statement	Statement	F 1	F 1	F 2	F 2	F 4a	F 4a	F 5	F 5
		Z-score	*Rank*	*Z-score*	*Rank*	*Z-score*	*Rank*	*Z-score*	*Rank*
1	1.The climate is changing.	2.14	1	1.73	1	0.97	5	0.86	6
2	2.I experience nuisance by flooding, drought and/or heat stress	0.28	11	-0.37	16	-0.32	17	-0.9	22
	in the direct proximity of my house.								
3	3.I am worried about the consequences of heat, drought and	1.02	4	-1	24	-0.23	16	-0.53	19
	heavy rain for the area I live in.								
4	4.I want to search for my own information before I adopt blue	0.47	10	-0.78	22	-0.02	13	1.02	4
	green measures.								
5	5.I have adopted many blue green measures already.	-0.07	15	-0.65	19	-1.88	25	1.52	1
6	6.I am skilled thus I can adopt blue green measures myself.	-0.37	17	-0.67	20	-0.34	19	-0.25	16
7	7.I do not want to much maintenance on my home and/or	1.32	2	0.17	11	0.43	10	0.61	10
	garden.								
8	8.I have sufficient space to take blue green measures.	-0.85	22	-1.97	25	0.13	11	-2.08	26
9	9.I know where to find the needed information to adopt blue	0.57	8	0.33	9	1.88	1	0.62	9
	green measures against extreme weather conditions myself.								
10	10.I think that blue green measures are rather expensive.	0.51	9	1.15	6	1.42	3	0.83	7
11	11.A subsidy should be installed for blue green measures.	0.75	7	1.34	3	1.45	2	0	14
12	12.Adopting blue green measures increases the value of	-1.71	25	-0.44	18	-0.15	14	-0.47	18
	my property.								
13	13.The municipality should do more to prevent nuisance by	-0.76	20	-0.41	17	-0.22	15	0.16	12
	heavy rain, drought and/or heat.								
14	14.I am responsible for water nuisance on my property due	-1	23	0.66	8	-1.88	26	-0.78	21
	to weather conditions.								
15	15.I am willing to adopt climate adaptive measures.	1	5	1.45	2	0.66	8	0.6	11
16	16.I am aware of the municipality's expectations regarding the	-1.4	24	-0.86	23	-1.22	23	-1.45	24
	prevention of nuisance due to heavy rain, drought and/or heat.								
17	17.The municipality should oblige the adoption of blue green	-0.65	18	0.1	12	-1.43	24	0.91	5
	measures on private property.								
18	18.It is a good idea to fine homeowners who do not take blue	0.18	13	1.28	5	0.68	7	1.38	2
	green measures to prevent nuisance due to heavy rain.								
19	19.Blue green labels, such as the energy labels, are a good idea.	0.25	12	0.26	10	1.11	4	1.32	3
20	20.Exhibiting examples of blue green measures at garden	1.07	3	-0.11	13	-1.09	22	-1.28	23
	centres is a good idea.								

actor ranking based upon Z-score

21	21.If somebody in my neighbourhood starts an initiative I	-0.19	16	-0.28	14	-0.64	21	-0.34	17	
	would like to join.									
22	22.The consequences of extreme weather are a conversation	0.85	6	1.32	4	0.66	9	0.77	8	
	topic in my social environment.									
23	23.I am willing to take climate adaptive measures to prevent	0.13	14	-0.35	15	-0.56	20	-0.71	20	
	nuisance for my neighbours due to heavy rain, drought and/or heat.									
24	24.Adopting blue green measures improves my living enviroment.	-2.08	26	-1.98	26	0.13	12	-1.83	25	
25	25.I rather take climate adaptive measures in my garden than at	-0.79	21	0.76	7	0.79	6	-0.01	15	
	my home.									
26	26.Before I took part in this research I did not put thought into	-0.68	19	-0.7	21	-0.32	18	0.04	13	
	whether I can do something to prevent nuisance by extreme weather.									

Table H.4: The Z-scores and rankings of each statements defined per factor

H.6. Crib sheets

Crib sheets are devised to systematically methodologically approach factor interpretation Watts and Stenner, 2012. They include four basic categories:

- The highest ranked statements
- The lowest ranked statements
- The statements ranked higher by the factor under research than the other research factors
- The statements ranked lower by the factor under research than the other research factors

The crib sheets of respectively factors 1, 2, 4a, 5 are depicted.

Table H.5: Cribsheet of factor 1

#	**Highest Ranked Statements**	**Statement type**
1	The climate is changing.	
7	The municipality should do more to prevent nuisance by heavy rain,	D*
	drought and/or heat.	
	Positive Statements Ranked Higher in factor 1 Array than in Other Factor Arrays	
20	The consequences of extreme weather are a conversation topic in my	D*
	social environment.	
3	I am worried about the consequences of heat, drought and heavy rain	D*
	for the area I live in.	
2	I experience nuisance by flooding, drought and/or heat stress in the	
	direct proximity of my house.	
23	Adopting blue green measures increases the value of my property.	
	Negative Statements Ranked Lower in factor 1 Array than in Other Factor Arrays	
19	I want to look for my own information before I adopt blue green measures.	
18	I am willing to take climate adaptive measures to prevent nuisance for my	
	neigbours due to heavy rain, drought and/or heat.	
26	I know where to find the needed information to adopt blue green measures	
	against extreme weather conditions myself.	
13	I rather take climate adaptive measures in my garden than at my home.	
25	I am skilled thus I can adopt blue green measures myself.	D*
	regarding the prevention of nuisance due to heavy rain, drought and/or heat.	
	Lowest Ranked Statements	
12	Before I took part in this research I did not put thought into whether	D*
	I can do something to prevent nuisance by extreme weather.	
24	It is a good idea to fine homeowners who do not take blue green	
	measures to prevent nuisance due to heavy rain	

Table H.6: Crib sheet of factor 2

	Highest Ranked Statements	**Statement type**
1	The climate is changing.	
15	I am willing to adopt climate adaptive measures.	

	Positive Statements Ranked Higher in factor 2 Array than in Other Factor Arrays	
25	I am skilled thus I can adopt blue green measures myself.	
14	I have adopted many blue green measures already.	D*
23	Adopting blue green measures increases the value of my property.	
2	I experience nuisance by flooding, drought and/or heat stress in the direct	
	proximity of my house.	
	Negative Statements Ranked Lower in factor 2 Array than in Other Factor Arrays	
7	The municipality should do more to prevent nuisance by heavy rain, drought	
	and/or heat.	
13	I rather take climate adaptive measures in my garden than at my home.	
26	I know where to find the needed information to adopt blue green measures	
	against extreme weather conditions myself.	
4	I do not want to much maintenance on my home and/or garden.	D
	regarding the prevention of nuisance due to heavy rain, drought and/or heat.	
3	I am worried about the consequences of heat, drought and heavy rain for	
	the area I live in.	
	Lowest Ranked Statements	
8	The municipality should oblige the adoption of blue green measures on	
	private property.	
24	It is a good idea to fine homeowners who do not take blue green	
	measures to prevent nuisance due to heavy rain.	

Table H.7: Crib sheet of factor 4a

#	**Highest Ranked Statements**	**Distinguishing**
9	A subsidy should be installed for blue green measures.	D*
11	Adopting blue green measures improves my living environment.	
	Positive Statements Ranked Higher in factor 4a Array than in Other Factor Arrays	
10	Exhibiting examples of blue green measures at garden centres is a good idea.	
19	I want to look for my own information before I adopt blue green measures.	
25	I am skilled thus I can adopt blue green measures myself.	
8	The municipality should oblige the adoption of blue green measures on private	D*
	property.	
24	It is a good idea to fine homeowners who do not take blue green measures	D*
	to prevent nuisance due to heavy rain.	
12	Before I took part in this research I did not put thought into whether I can do	
	something to prevent nuisance by extreme weather.	
13	I rather take climate adaptive measures in my garden than at my home.	
	Negative Statements Ranked Lower in factor 4a Array than in Other Factor Arrays	
26	I know where to find the needed information to adopt blue green measures	
	against extreme weather conditions myself.	
23	Adopting blue green measures increases the value of my property.	
20	The consequences of extreme weather are a conversation topic in my social	
	environment.	

17	I am responsible for water nuisance on my propery due to weather conditions.	D
	Lowest Ranked Statements	
5	I have sufficient space to take blue green measures.	D*
14	I have adopted many blue green measures already.	D*

Table H.8: Crib sheet of factor 5

#	Highest Ranked Statements	Statement type
5	I have sufficient space to take blue green measures.	D*
18	I am willing to take climate adaptive measures to prevent nuisance for my	
	neighbours due to heavy rain, drought and/or heat.	
	Positive Statements Ranked Higher in factor 5 Array than in Other Factor Arrays	
19	I want to look for my own information before I adopt blue green measures.	
4	I do not want to much maintenance on my home and/or garden.	D
17	I am responsible for water nuisance on my propery due to weather conditions.	D*
13	I rather take climate adaptive measures in my garden than at my home.	
26	I know where to find the needed information to adopt blue green measures	
	against extreme weather conditions myself.	
	Negative Statements Ranked Lower in factor 5 Array than in Other Factor Arrays	
15	I am willing to adopt climate adaptive measures.	
11	Adopting blue green measures improves my living environment.	D*
23	Adopting blue green measures increases the value of my property.	
2	I experience nuisance by flooding, drought and/or heat stress in the direct	
	proximity of my house.	
20	The consequences of extreme weather are a conversation topic in my social	
	environment.	
	the prevention of nuisance due to heavy rain, drought and/or heat.	
	Lowest Ranked Statements	
24	It is a good idea to fine homeowners who do not take blue green measures	
	to prevent nuisance due to heavy rain.	
8	The municipality should oblige the adoption of blue green measures on private property.	

H.7. Composite Q-sorts

In this section the composite Q-sorts of each of the four identified perspectives are presented. The legend to all figures is provided firstly to ensure proper interpretation. Consequently, the composite Q-sort of factor 1, 2, 4a and 5 are respectively depicted.

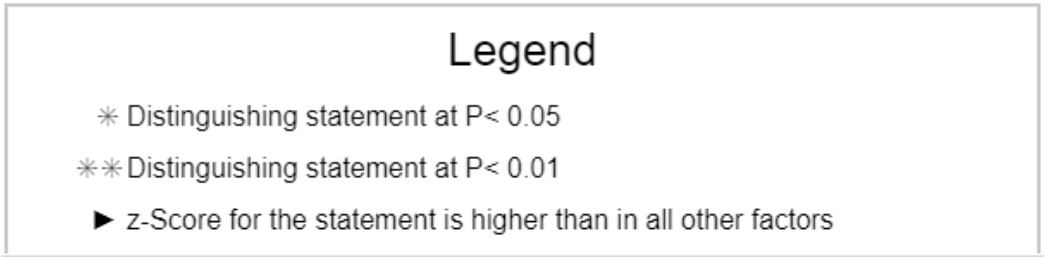

Figure H.2: The legend of the composite Q-sorts

A distinction was made between distinguishing statements with p<0.05 and p<0.01. In this research a p<0.05 is considered significant. Statements with a p<0.01 are weighted equally and are included to obtain an idea whether the same interpretation could be obtained.

Composite Q sort for Factor 1

-3	-2	-1	0	1	2	3
✳✳◄ 12.Nog niet over nagedacht.	✳✳ 8.Verplichten huiseigenaren .	6.les duur.	2.Ik ervaar overlast.	22.Meedoen buurt initiatief.	✳✳► 20.Extreem weer preksonderwerp.	1.Het klimaat verandert
24.Boetes.	14.Al veel blauw groene maatregelen genomen.	✳ 17.Zelf rantwoordelijk.	19.Eigen informatie zoeken.	✳ 11.Blauw groene maatregelen verbetert mijn leefomgeving.	✳✳► 3.Ik maak me zorgen .	✳✳► 7.De gemeente meer doen.
	16.Verwachting van gemeente duidelijk.	26.Locatie informatie bekend.	18.Aanpassingen voor buren	9.Er moet een subsidie regeling .	15.Bereid blauw groene maatregelen te nemen.	
		13.Liever in mijn tuin dan aan mijn huis.	23.Waarde toename.	10.Tuincentra voorbeelden .		
		✳✳◄ 25.Ik ben handig.	✳ 5.Ik heb voldoende ruimte .	4.Ik wil niet te veel onderhoud .		
			21.Blauw-groen label.			

Figure H.3: Composite Q-sort of factor 1

Composite Q sort for Factor 2

-3	-2	-1	0	1	2	3
8.Verplichten huiseigenaren .	✳◄ 4.Ik wil niet te veel onderhoud .	13.Liever in mijn tuin dan aan mijn huis.	7.De gemeente meer doen.	10.Tuincentra voorbeelden .	11.Blauw groene maatregelen verbetert mijn leefomgeving.	1.Het klimaat verandert
24.Boetes.	16.Verwachting van gemeente duidelijk.	12.Nog niet over nagedacht.	✳✳ 17.Zelf rantwoordelijk.	25.Ik ben handig.	22.Meedoen buurt initiatief.	15.Bereid blauw groene maatregelen te nemen.
	3.Ik maak me zorgen .	✳ 5.Ik heb voldoende ruimte .	✳✳ 20.Extreem weer preksonderwerp.	✳✳► 14.Al veel blauw groene maatregelen genomen.	18.Aanpassingen voor buren	
		6.Ies duur.	21.Blauw-groen label.	9.Er moet een subsidie regeling .		
		26.Locatie informatie bekend.	23.Waarde toename.	19.Eigen informatie zoeken.		
			2.Ik ervaar overlast.			

Figure H.4: Composite Q-sort of factor 2

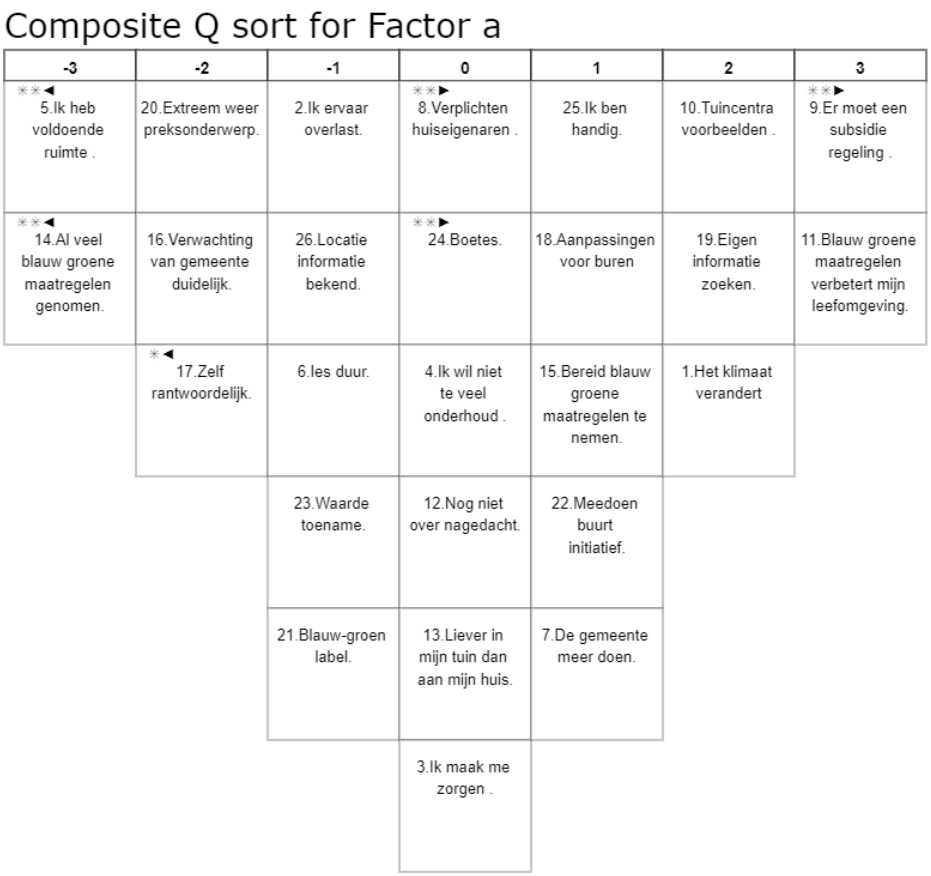

Figure H.5: Composite Q-sort of factor 4a

Composite Q sort for Factor 5

-3	-2	-1	0	1	2	3
24.Boetes.	2.Ik ervaar overlast.	21.Blauw-groen label.	15.Bereid blauw groene maatregelen te nemen.	1.Het klimaat verandert	19.Eigen informatie zoeken.	✳✳► 5.Ik heb voldoende ruimte .
8.Verplichten huiseigenaren .	20.Extreem weer preksonderwerp.	12.Nog niet over nagedacht.	13.Liever in mijn tuin dan aan mijn huis.	10.Tuincentra voorbeelden .	✳► 4.Ik wil niet te veel onderhoud .	18.Aanpassingen voor buren
	16.Verwachting van gemeente duidelijk.	3.Ik maak me zorgen .	26.Locatie informatie bekend.	22.Meedoen buurt initiatief.	✳✳► 17.Zelf rantwoordelijk.	
		23.Waarde toename.	✳✳◄ 11.Blauw groene maatregelen verbetert mijn leefomgeving.	9.Er moet een subsidie regeling .		
		14.Al veel blauw groene maatregelen genomen.	✳ 25.Ik ben handig.	7.De gemeente meer doen.		
			6.Ies duur.			

Figure H.6: Composite Q-sort of factor 5

CFA versus PCA

The same data set as used in this research has been analysed using PCA which resulted in an expected higher explained variance and differences in composite Q-sorts. The explained variance was 9% higher using PCA than CFA, respectively 64% and 55%. Consequently the roughly same amount of factors, 4, have been extracted. The PCA composite Q-sorts and the differences between the CFA and PCA Q-sorts are provided but not interpreted below. The caption of the figure indicates with which factor in the CFA the factor corresponds. No differences were observed in the statements scores of factor 2a and its CFA equivalence 4a.

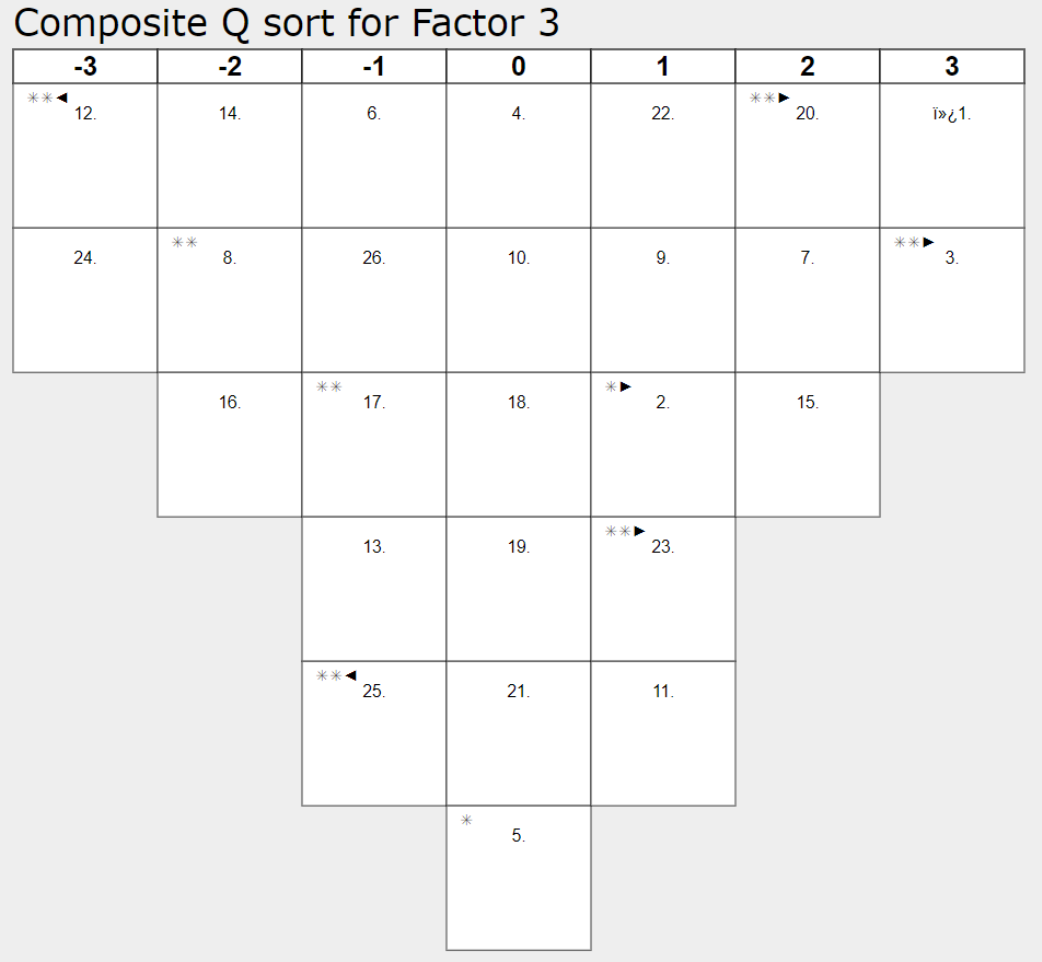

Figure I.1: Factor 3 is the equivalent of factor 1 in the CFA

No. Statment	Score CFA	Score PCA
7	3	2
3	2	3
10	1	0
4	1	0
23	0	1
2	0	1

Table I.1: Overview of the statements that were scored differently in factor 3 of PCA and its equivalence in factor 1 of CFA

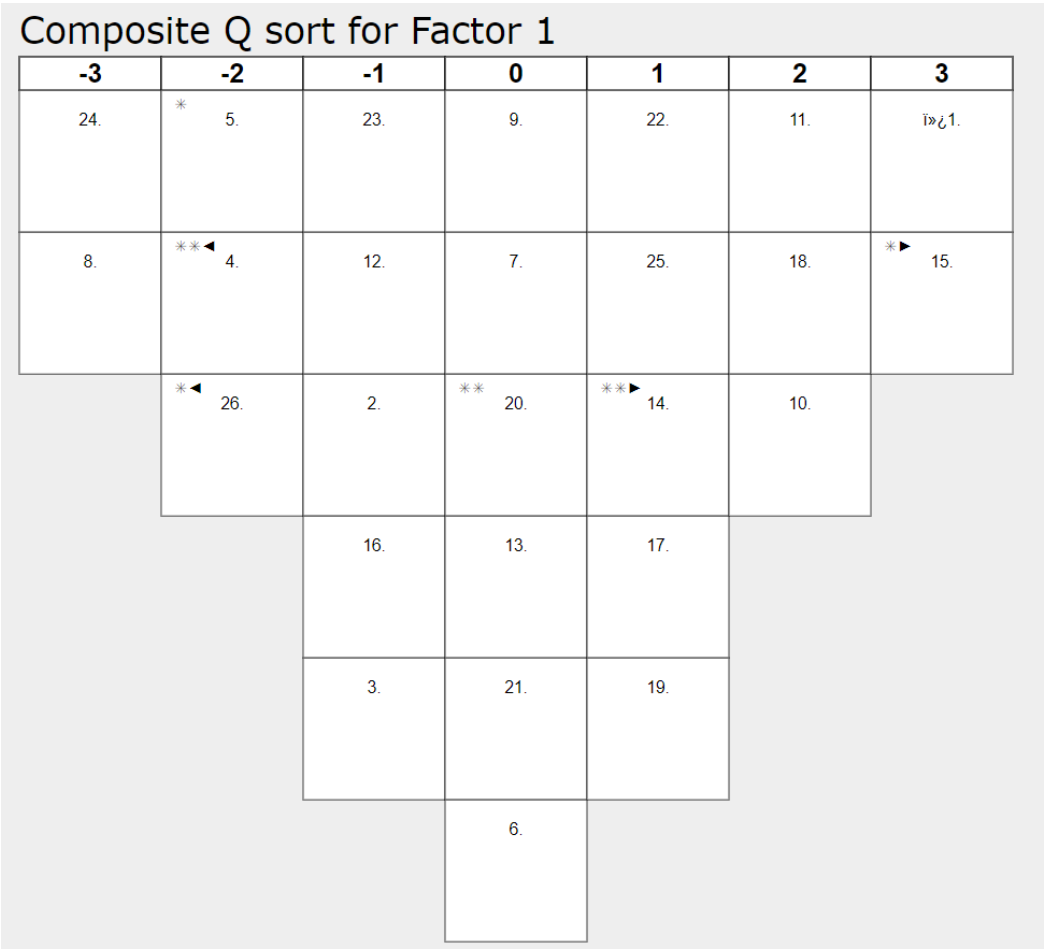

Figure I.2: Factor 1 is the equivalent of factor 2 in the CFA

No. Statment	Score CFA	Score PCA
22	2	1
10	1	2
9	1	0
17	0	1
23	0	-1
2	0	-1
13	-1	0
5	-1	-2
6	-1	0
26	-1	-2
16	-2	-1
3	-2	-1

Table I.2: Overview of the statements that were scored differently in factor 1 of PCA and its equivalence in factor 2 of CFA

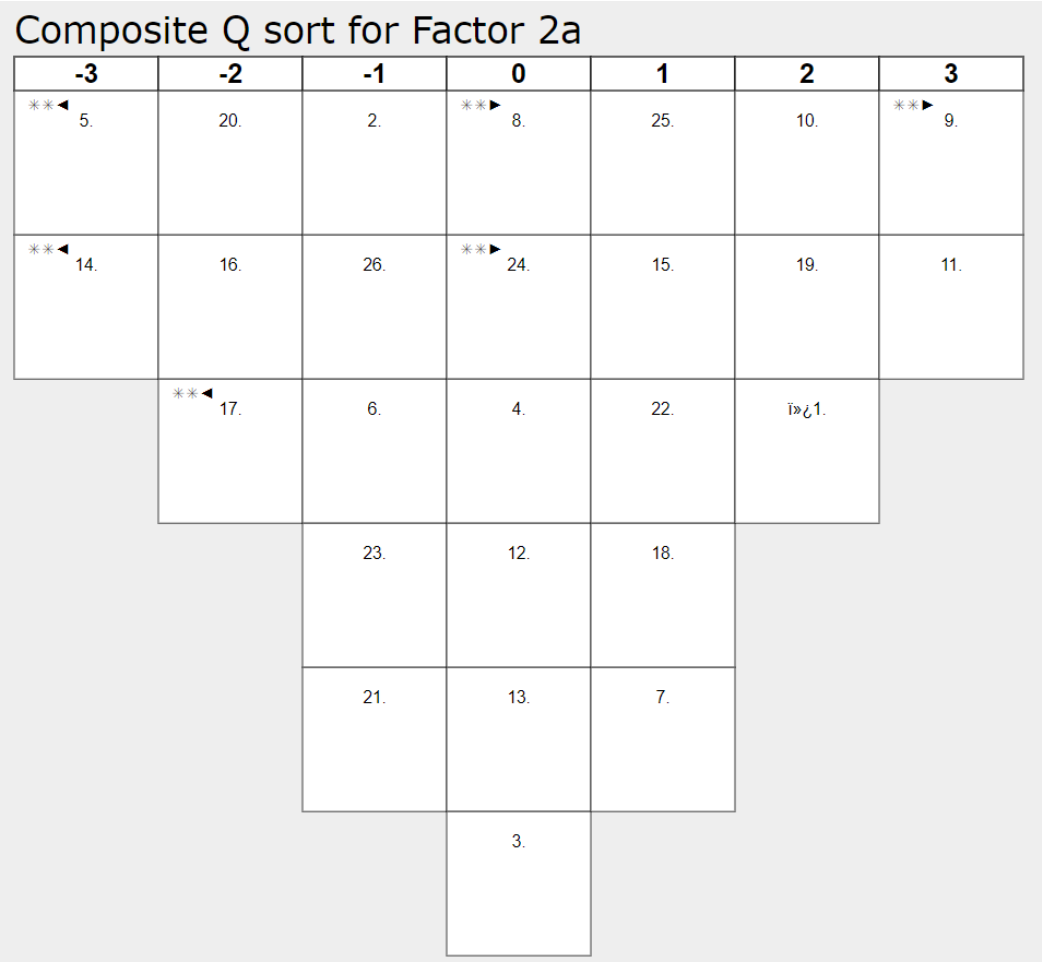

Figure I.3: Factor 2a is the equivalent of factor 4a in the CFA

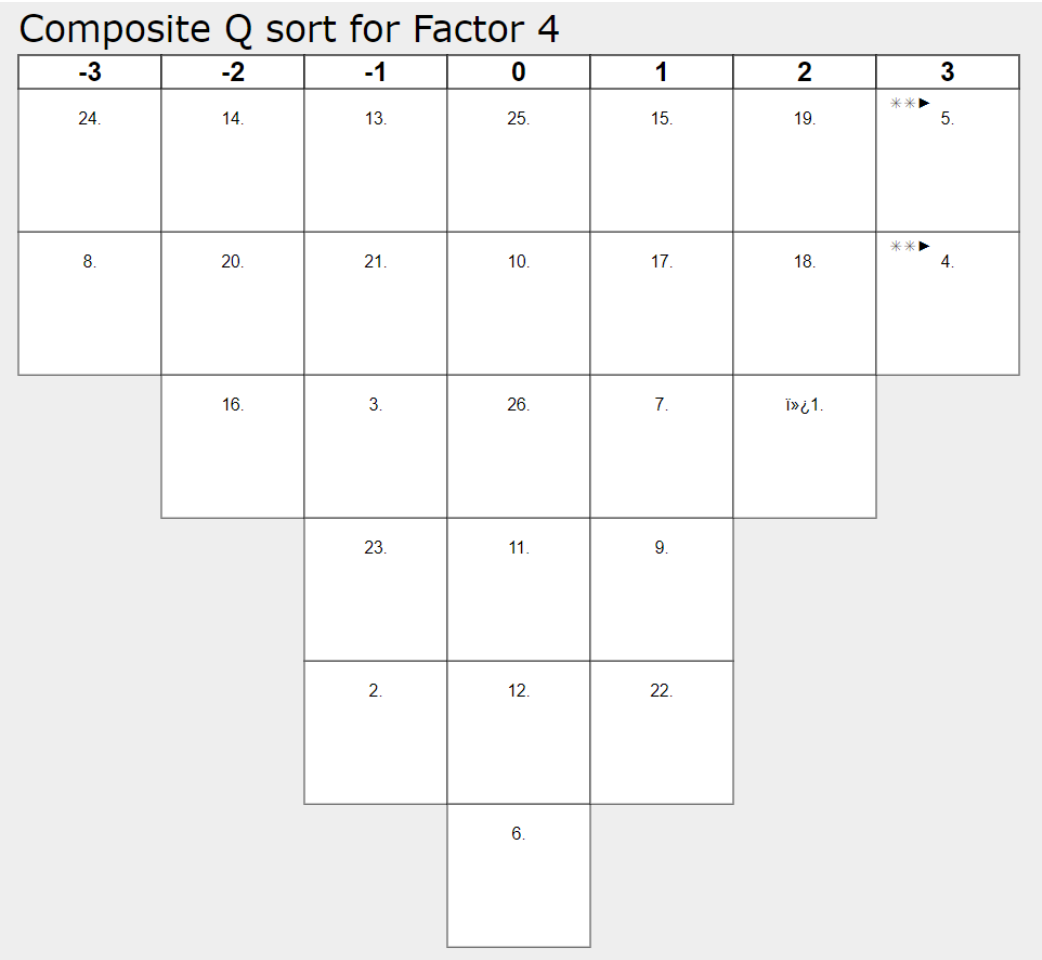

Figure I.4: Factor 4 is the equivalent of factor 5 in the CFA

No. Statment	Score CFA	Score PCA
18	3	2
17	2	1
4	2	3
1	1	2
10	1	0
15	0	1
13	0	-1
12	-1	0
14	-1	0
2	-2	-1

Table I.3: Overview of the statements that were scored differently in factor 4 of PCA and its equivalence in factor 5 of CFA