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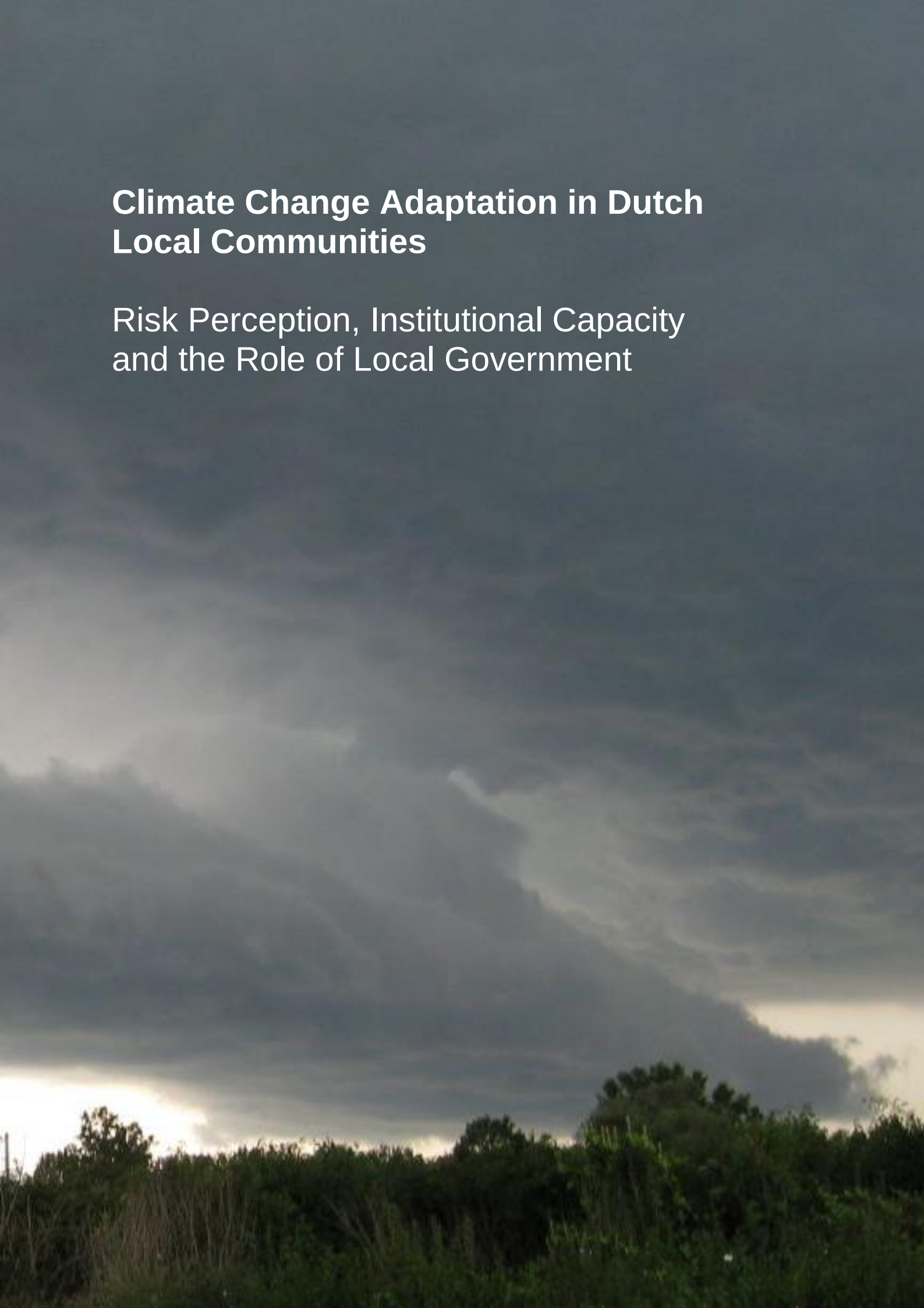

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Risk Perception, Institutional Capacity and the Role of Local Government

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Climate Change Adaptation in Dutch Local Communities: Risk Perception, Institutional Capacity and the Role of Local Government

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This is the final report of the research project 'Analysing Local Climate Vulnerability and Local Adaptation Strategies' (project 454-04-036) funded within the Research Programme Vulnerability, Adaptation and Mitigation (VAM) from the Netherlands Organisation for Scientific Research (NWO).

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Key words: adaptation, adaptive capacity, flooding, risk perception, local government, the Netherlands

PREFACE

This is the final report of the research project 'Analysing Local Climate Vulnerability and Local Adaptation Strategies' which was carried out from 2005 up till 2009 at the Twente Centre for Studies in Technology and Sustainable Development (CSTM) from the University of Twente. The project is funded within the research programme Vulnerability, Adaptation and Mitigation (VAM) from the Netherlands Organisation for Scientific Research (NWO).

The project was initiated as a PhD research project. After three years' work, however, difficulties manifested as the PhD researcher decided to step down and leave the VAM project. In consultation with the financer, it was then decided to round off the project with a new researcher using a pragmatic and practical approach. Because of this, the final report lacks a firmly-embedded theoretical approach, but its empirical base is solid and it constitutes the start-up of the building blocks for a new PhD project.

I would like to thank the NWO for funding this project. And in addition, many thanks to the people who were prepared to spend their precious time in giving an interview as part of this project: Nathalie Thoonsen (gemeente Hengelo), Jan Dijk (gemeente Enschede), Jaap de Wolf (GGD Twente en IJsselland), Inge van de Klundert (gemeente Utrecht), Bart Horsselenberg (gemeente Tubbergen), Richard Nispen (gemeente Breda), Tom Vermin (gemeente Noord-Beveland), Albert Jong en Peter Otten (gemeente Almere), Theo de Vries (gemeente Schiermonnikoog), Leo Bouwman (gemeente Terschelling), Ton Verhoeven and Martin Ruiter (gemeente Nijmegen) and Peter van Deelen (gemeente Millingen aan de Rijn). Chapter 3 in this report is primarily made for all of you who showed interest in the research in general and its outcomes -we hope this satisfies some needs.

The work discussed in this report was carried out in close cooperation with the two other researchers involved. Many thanks to Frans Coenen and William Lafferty for their efforts and time. For a researcher without a social science background, their support and trust was very much appreciated.

Enschede, June 16, 2010,
Maya van den Berg

SUMMARY

This report explains the outcomes of the research project *Analysing local climate vulnerability and local adaptation strategies* which was carried out from 2005 up till 2009 at the Twente Centre for Studies in Technology and Sustainable Development (CSTM), University of Twente. This project is funded within the research programme Vulnerability, Adaptation and Mitigation (VAM) from the Netherlands Organisation for Scientific Research (NWO).

The role of local government is crucial for preparing society for climate change impacts. Yet there are relatively few systemic studies of local community initiatives to improve adaptation capacities. The current study presents an analytic scheme for assessing Dutch municipalities in the context of multilevel governance. The scheme focuses on: (1) historical experience with flooding impacts, and (2) the probability/risk of new climate change impacts. Controlling for size and type of community (rural/urban), the study presents interview-based data for nine case studies.

We can conclude that adaptation to climate change at the local level is a complex policy issue, depending on many external and internal factors. We have tried to gain insights into these factors by investigating the role and the institutional capacity of municipalities in the Netherlands. We have distinguished local 'firebrands' of significant importance. The presence of a local administrator (alderman) on environmental affairs from the national Green Party is related crucial to the promotion of climate-related initiatives.

We also found that the more 'willing' cases were active in all sorts of networks. This varied from EU projects to urban networks and inter-municipal cooperation. Interviewees actively confirmed that these networks played a key role, as they enable the local actors to exchange knowledge and best practices, and to share the costs of research and trial projects. Within such stimulating networks, local actors are more motivated to explore climate-adaptation efforts that would otherwise be too ambitious (resource-demanding) for a single municipality.

The urban cases proved almost all (3 out of 4) to be active climate mitigation frontrunners. They generally consider climate change adaptation as a new dimension of climate policy. However, while mitigation now has become an urgent issue, the challenge of specific adaptation initiatives is new and combined with many uncertainties. In nearly every case, there was little sense of urgency in relation to either vulnerability or preparedness. Despite the complex nature of the problem, interviewees in the mitigation frontrunner cases express their belief that the problem of climate change adaptation will gradually 'settle' into a more commonly accepted issue.

Local conditions proved to be most decisive in our study of local adaptation strategies. The study reveals that the local situation exerts a significant impact on the climate change problem. It makes clear that all cases have their own particular situation that is determinative for the effects of climate change impacts. For instance, while the cases with high risk and experience are 'used' to preparing themselves for climatic events, the urban case without increased risk or any experience appeared to be similarly involved in climate change adaptation without any clear threat. The factors risk and experience did not prove as decisive as anticipated.

SAMENVATTING

Dit rapport geeft de resultaten weer van het onderzoeksproject *Analyse van lokale kwetsbaarheid en adaptatie bij klimaatverandering* dat tussen 2005 en 2009 is uitgevoerd bij het CSTM van de Universiteit Twente. Het project is gefinancierd binnen het onderzoeksprogramma Kwetsbaarheid, Adaptatie en Mitigatie van de Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO).

De lokale overheid speelt een doorslaggevende rol bij het voorbereiden van de samenleving op de effecten van klimaatverandering. Toch zijn er maar weinig studies die kijken naar lokale initiatieven om de lokale capaciteit te vergroten. In dit onderzoek staat een analytisch model centraal om Nederlandse gemeenten te onderzoeken binnen het systeem van *multi-governance*. Dit model bevat de dimensies (1) ervaring met overstroming en (2) het risico op door klimaatverandering veroorzaakte overstromingen in de toekomst. Tevens is er geselecteerd op grootte en karakter van de gemeente (platteland/stedelijk). Voor het onderzoek zijn interviews afgenomen in negen gemeenten.

Wij kunnen concluderen dat het aanpassen aan klimaatverandering op lokaal niveau een complex beleidsthema is dat verbonden is met veel interne en externe factoren. Wij hebben inzicht willen krijgen in deze factoren door het bestuderen van de rol en de institutionele capaciteit van gemeenten in ons land. Daarbij viel het op dat de aanwezigheid van een lokale 'enthousiasteling' van groot belang is. De aanwezigheid van een Groenlinkse wethouder voor milieu lijkt (vooralsnog) cruciaal bij het succesvol promoten van klimaatbeleid.

De gemeenten binnen onze selectie die actief zijn op het gebied van klimaatbeleid blijken tevens actief in allerlei netwerken, variërend van Europese projecten tot stedelijke en intergemeentelijke verbanden. Respondenten gaven aan dat deze netwerken bepalend zijn, omdat die de gemeente in staat stellen om kennis en *best practices* uit te wisselen en de kosten te delen voor onderzoek en proefprojecten, die voor een enkele gemeente te kostbaar zou zijn. De stimulerende werking die uitgaat van dergelijke netwerken is extra motiverend om met de aanpassing aan klimaatverandering om te gaan.

De stedelijke gemeenten blijken in de meerderheid (3 van de 4) actieve voorlopers in klimaatmitigatie. Over het algemeen zien zij klimaatadaptatie als een extra dimensie van klimaatbeleid. Terwijl klimaatmitigatie urgent is geworden, blijkt klimaatadaptatie echter nieuw en omgeven met veel onzekerheden. In vrijwel alle onderzochte gemeenten maakte men zich weinig zorgen over de eigen kwetsbaarheid en de mate van voorbereiding. Ondanks de complexiteit van het probleem, gaven de respondenten in de drie actieve steden aan dat zij verwachten dat klimaatadaptatie evengoed geleidelijk zal 'landen' zoals ook bij mitigatie, dat nu een algemeen geaccepteerd beleidsthema is.

In het onderzoek bleken de lokale omstandigheden het meest bepalend voor het opstellen van lokaal adaptatiebeleid. Alle onderzochte gemeenten bevinden zich in hun eigen bijzondere context die bepalend is voor de effecten die klimaatverandering uiteindelijk zal hebben. Zo blijken de gemeenten die ervaring hebben met overstroming, en tevens verhoogd risico lopen, 'gewend' te zijn om zich voor te bereiden op klimatologische voorvallen. De stedelijke gemeenten zonder ervaring of verhoogd risico bereiden zich echter op vergelijkbare wijze voor, terwijl de plattelandsgemeenten in deze categorieën dat niet (kunnen) doen. De factoren risico en ervaring bleken dus niet zo doorslaggevend als vooraf gedacht.

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1 INTRODUCTION

This study is part of the research programme 'Vulnerability, Adaptation and Mitigation' (VAM), which investigated the impacts of climate change from a social science perspective. The Netherlands Organisation for Scientific Research (Nederlandse Organisatie voor Wetenschappelijk Onderzoek; NWO) has funded 13 projects within the programme, which ran from 2005/2006 up to 2009/2010.

The research project 'Analysing Local Climate Vulnerability and Local Adaptation Strategies' started to compare the usefulness of climate change impact models in Norway and the Netherlands. This theoretical phase was concluded in a paper that was presented at the 13th Annual International Sustainable Development Research Conference in 2007 (Clausen 2007). Then, the fieldwork phase started. An analytical framework was set up, cases were selected and people were interviewed. This empirical phase resulted in a book chapter yet to be published (Van den Berg, Lafferty & Coenen 2010, forthcoming). The current report concludes the project.

The main research topics are a general understanding of the climate impact literature, the role of municipalities within a multilevel governance system and the local capacity to adapt to climate change. The goal is to offer an improved knowledge base for both scientists and politicians involved in the development of local adaptation policy. We want to gain insights in the motivations for local climate adaptation strategies and in the barriers when implementing these policy plans. Indirectly, we hope to find clues for what is seen as institutionally *new* to climate adaptation by determining what is *different* from existing civil preparedness.

In this introduction, we continue by discussing the terminology related to climate change preparedness, describing the special relationship of the Dutch with water and presenting our research design and the research questions. Next, we focus on the topic of our research by introducing climate change and the possibilities for local climate adaptation in the Netherlands (Chapter 2). We then provide an overview of Dutch local preparedness for climate change impacts before proceeding to a documentation of patterns of local preparedness (Chapter 3). Finally, we draw preliminary conclusions on possible future roles for local governments in a changing climate context and we address future research questions (Chapter 4).

Many Dutch policy documents have been consulted for this research. To keep the running text as readable as possible, it was decided to show the in-text references to these documents in Dutch. Readers interested in an English translation of the Dutch documents are invited to go to the reference pages at the back of this report. When needed, English translation are provided for Dutch names of institutions and the original Dutch name is given in brackets.

1.1 Context of the Study

Based on the most recent data, the Intergovernmental Panel on Climate Change maintains that climate change is an inevitable development. Current observations prove that many natural systems around the globe are already being affected by climate change (IPCC 2007). In addition, even worse is that if we were able to curb our emissions today, the climate will change anyhow due to the greenhouse gases emitted in the past. Thus, even from a sceptical point of view, it is now widely recognized that we must begin to initiate adaptation measures now.

The issue of climate change adaptation has thus far been viewed as primarily a top-down initiative, with national governments taking a lead on the issue. In its 2009 climate-adaptation white paper, however, the European Commission stresses the crucial role of the local level,

where most of the detailed knowledge on local characteristics is available and where civil awareness can be most effectively raised (COM 2009). Two years earlier, the Dutch government has published its National Adaptation Strategy (Ministerie van VROM 2007). Generally known as the ARK Programme, the strategy also refers to the importance of local government.

In the Netherlands, climate change impacts are primarily a result of excess water entering the Dutch delta (see Section 2.2). In addition to adjusting for increased precipitation, the ARK Programme focuses on sea-level rise and higher river discharges. Also the 2008 Delta Commission focuses on the most vulnerable areas of flooding[1], while the impacts from climate change will also be felt in higher areas in the country. In its report on climate change, the Netherlands Scientific Council for Government Policy deals with the local consequences of these impacts, such as a changing water system and shifting agricultural activities (Ministrie van AZ 2006). The Council states that given the scale of local impacts, municipalities will have to develop solutions to deal with climate change.

The local level is thus crucial. Also, municipalities have many duties and responsibilities within their borders that affect the local vulnerability. They also have the knowledge on their local conditions. After all, whereas a country as a whole could be considered resilient, local areas can nonetheless be vulnerable due to their economic structure, geographic situation and infrastructure (Næss, Bang, Eriksen & Vevatne 2005). As a preliminary step in determining local vulnerability, several assessment models were reviewed in an earlier phase of the current project (Clausen 2007). It was also established in this early phase that local adaptation to climate change was attracting greater research attention (Adger & Vincent 2005; Adger, Arnell & Tompkins 2005; Wall & Marzall 2006; Wilson 2006). There are, however, few studies that address the role of local level government in adaptation initiatives in a multilevel governance structure; particularly as to how local institutional capacity affects the level of preparedness. This study thus applies a local perspective to adaptation strategies by investigating the effect of capacity of a municipality organisation on local initiatives within a multi-government context.

Climate Change Impacts, Vulnerability and Risk

Since the IPCC's Third Assessment Report, the impacts of climate change on the many affected social, biological and geophysical systems are of major interest of both policy makers and scientists. In this context, *impact* is a specific change in a system (which could either be natural or social, but these always dynamically interact; Klein, Smit, Goosen & Hulsbergen 1998) caused by climate change. These impacts are strongly related to vulnerability. *Vulnerability* can be seen as the degree to which a system is susceptible and unable to cope with climate change impacts (Klein, Smit, Goosen & Hulsbergen 1998). The Netherlands are considered to be one of the most vulnerable areas in Europe, since the majority of the Dutch live in areas that are located below sea level and in these areas, 70 percent of Dutch GNP is earned (Kolen, Engel, Van der Most & Van Ruiten 2009).

Since climate change vulnerability is studied by researchers from a wide range of disciplines, it is used in different 'languages' and implemented in various types of models. When discussing vulnerability, social scientists think in terms of coping, whereas climatic scientists generally focus on risk (Brooks 2003). As the concept of *risk* captures uncertainty in the underlying process of climate change impacts, it is essential for decision makers (IPCC 2007). In

[1] This climate change induced flooding risk is problematic since the traditional dykes and water embankments are not designed to withstand sea level rise or structurally higher water levels. The 2008 Delta Commission - advising the national government on becoming a 'climate proof' country - recommended to enforce all dykes tenfold (Deltacommisie 2008). Today, the inland river protection system is already being adapted to the needs of the latest climate change scenarios.

the Netherlands, many types of risk have been visualized through regional 'Risk Maps'.[2] Apart from the exceptional risk of flooding, however, no other climate-induced risks are visualised in this public available online tool.

Adaptation to Climate Change

Stemming originally from evolutionary biology, the term *adaptation* is relatively new to the climate change field. Adaptation in the climate change literature generally refers to a process, action or outcome in a system in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard or opportunity (Smit & Wandel 2006). Based on their timing, adaptations can be anticipatory or reactive, and depending on their degree of spontaneity they can be autonomous or planned. In the Netherlands, traditional adaptation is reactive, as it has generally involved dyke reinforcement in the aftermath of a flooding event (e.g. the Delta coastal defence system after the 1953 North Sea Flood).

Adaptation can significantly reduce or avoid potentially dangerous impacts of climate change. However, as single adaptation measurements are complex and costly, these are rarely undertaken in response to climate change effects alone. Hence, the IPCC (2007) reported that the actual planning and implementation of adaptation strategies are currently limited in many regions. Some successes in practical implementation occurred when measures to address climate change risk were incorporated into existing decision structures. Smit and Wandel (2006) call this the 'mainstreaming' of adaptation to climate change.

Smit, Burton, Klein & Wandel (2000) have categorised adaptation studies in four types depending on the purpose of the research. The first type estimates the degree to which modelled impacts of climate change scenarios could be moderated. The second type has its focus on specific adaptation options for a particular system and rates the possible options –mostly as part of a policymaking process. The third type concentrates on the adaptive capacity of certain areas and involves a comparative evaluation or rating based on criteria and variables selected by the researcher. In contrast to the other categories, the fourth type deals with practical adaptation initiatives. It investigates the adaptive capacity and adaptive needs in a particular region or community in order to identify means of implementation initiatives or enhancing adaptive capacity. In contrast to the first three top-down scenario-based approaches, this approach is sometimes called the bottom-up approach. Our research is part of this fourth category.

Throughout the report, we use a general approach to climate change adaptation. We consider it to be as 'governmental initiatives that aim at mitigating the impacts of primary and secondary climate change effects by existing and new policies'. This simplified definition enables us to use a pragmatics approach during the data gathering phase.

Adaptive Capacity and Resilience

Adaptation is closely associated with the concept of *adaptive capacity*, which reflects the capability of the system to cope with, adapt to or recover from the effects of climate change (Smit & Wandel 2006). Füssel and Klein (2006) observed a negative correlation between adaptive capacity and vulnerability under ceteris paribus conditions: a system that has more adaptive capacity will tend to be less vulnerable. Clearly, there are many forms and 'levels' of adaptive capacity. These can be classified in many ways, such as timing, intent, spatial scope and form. Community-based analyses have shown (Smit & Wandel 2006) that conditions that shape adaptive capacity –and hence create the need and opportunities for adaptation– are community

[2] See Section 2.3; the Risk Map is available on the internet at www.risicokaart.nl (in Dutch only).

specific. It can be influenced by many non-climatic drivers such as managerial ability and access to financial, technological and information resources. Adaptive capacity is thus context-specific – and it changes over time. Its dynamics are caused by changes in economic, social, political and institutional conditions.

Klein, Smit, Goosen and Hulsbergen (1998) present *resilience* as the capability of a system to cope with external pressures such as climate change impacts and propose enhancement of a system's resilience as an appropriate proactive adaptive response to reduce vulnerability. Folke, Carpenter, Elmqvist, Gunderson, Holling and Walker (2002) relate resilience to (1) the magnitude of the shock that a system can absorb; (2) the degree to which a system is capable of self-organisation and (3) the degree in which a system can build capacity for learning and adaptation. More resilient systems are thus able to absorb larger shocks without changing in fundamental ways. Furthermore, resilient systems can better cope, adapt and reorganize when massive transformation is inevitable.

1.2 The Dutch and Water Management

Apart from higher sandy grounds in the southern and eastern parts of the county, the Dutch territory consists of the large Rhine and Meuse delta. This physical situation has shaped the population's history. While its neighbouring countries were still rural, Golden Age heartland Holland was already remarkable highly urbanised due to large-scale civil engineering works that prevented (regular) flooding. Today, about 40 percent of the territory exists of below sea level areas, including the whole of historic Holland which is still the country's economical, political, and cultural centre. In these low-lying areas, the majority of the habitants live and most of the GPD is earned. This gives a special dimension to the Dutch society facing the effects of climate change. The current vulnerability for flooding is depicted in Figure 1.

As the saying goes, God created the World, but the Dutch created Holland. The inhabitants of the Dutch delta have always tried to adjust water patterns by developing new earthworks and other modes of creative water engineering. About 3,000 polders were created, numerous canals, dykes, dams, locks, windmills, and sluices and a 30 km dam to create the Ijsselmeer Lake, being the largest fresh water lake of the country. These water engineering is still ongoing: established in 1986, the newest province of the country Flevoland completely consists of polders.

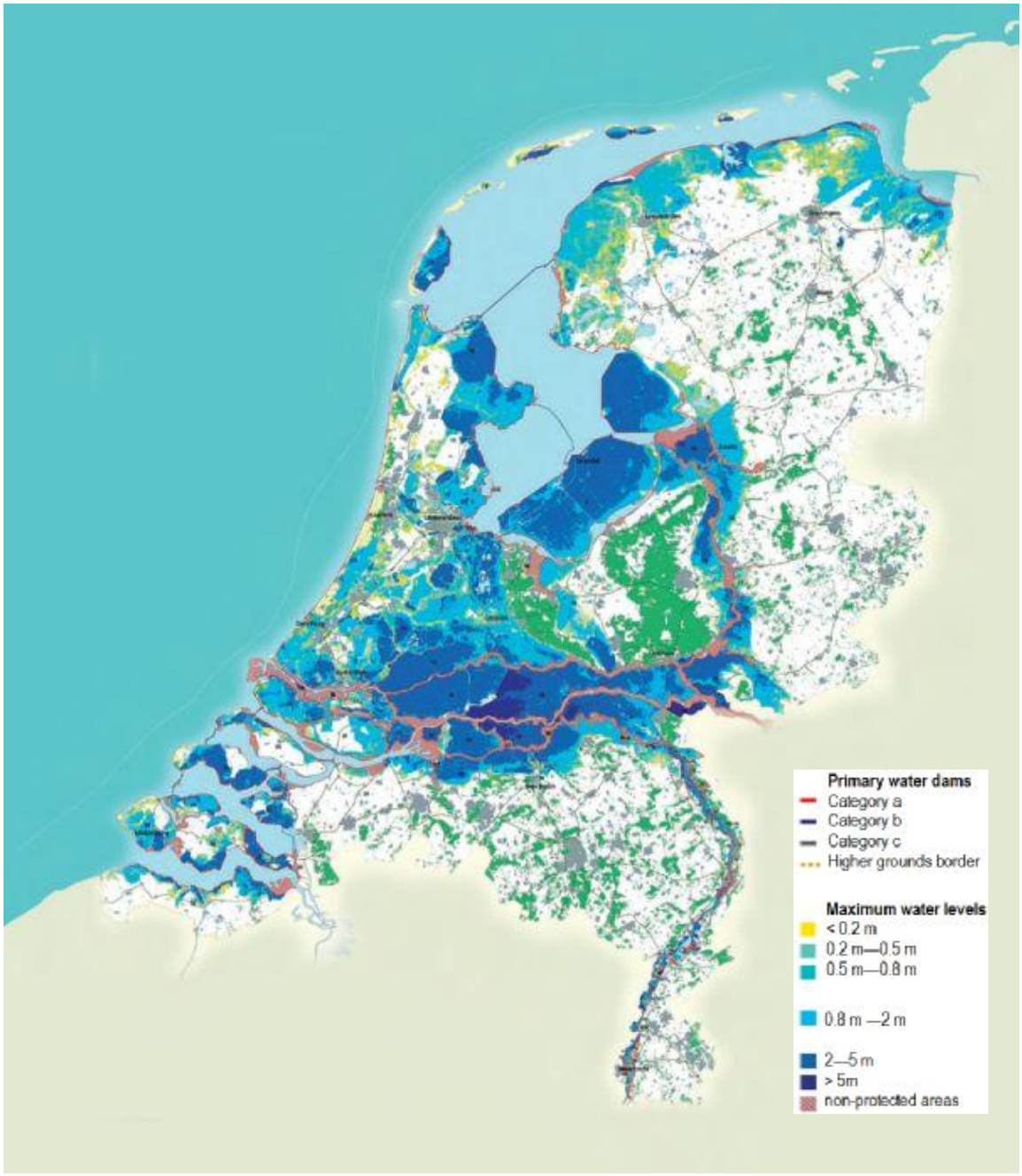
For ages, sea floods and storm tides have been testing the durability of these inventive Dutch water works. When dykes proved to be weak, towns drowned and the loss of lives and livestock was substantial. The 1421 Saint Elizabeth's Flood burst through the chain of dunes protecting the lower parts of Holland. Repairs were destroyed by a next Saint Elizabeth's Flood in 1424. The Saint Maarten's Flood in 1686 swept away the dykes in the north leaving the whole province of Groningen flooded. In 1855, the Rhine River burst through its dykes due to drifting ice. The 1906 flooding led to the construction of concrete tops on the dykes of Zeeland. However, these adjustments proved to be inadequate during the next flooding in 1953.

In 1953, dykes in the south-western parts of the country were not able to resist the combination of spring tide and a north-westerly storm. In this North Sea flood (in Dutch: Watersnoodramp) over 1,800 people died, comparable to Katrina's death toll in New Orleans in 2005. It urged the national government to act. The Delta Commission was installed to advice on measures preventing future floods. In the following decades a heavy set of coastal works was carried out to prevent the threat from the sea for once and for all. In 1997, the project was

finalised with the completion of the Maeslantkering, a storm surge barrier in the Nieuwe Waterweg which is the main entrance to the Port of Rotterdam.

The most recent water related disasters occurred in 1993 and 1995, when extremely high river discharges in the Meuse and Rhine river tested the durability of the dykes in the south and central parts of the country. In both years, the river dykes proved to be stable in the end. During the 1995 'near-flooding' event, the largest post-war evacuation took place: 250,000 people (and all livestock) were forced to evacuate.

Figure 1 *National Flooding Map*



Source: Ministry of V&W 2009a: 67

At the social-administrative level, the water challenge has also led to new forms of social cooperation at an early stage. Already in the middle ages, local communities were involved in local water management cooperation, and by the 13th century these communities developed into the forerunners of today's water boards (in Dutch: waterschappen). The 21st century water boards still prevent the Dutch from getting wet feet by maintaining waterways and dykes, and they also distribute water and take care of the purification of waste water. Besides the water board system, national water management became accommodated at the national water agency *Rijkswaterstaat* in 1798. Today, *Rijkswaterstaat* is the executive agency of the Ministry of Transport, Public Works and Water Management (Ministrie van V&W). The agency's water management tasks are similar to the water boards, but involve only national waterways, such as the large rivers, and coastal defence.

At the political level, recently some major shifts occurred in water management. The centuries-old notion of 'fighting' the water turned into a more sustainable vision of 'living with water'. Several national policy plans in the Netherlands already brought this vision in practice in large scale engineering projects and in public campaigns. Below we sum up the most significant policy developments in the last decade.

Firstly, the *Commission on Water Management 21st Century* (in Dutch: Commissie Waterbeheer 21e eeuw or Commissie Tielrooij) advised the government in 2000 on new approaches to water policies. The advice was generally adopted by the government and is now being implemented. The new water policy includes the idea of anticipating instead of reacting, to provide space for water and to preserve water instead of discharging it as soon as possible.

Secondly, the new water vision is implemented in the national programme *Room for the River* (in Dutch: Ruimte voor de Rivier), which provides rivers with more space to flow. It consists of many local projects on dyke improvement, dyke relocation and the removal of obstacles along the IJssel, Rhine and Meuse, the larger rivers in the country. In 2008, the public was informed on the new vision in the campaign 'The Netherlands live with Water' through activities and the media.

Thirdly, in 2008 a new *Delta Commission* (in Dutch: Deltacommissie or Commissie Veerman) advised the national government on how to be 'climate proof' in the coming century. The focus was on the safety of dykes, the allocation of new residential areas, the protection of weak areas (the North Sea and Wadden coast and river flooding areas) and to improve the administrative and financial organisation. The commission concluded that urgency is high as the country is behind in keeping up to current standards. The main outcomes should to be included into a new Delta law (Deltacommisie 2008: 12-13).

This Delta Commission's advice is now being elaborated in a *National Water Plan*. This plan outlines the national policy on water affairs. Important are the new policies on water safety, the Ijsselmeer area and the North Sea area. The National Water Plan is composed by the three concerned ministries as well as the associations of the different lower-level governments, which are the provinces, water boards and municipalities. After its implementation, it shall be updated every six years. The implementation of this far-reaching plan is dependent on many parties from government, business and science (Ministrie van V&W 2009a).

1.3 Research Design

After this general outline on climate change terminology and the special relationship of the Dutch with water, we will now explain our research approach. The research has a Dutch context. The Dutch delta is expected to be affected in a particular way by the new climate conditions as the

location below sea level in combination with large river estuaries make the country extra vulnerable for extreme weather events and flooding (see Figure 1 and Section 2.2). The country is thus an interesting area for institutional reactions to climate change as we can expect a high sense of urgency and thus a high level of action.

One of the aims of the project was to investigate the level of local governmental preparedness for climate change impacts. A major aim was to explore the actual role of specific local governments in relation to current and future adaptation to climate change impacts. Research Question 1 was thus formulated as follows: *What is the current and projected role for local government within a multilevel governance model for climate adaptation*? Further, with an eye towards future adaptation initiatives, Research Question 2 focuses on the capacity at the local level: *How far does institutional capacity influence the possibilities and limitations for developing local adaptation strategies, and how can this capacity be expanded*?

The research design rests on the clear premise that impacts from natural, weather-related events (in the present case: flooding) are not new. What is at issue now is the specific 'increment' of future impacts that are specifically attributable to climate change. We thus focus on relating past experience with severe flooding impacts to future probabilities of climate change related impacts. In our case, these 'severe' floods have been recorded in the International Disasters Emergency Database of the Centre for Research on the Epidemiology of Disasters (www.emdat.be). The approach leads to the conceptual fourfold scheme presented in Table 1.

Table 1 *Analytic Framework on the Role of Local Government in Relation to Experience and Perceived Risk*

		History of exposure to a specific type of extreme weather event	
		No	Yes
Projected risk of negative climate change impact	Low	Spectators	Veterans in reserve
	High	Recruits at the front	Veterans at the front

For ease of communication and analysis, the logic of the scheme is synthesized in terms of four 'ideal types'. At one end of the continuum, *'Spectators'*, are seen as cases that have no serious history of exposure to flooding events and a relatively low probability for climate change impacts in the future. At the opposite end, *'Veterans at the front'* are seen as cases that have both a history of exposure to flooding events; and a relatively high probability of climate change impacts in the future. In between these two types, we have *'Veterans in reserve'* (with an earlier history of flooding impacts, but low probability of impacts from climate change); and *'Recruits at the front'* (with no significant history of exposure to flooding events, but high probability of future impacts of climate change).

To increase the scope of the analysis, we have further differentiated the four types to 'rural' and 'urban' characteristics. This generates a grid of eight possible conceptual categories, based on three criteria. The *rural-urban* dimension was largely operationalised according to size of population. The *history of exposure* dimension was operationalised in relation to the 1953 North Sea Flood and the 1993/1995 high waters (see Section 1.2), events that could be assumed as 'settled' in the institutional memory of the relevant cases. The *projected risk* dimension was

operationalised in relation to a 'regional risk map' for climate-related flooding (see reference at Footnote 2).

Case Selection

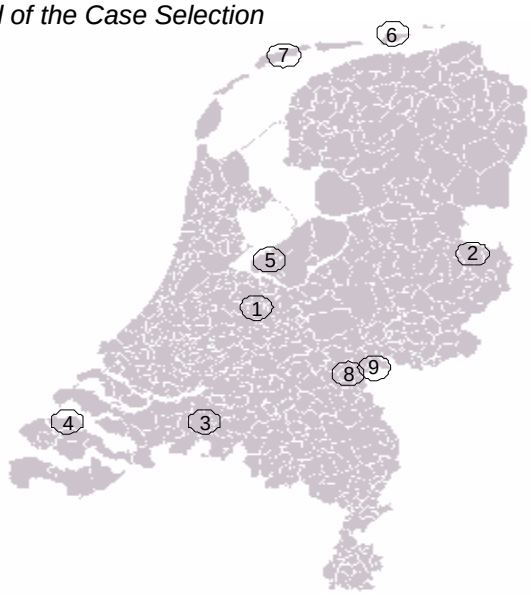
Potential cases could be any municipality in the Netherlands. Though urban and rural cases may face the same primary climate change effects (extreme weather events and flooding), secondary effects differ due to differences in social, economical and physical character. Cities face difficulties in the heat island effect and discharging increased precipitation due to their paved character, whereas rural areas have to cope with agricultural effects such as droughts and salt intrusion. By comparing both, we hope to gain insights in the civil preparedness for climate change impacts on the Netherlands as a whole.

A preliminary scoping of relevant municipalities with respect to the three dimensions (risk, experience and size) was conducted, resulting in the selection of specific cases as indicated in Figure 2. In the 'Recruits at the front' category, two rural cases have been studied (Schiermonnikoog and Terschelling). The urban cases are selected from the top15 Dutch municipalities with the greatest population. Further selection was based on municipal disaster plans in which the municipality states its risk perception. In case of the *Urban Spectator*, the disaster plan specifically mentions the non-vulnerability of the municipality to climate change effects. The rural selection is based on general-known areas being either at risk or having experienced extreme weather or are characterised by both. From the least populated municipalities we again further selected on the local disaster plan. The extreme weather event experience is based on events recorded in the International Disaster Database EM-DAT.

In a case profile we have determined how the local preparedness for climate change impacts is organised for the different cases. This is completed with semi-structured interviews with an open-ended questionnaire. We interviewed civil servants from various departments, depending on where adaptation is embedded (mostly the Environment Department); this effected in 16 interviews in total. We have arranged the interviews in general in May and June 2009. An overview of the interviewees is attached as Appendix II. The interviews, based on the semi-structured questionnaire in Appendix III, have been recorded in Dutch.

Figure 2 *Case Characteristics and Geographical Spread of the Case Selection*

Case	*Increased risk*	*Flooding experience*	*Character*
1. Utrecht			Urban
2. Tubbergen			Rural
3. Breda		X	Urban
4. Noord-Beveland		X	Rural
5. Almere	X		Urban
6. Schiermonnikoog	X		Rural
7. Terschelling	X		Rural
8. Nijmegen	X	X	Urban
9. Millingen aan de Rijn	X	X	Rural

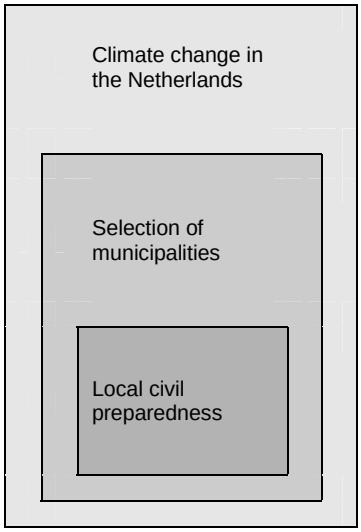


Field Procedures

To carry out our case studies, we used the *embedded multiple case design* from Yin (2003). As shown in Table 2, we used three levels of analysis. The context is investigated to offer a framework offered by a state of the art overview of national preparedness for climate change impacts. The framework will be completed with a study of cases consisting of a case profile on the municipality including a separate analysis of the local civil preparedness for climate change. We analyse the field of preparedness as a whole by investigating concerned policy plans. These profiles are completed with an interview round that enables us to determine how the local governmental level is preparing for climate change.

Table 2 *Analysis Levels to Study Local Civil Preparedness for Climate Change Impacts*

Context	Climate change in the Netherlands	The *context* is climate change affecting the Netherlands and how the national government respond
Case	Selection of municipalities	The *case* is a municipality with a certain degree of (projected) risk and extreme weather event/flooding experience
Unit of analysis	Local civil preparedness	The *unit of analysis* is the municipal department that prepares for local climate adaptation. In general, this is the environmental or spatial planning department

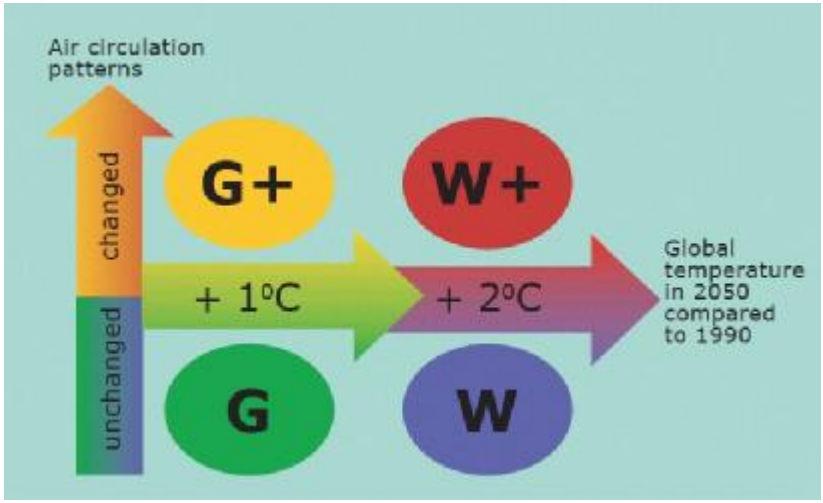


2 CLIMATE CHANGE AND ADAPTATION STRATEGIES IN THE NETHERLANDS

2.1 Climate Change Effects on the Netherlands

The leading Dutch climate change scenarios for 2050 – considered as the national standard to address adaptation questions – are formulated by the Royal Netherlands Meteorological Institute (in Dutch: KNMI). The scenarios are visualised in Figure 3. They show variations in expectations on temperature rise (1°C or 2°C rise) and wind patterns (changed or unchanged). According to the *KNMI*, we can expect the following primary climate change effects (KNMI 2006): sea level rise, increased average temperatures, more summer droughts, a greater number of heat waves, increased winter precipitation and greater overall levels of precipitation. Secondary effects result from these primary effects; an example is higher river discharges due to increased snow and ice melt in the Alps caused by a rising temperature.

Figure 3 *KNMI06 scenarios for climate change in the Netherlands by 2050 compared to 1990*



Source: KNMI 2010

The KNMI06 scenarios are at the base of the strategies that are proposed in the ARK Programme (National Adaptation Strategy from 2007, see Section 1.1). This programme qualifies excess water as the major negative effect of climate change caused by sea level rise, higher river discharges en periods of heavy precipitation in the river areas and low coastal area. This excess water causes an increased flooding risk, which makes the Netherlands one of the most vulnerable areas in Europe (Ministrie van VROM 2007). Climate change will thus once again challenge the Dutch in keeping out the water, since the traditional dykes and river embankments are not designed to withstand sea level rise or structural higher water levels. The negative climate change effects are increased by descending soils in the western and northern areas –the lowest parts already- due to peat settling and oil, gas and salt extraction respectively (Ministrie van V&W 2009b).

2.2 Dutch Authorities Adapting to Climate Change

Adaptation to Climate Change at the National Level

After Katrina hit New Orleans in August 2005, the Dutch government realised that it also was not prepared for a large-scale flooding (Taskforce Management Overstromingen 2009: 15). By the

end of 2006, the Dutch government installed the Flooding Management Taskforce, a special taskforce to prepare the administrative levels for the consequences of flooding (in Dutch: Taskforce Management Overstromingen, TMO). *TMO*s main activities consisted of networking, connecting knowledge sources and raising awareness amongst politicians and administrators. *TMO* focussed on the organisation of emergency services, public information services and the preparedness of relief workers. In 2008, it organised an international exercise week with the simulation of a super storm. In February 2009, *TMO* wound up its activities leaving behind regional flooding plans, arrangements on risk and crisis communication and a national expert group on flooding risks.

Flooding risk is considered as the major physical threat from climate change. The government categorizes this risk as 'low probability, high impact'. The six regional Worst Case Flood Scenarios (designed by *TMO*) are qualified by experts to be realistic but with a small probability of occurrence. Because of the large impact of flooding risk, preventive measures are of major concern. These are detailed in the National Water Plan. The need to take additional measures based on the Worst Case Scenarios are considered to be a political question (for example: in the first eight hours of flooding of the western coastal area Randstad 1,8 million people will be affected of whom 10,300 people die; Ministrie van BZK 2008).

Recently, the Ministry of the Interior and Kingdom Relations (Ministrie van BZK) and the Ministry of V&W have started the campaign 'Think Forward' (in Dutch: Denk Vooruit) urging citizens to acquire an emergency package and to store food in the preparation of a possible disasters, such as flooding. The campaign explains that in case of a disaster the government cannot help all in need. The two ministries have also launched the Risk Map (Risicokaart, see reference at Footnote 2). On this interactive map, potential risks are visualised, varying from chemical depots to flooding and from traffic accidents to forest fires. The *Ministrie van BZK* is responsible for the Risk Map, yet each of the 12 provinces is in charge of updating its own map.

The ARK Programme, running until 2014, is a cooperation of all government levels: four concerned ministries and the lower bodies represented as associations of provinces, water boards and municipalities. The first deliverable was the National Adaptation Strategy in 2008, providing an overview of adaptation measures to be taken. The ARK Programme aims at adapting spatial planning in the Netherlands to the KNMI06 scenarios (see Section 2.2). On the long term, adaptation is to be anchored in awareness, policy and rules. From 2015 onwards, climate adaptation must be considered in all spatial planning processes –this is also one of the considerations in the climate agreement between the national government and the 12 provinces (Klimaatakkoord Gemeenten en Rijk 2009: 2). Adaptation possibilities are sees in various sectors, such as water, spatial planning, energy supplies, transport and ecosystems.

The ARK Programme closely connected to the scientific research programme Knowledge for Climate (in Dutch: Kennis voor Klimaat). Like its predecessor Climate Changes Spatial Planning, also the Knowledge for Climate programme unites climate change researchers and practitioners to prepare the Netherlands for climate change effects. It aims at generating practical knowledge to 'climate proofing' the Netherlands on time and at the lowest costs. From the perspective of thematic hotspots, adaptation strategies are developed in eight areas, all with a multi-stakeholder and participative focus. The related Living with Water (in Dutch: Leven met Water) focuses on water and spatial planning, varying from research on water in urban areas to innovative building with water and the deepening the knowledge base. Next to this, Habiforum brings knowledge in practice by developing new forms of sustainable spatial planning.

Next to stimulating scientific and practical research, the national government also draws in lower-level authorities to cooperate in the climate change challenge. Several agreements have been signed between the various governments to collectively reach the national climate policy targets. These agreements mostly consist of mitigation measures with adaptation as an additional element. The involved authorities and the goals are shown in Table 3.

Table 3 *Climate Policy Agreements in the Netherlands*

Name of the Agreement	***Authorities involved***	***Adaptation goals***
Updated National Administrative Agreement on Water (in Dutch: Nationaal Bestuursakkoord Water Actueel 2008)	National, provinces, municipalities, and water boards *Runs from 2008*	- Preparing the Dutch water management and anticipate on climate change bringing more extreme wet and extreme dry periods to the Netherlands; areas with potential flooding must be dealt with - All make an effort to decrease water shortage vulnerability; - Water users will be informed in periods of droughts
National Provincial Climate Agreement (in Dutch: Klimaat-Energieakkoord tussen Rijk en provincies 2009)	National and provinces *Runs 2009 - 2011*	- Development of a climate change assessment for large scale spatial projects - Provinces screen plans and rules for the need to adapt to climate change; consider climate adaptation in current spatial development projects; explore the economic opportunities climate change brings
Climate Agreement State and Municipalities (in Dutch: Klimaatakkoord Gemeenten en Rijk 2007)	National and municipalities *Runs 2007 - 2011*	- Both map the measures for climate adaptation. Effects must fit in with spatial and urban development plans, water management, and health care in the municipality

Furthermore, an important national government's tool to prepare the Netherlands for climate change effects is the Water Assessment (in Dutch: Watertoets). This assessment is now an obligatory part of the spatial planning process. It assures the involvement of the water managing authority (mostly the water board) from the start-up to guarantee the integration of water management interests in the spatial planning process in order to limit negative effects of climate change effects (Helpdesk Water 2009).

Adaption to Climate Change at the Regional Level

Concerning climate adaptation, the provincial level proves to be quite relevant as spatial planning is one of its main appointed tasks. Each province (the Netherlands consist of 12) designs regional planning that fits into the national spatial planning framework -local spatial plans need to fit into these regional plans. Water and environmental management are also significant province tasks. The province, for example, issues regulations, cares for air pollution reduction and stimulates environmentally friendly waste disposal.

The National Provincial Climate Agreement is funded on the allocation of provincial tasks and funds to participate in the national climate goals. As shown in Table 3, it is agreed that the provinces explore the possibilities to implement adaptation measures as well as the opportunities that are associated with a changing climate. The provincial board agreements also must show a clear ambition to contribute to climate adaptation. Furthermore, provinces are willing to encourage their stakeholders to take up climate and energy questions. They will also facilitate initiatives from the lower authorities (Klimaat-Energieakkoord tussen Rijk en provincies 2009; 2-4).

Some examples to illustrate the provincial activities in adaptation policies on climate change are the Zuidplaspolder in Zuid-Holland, the Groningen-Drenthe 'Climate Effect Sketchbook', and the Gelderland Climate Programme. Firstly, the Zuidplaspolder is appointed as one of the development areas of the urbanized Randstad. At six meters below sea level, it is also one of the deepest polders in the Dutch delta. Safe habitation is to be combined with adaptation to climate change effects. To prepare this, the province of Zuid-Holland established Xplorelab, an provincial experimental working method where provincial employees from different divisions and directorates cooperate on a pioneering and interdisciplinary base on spatial questions, process innovation and method development (Xlporelab 2009).

Secondly, as six other provinces have done, the provinces of Groningen and Drenthe have jointly developed a 'Climate Effect Sketchbook' (in Dutch: Klimaatschetsboek) which maps the effects of climate change at the regional level. It maps the effects of both primary and secondary climate change effects. It provides a factual base for the discussion on 'climate proofing' the regional environment (Alterra, DHV bv, KNMI & VU 2008: 7).

Thirdly, in its Climate Programme, the province of Gelderland outlines the route to become 'climate proof' by 2050. The programme consists of a policy framework and a yearly updated executive programme running several years. Also a 'Climate Expert Forum' is established that supports the province in gaining social support and providing inspiration and feedback. In the draft phase, many parties were drawn in: from housing agencies and environmental organisations to the business community and other governmental bodies. To guarantee commitment, the province will sign memoranda of understanding with its partners. (Provincie Gelderland 2008).

Due to the Water Assessment we discussed already, the water boards are now much more involved into local and regional spatial planning. The water boards are also participating in the National ARK Programme. In two policy papers the water boards explain their vision on climate adaptation. In 2007, the Association of Water Boards (in Dutch: Unie van Waterschappen, UvW) has drawn up a Climate Action Plan to contribute to the national climate goals. The plan aims at support for climate matters in the association, to frame input to the ARK Programme and to develop a long term strategy on regional water management. The work will mainly be at the policy level, for example to stimulate climate consciousness at the water boards; it does not include many physical adaptations (Unie van Waterschappen 2009)

The long term vision is reflected in the 2008 Climate Factsheet where the Association of Water Boards stresses the need to take urgent action on adapting to the changing climate by being more aware of the risks and opportunities a changing climate brings along. The factsheet continues to explain the water boards' position by emphasising their importance as a partner because of the broad knowledge of and experiences with water management. Physically, regional water systems will be prepared to tackle flooding and limit water shortages (Unie van Waterschappen 2008: 1). The effects of climate change bring the position of the water boards into public discussion. A majority of 'environmental-minded' Dutch think that water boards should be given far-reaching authorities to take care of climate change effects. For example, water boards should be allowed to inundate inhabited polders to protect the Dutch delta from rising waters (Milieufederatie Drenthe 2009).

Adaptation to Climate Change at the Local Level

At the local level, municipalities have committed to the national climate goals in signing the 'Climate Agreement State and Municipalities' as shown in Table 3. In this agreement, it is settled that both survey climate adaptation measures that fit into their existing policies. Furthermore, only cooperation in the ARK Programme and the Knowledge for Climate programmes is mentioned as concrete adaptation activities. The agreement stresses the importance to act on climate change effects by adapting current policies on spatial planning, water management and health care. Negative climate change effects, such as extreme drought and higher temperatures, should be tackled, whereas positive effects should be better exploited (Klimaatakkoord Gemeenten en Rijk 2007: 2).

The national-local agreement considers that of all government layers, the local level has the closest connection to citizens and businesses and for that reason it can best set an example. Furthermore, the local authorities are capable of gathering people to organise effective actions and acting as a stimulator by setting climate change on the local agenda. Municipalities will be supported by the national government and they will be given time and space to concentrate on reaching the national climate ambitions.

To illustrate local level adaptation initiatives, we present two frontrunner municipalities on this: Tilburg and Rotterdam. With a population of 200,000 inhabitants, Tilburg is the sixth largest municipality in the Netherlands. The city lies on elevated sandy grounds in the southern part of the country. Due to its location, the city is not threatened by river or sea floods, but other impacts are expected: sewer and waterways overloads and health problems among vulnerable groups (Kwadijk, Klijn & Van Drunen 2007: 29). This makes Tilburg exemplarily for large parts of the country. The city was one of the Climate Changes Spatial Planning hotspots. The Tilburg hotspot project aims at developing a methodology on coping with climate change, which is also to be used in similar regions and municipalities (Klimaat voor Ruimte 2009). The Tilburg hotspot also included the renewal of the city's climate programme. The new programme consists of 38 projects on both mitigation and adaptation. Furthermore, local parties are called up sign a Climate Agreement. In 2009, 33 companies and organisations did this (Gemeente Tilburg 2009).

Rotterdam is the second city of the country with a population over 500,000. Rotterdam and its suburbs make up the most highly urbanized parts of the country. The Port of Rotterdam, one of the largest in the world, is of major importance to the country. The city lies approximately two meters below mean sea level and the Nieuwe Waterweg, an artificial estuary of the Meuse which is the main entrance to the harbour, brings the city in direct contact with the North Sea. In the coming decade, huge investments are planned for urban planning in the former harbour areas as well as for further developing the current harbour. These low-lying areas are also the most vulnerable to flooding from sea and river discharges and changing water levels.

To link 'climate proofing' to the urban development plans, Rotterdam has launched its adaptation programme Rotterdam Climate Proof. Rotterdam Climate Proof is part of the Rotterdam Climate Initiative that aims at a safe, economically strong and attractive city and harbour. By developing expertise and applying innovative water concepts, such as floating houses, Rotterdam wants to present itself worldwide as an example of a 'climate proof' delta city. The main themes are: water safety, accessibility, adaptive building, urban water management and urban environment. For each theme, objectives and set of measures are defined. The Rotterdam Climate Initiative is an initiative by the Port of Rotterdam Authority, the Rotterdam municipality, business organisation Deltalinqs en DCMR Environmental Protection Agency. The Rotterdam Climate Initiative offers a platform for cooperation on climate change by government,

organisations, companies, knowledge institutes and civilians (Rotterdam Climate Initiative 2009). The city also is a Knowledge for Climate hotspot because of its economical value and vulnerable location. Special attention will be paid to safety, water transport and urban planning (Kennis voor Klimaat 2009).

2.3 Nongovernmental Organisations Adapting to Climate Change

At the level of nongovernmental organisations on environmental protection, adaptation is gradually being included. We illustrate this by presenting three examples of NGO activities on climate change adaptation (we do not intend to give a representative picture). Firstly, with the construction of 'Climate Buffers', seven environmental protection organisations have started this project as a precursor of the national Delta Programme. 'Climate Buffers' are wildlife areas that react to climate change in a natural way by acting as a sponge: they can catch, store and discharge water. Some buffers are already functioning, others are being developed. As more buffers should be created, others are called on to join, especially partners in business and agriculture. Secondly, the HERE campaign (in Dutch: HIER) urges to pay more attention to adaptation and to exchange experience and knowledge with scientific institutes, business and the government in order to make the Dutch population more aware of the fact that climate change is happening now and not just only in the future. Thirdly, in its manifesto on climate change, Friends of the Earth Netherlands (in Dutch: Milieudefensie) stresses the need to adapt to climate change. Nature should be given more space as natural processes can help us in getting a 'climate proof' country (Milieudefensie 2007). In 2008, a public campaign by *Milieudefensie* resulted in the collection of 75,000 signatures for a Climate Law, which should offer legal grounds for mitigation and adaptation.

2.4 Local Involvement in Climate Adaptation in the Netherlands

We conclude this chapter by defining the potential of policy involvement at the local level. In spite of the fact that climate change involves many climatic and meteorological effects, also the local authorities in the country commonly 'translate' the impacts into increasing precipitation quantities and an increasing frequency of heat waves. Therefore, the policy domains involved in climate change adaptation strategies are the spatial planning and environmental departments. Concerning local water management, municipalities can rely on the regional water board system, which has the task to prevent local and regional flooding and to manage groundwater levels.

Earlier research (Van Ierland et al. 2007) has resulted in the identification of 96 adaptation options throughout the country and at the various governmental levels. The full list is added as Appendix IV. In this list, the various options are ranked based on a score that combines importance, urgency, no regret, additional effects and the possibilities for climate change mitigation –thus resulting in options at the top of the list to have the highest priority. As we are primarily interested in the local level, we focus on the extra column added to the table in Appendix IV that marks the options that are relevant for the local level of implementation. This resulted in the following overview of adaptation options for local implementation, to which we have added the concerned local policy domain (Table 4).

Table 4 *Local Implementation Adaptation Options*

Local Implementation Adaptation Options	***Local Domain***

Local Implementation Adaptation Options	*Local Domain*
Make existing and new cities robust –avoid 'heat islands', provide for sufficient cooling capacity	Urban planning/ Public Space
Design spatial planning – construct new housing and infrastructure	Spatial planning
Construct buildings differently in such a way that there is less need for air-conditioning/ heating	Spatial planning
Design houses with good climate conditions (control) – 'low energy'	Spatial planning
Water management systems: revision of sewer system	Water management
Increase standards for buildings as to make them more robust to increased wind speeds	Spatial planning
Spatial planning of locations for power plants (nuclear in particular)	Spatial planning
Relocation of fresh water intake points	Water management
Water management systems: emergency systems revision for tunnels and subways	Water management
Improved air conditioning in nursery homes or hospitals	Public Health
Water management systems: options for water storage and retention in or near city areas	Water management
Adapted forms of building and construction	Spatial/urban planning
Enhancing capacity of sluices and weirs	Water management
Water management and agriculture	Water management
Sluices	Water management
Land use change	Spatial planning/ economics
Water storage on farmland	Water management
Adjusting crop rotation schemes and planting and harvesting dates	Non-governmental
Reduction salt water tongue	Water management
Reconnecting water systems in Delta area (e.g. Volkerak Zoommeer and Oosterschelde)	Water management
Moving power plants to coast (cooling water)	Spatial planning/ economics
Development and growing of crops for biomass production	Non-governmental
De-salinisation	Water management
Aquaculture on former grassland	Non-governmental

Source: Left column from Van Ierland et al. 2007; Right column is own interpretation

Table 4 thus confirms the large involvement of spatial planning and water management to the implementation of local adaptation options, but is does not cover the full spectrum of a municipal working field. A broader local institutional involvement could also include: disaster management, public health, economic affairs including recreation, economic strategic planning (such as climate change impact assessments on local industries) and institutional adaptation. The potential for climate change adaptation is has a broader scope. This is shown in Table 5.

Table 5 *Potential for Local Climate Adaptation*

Climate-induced Impact	*Environ-ment*	*Public space*	*Water*	*Spatial planning*	*Econo-mics*	*Public health*	*Disaster manage-ment*
Sea level rise			X	X	X		X
Increased average temperatures	X				X	X	
More summer droughts			X	X	X		
A greater number of heat waves	X	X	X	X	X	X	
Increased winter precipitation			X	X			
Greater overall levels of precipitation			X	X			

The involvement of the seven policy domains can be explained as follows:

- Environment as the initiator of the local adaptation strategy
- Public space includes adjustments of plazas and parks to heat and/or water storage
- Water includes adjustments for water storage, smart discharge and the catchment of droughts (see Table 4)
- Spatial planning includes the adaptation of new housing development areas to heat and/or water storage (see Table 4)
- Economics includes for example plans for recreation in the new climate and rural areas (see Table 4)
- Public health includes the public care for vulnerable groups in case of a heat wave
- Disaster management includes the (usage of climate change scenarios in) preparations for a higher risk for flooding

This framework is used in Section 3.4 to analyse the level of institutional involvement in the cases we have studied. More explanation of the various policy domains is provided in Sections 3.4 and 3.5.

3 INVENTORY OF DUTCH MUNICIPALITIES ADAPTING TO CLIMATE CHANGE

3.1 Municipalities and Climate Policy

Before discussing local climate adaptation in a Dutch context, we briefly outline the role of local authorities in Dutch climate policy. In the Netherlands, environmental policy has its roots in local policy. Until the 1970s, the local level was mainly responsible for environmental policy making and implementation. At the end of the 1960s, more and more local environmental tasks shifted towards the national level due to the complexity and importance of environmental issues. In the 1980s and 1990s, the national level targeted at improving the domain of local environmental policy as the national government still considered local environmental policy as a municipal task financed by central funding. A long discussion on who should pay what in local environmental policy was only solved by research showing that municipalities had a severe deficit in funding the extension of environmental tasks in the seventies; from the nineties onward local authorities receive earmarked funding to bring their environmental policy to an adequate level (Coenen 2001). Today, local authorities consider climate policy as part of environmental policy.[3]

On the contributions of Dutch municipalities to climate change, the Dutch branch of Friends of the Earth *Milieudefensie* argues that Dutch municipalities are 'co-responsible' for climate change, as they produce 1.5 Megaton of CO2 emissions. The NGO also sums up why municipalities should participate in climate mitigation policy (but not a word is said about adaptation; Milieudefensie 2010):

- Municipalities are directly confronted with climate change impacts
- The national government aims at 13 Megaton fewer emissions in the Netherlands. Municipalities can contribute to this by using green energy which saves 0.9 Megaton of emissions.
- Municipalities can show citizens that it is possible to use less and cleaner energy without giving up quality or comfort. Municipalities would also stimulate the market for climate-friendly products.
- The efforts of municipalities are necessary to reach the 2010 ambition of 9% sustainable energy generating. The municipality has an essential role in this, as it makes policy, assesses and grants permits.

Whilst *Milieudefensie* does not encourage municipalities to take climate change adaptation measures, the national government does so in the Climate Agreement in which is agreed that the municipalities join the national government to join in realising the national climate ambitions (Section 2.2). In practice, however, mitigation is closely associated with saving energy and thus money (see Section 4.3 and Table 11), while adaptation can involve additional spending without direct gains.

3.2 Legal and Financial Constraints for Local Climate Adaptation

The local government in the Netherlands is based on the Municipal Act (1851; in Dutch: Gemeentewet) that prescribes some environmental tasks, such as an annual Environmental Policy Plan, but it does not deal with climate related issues. The Disaster Act (1985; in Dutch: Wet op rampen en zware ongevallen) prescribes the municipal tasks involved with disasters and

[3] VNG, the Association of Dutch Municipalities, defines 'climate' is as one of the components of the environmental policy domain on its website: www.vng.nl (assessed October 21 2009 – in Dutch); this also counts for the Ministry of VROM: www.vrom.nl/pagina.html?id=4178 (accessed February 24 2009 – in Dutch).

heavy accidents, and it only deals with the possibility of 'regular' extreme events such as flooding or extreme weather events. More latent developments, such as an increasing average temperature, are not covered. Further, the most important law on the environment, the Environmental Conservation Act (1993; in Dutch: Wet Milieubeheer), does not deal with climatic issues at all. Besides this legal deficit, the existing legislation is also considered to be insufficient as it proves not to be flexible enough to deal with a changing climate (Verschuuren 2007).

Several interviewees stressed a lack of instruments available to enforce adaptation measures within their communities. They state that the municipality is unable to implement its adaptation strategies sufficiently, for example that the municipality cannot oblige real estate developers to build 'climate proof' houses. This also has internal effects: local administrators first focus on the tasks that are obliged by higher level authorities. Local voluntary activities such as climate-adaptation policy have low priority and funding is minimal.

There are also constraints on funding. Compared to other EU member states, the Dutch local government is largely dependent on the national government for its finances. No less than 68 percent of all income of the lower governments is coming from the national government. About half this central funding is earmarked funding; the other half originates from the Municipal Fund, upon which budgets are distributed based on criteria such as the number of participants. Another nine percent of the lower governments' income is originating from its own taxes; this is the lowest percentage in the EU, except for Malta that hardly has a local governmental layer (CBS 2008). The many earmarked funds leave little room for voluntary tasks, such as climate-adaptation policy. Budgetary constraints thus pose limits on what can be attempted in the way of climate change adaptation.

3.3 Case Descriptions

This section describes the adaptation strategies at the nine case studies we have carried out in 2009. Appendix V contains an additional overview of the case profiles we have prepared before conducting interviews. In Table 6, the key figures of the nine cases are presented (in addition, Table 2 shows the cases' characteristics on risk, experience and size).

Table 6 *Key Figures of Case Selection*

Case	*Inhabitants*	*Land area*	*Capacity*
Utrecht	300,000	95 km2	1,600 staff
Tubbergen	21,000	147 km2	160 staff
Breda	170,000	127 km2	2,200 staff
Noord-Beveland	7,500	86 km2	60-70 staff
Almere	186,000	130 km2	1,600 staff
Schiermonnikoog	944	41 km2	20 staff
Terschelling	5,000	87 km2	80 staff
Nijmegen	160,000	54 km2	2,000 staff
Millingen a/d Rijn	5,000	9 km2	36 staff

Case 1: Utrecht

The fourth city of the country Utrecht is one of the oldest cities of the country. Centrally situated on railroad, road and waterway junctions, the city has become the major city in conferences and

fairs and now is the fastest growing economical centre in the country. Utrecht was founded on the Rhine river bank, yet today's remaining Rhine runs through the city as a small canal. Its surroundings are below mean sea level, yet most parts of the city are located on higher grounds, which limit risk of flooding.

Utrecht does not have an adaptation policy yet, but a broad approach is present in their adaptation plan that covers water nuisance, heat wave and flooding in the pilot area Rijnenburg. In this new residential district adaptation measurements are applied by the involved policy fields of urban planning, public space, water management and health; yet the matter of adaptation is considered to be still in its infancy in Utrecht. The typical Utrecht modest character can explain why the fourth city of the country is not as active in climate adaptation like Rotterdam. No sense of urgency is present in Utrecht, but practical experiences can speed up the development of climate adaptation measures. Remarkably, Utrecht has a coordinator on adaptation policy, an indicator that reflects a front running position in climate adaptation, despite the fact that the city does not face increased risk or has had climate-related experience. The activism of Utrecht can probably be explained from local conditions, such as a 'green-minded' City Board (which aimed at a broad and environmental-friendly Environmental Policy Plan), the presence of climate research institutes in the city, close cooperation with the province that has an active climate policy and plans for new residential districts on less favourable, flood prone areas.

Case 2: Tubbergen

On the border to Germany lies the municipality of Tubbergen, including nine villages and three hamlets. The village of Tubbergen counts most of the inhabitants and is the geographical and administrative centre of the municipality. Traditionally, the municipality of Tubbergen has an agricultural character. However, today the agricultural sector is more and more subjected to pressure and the Tubbergen farmers are heading for additional forms of income. One example is tourism. Tubbergen is part of the National Landscape North-eastern Twente (in Dutch: Nationaal Landschap Noordoost-Twente), a status that stresses the special natural and cultural historical landscape of this part of the Twente region. A National Landscape receives additional funding to conserve the landscape and to develop its local economy.

Tubbergen climate policy, which includes mitigation, is the responsibility of the Environment Department. Remarkably, adaptation is separated from this climate programme as it is the responsibility of the civil servants on sewage and water management –a department that experiences an increasing work load. In Tubbergen, climate adaptation is considered to as increasing precipitation in frequency and size, of which Tubbergen has experienced some already over the past years. Drought or heat is not considered to cause problems (in the 2006 heat wave no complaints were recorded), also because the water board is responsible for the groundwater levels in the rural areas. Political support is potentially present, but the matter is not considered to be urgent at the civil servants' level, explaining the lack of action. The pressure caused by the national governance is not shared in Tubbergen, which the respondent explains by the lack of sea or large river proximity.

Case 3: Breda

Breda was founded as a fortress on higher sandy grounds. The city has always been a military base. Lying south to the rivers Rhine and Meuse, Breda is part of the catholic part of the Netherlands. The municipality is located on a junction of the rivers Aa and Mark. For centuries, the latter was in direct contact to the sea, bringing tide to the city. In those days, flooding was not

unusual, as the Mark river valley was narrow and steep. Later, the Mark was diverted outside the city to be brought back only last year. In its disaster plan, the municipality mentions having solved flooding of the Mark now permanently due to improved sluices and basins but it does not consider any climate change effects. The development of an adaptation strategy is part of the city's climate programme 2009-2012. To implement this, expected shortages in institutional capacity are foreseen.

Breda has an ambitious climate policy programme for 2009-2012, including two adaptation projects. Special to these two projects is their rather 'integral' (see Footnote 6) character including green spaces, water management, flora and fauna, agriculture, and also health. Breda aims at cooperation with the municipal health service GGD and the water board as well as with the farmers' organisation LTO and the housing corporations. The national level is expected to improve its coordination, to deliver a national vision in adaptation and to provide tools for the local level. The implementation of the adaptation in Breda is expected to take time. After convincing colleagues for the necessity to take mitigation actions, it is now the turn to adaptation; an important part of the adaptation projects therefore is a 'conscious rising campaign', but extra funding and staff is needed to implement this. The civil servants at the Environmental Department are responsible for adaptation policies.

The drive for adaptation in Breda cannot be explained from past experience or increased risk, but from an institutional context of a Green Party[4] local administrator (aldermen), a green minded and proactive civil service which value climate adaptation as an opportunity to develop the city. All is being stimulated by a proactive province and the urban network B5, enabling the Brabant cities to jump into joint research and trail projects.

Case 4: Noord-Beveland

Noord-Beveland is located in the south-western part of the country on a former island at the shores of the Scheldt estuary and it is connected to the mainland by three dams and a bridge. The municipality consists of six villages and extensive rural areas, making it one of the least inhabited areas in the country with tourism and agriculture as its principal economical sectors.
Noord-Beveland's history is entwined with water. Due to the close proximity of open water, the island relies on water sports, but also flooded many times in the past. Most recently, the 1953 North Sea Flood flew over most of the island (see Section 1.2). As a part of the following Delta Plan, the surrounding waters of Noord-Beveland were closed from the sea with heavy coastal defence works (Oosterscheldekering 1986, Veerse Gatdam 1961). The island as a whole is defended by a primary dyke with a flooding chance of 1:4,000 (exceeding chance of one per 4,000 years). In 2008, sand was supplemented by Rijkswaterstaat to prevent coastal erosion from the sea and sea level rise. Due to the many floods, the island does not count many historical buildings except for the fifteenth-century church of Kortegene.

Tourism is an important source of income for the municipality, which by it has sufficient funds to carry out its duties and activities. Climate policy is translated into sustainable energy and sustainable housing. Noord-Beveland participates in the European project 'Building with CaRe' and will construct 60 passive (energy-neutral) houses, to which some adaptation elements are added (such as porous concrete on the road). The municipality is also considering energy generation from wind and biomass.

[4] The Dutch political spectrum varies from leftwing up till rightwing parties. In general, leftwing parties are progressive and more 'green minded' (environmentally minded) then right-wing, conservative parties. One of the Dutch leftwing parties is GroenLinks (in English: Green Left), the Dutch Green political party. The party is called Green Party throughout the report.

The people and municipality of Noord-Beveland are very aware of the threat of flooding, but feel protected by the dyke system. Furthermore, flooding protection is a water board's responsibility and not a municipality's. With the project Koppeling (to be translated as 'Connection') the water board is 'climate proofing' the Noord-Beveland island. For the municipality, climate change does not include new actions, also not in its tourism policy. Concerning disaster management, Noord-Beveland is badly prepared. While flooding risk for most of the parts of the Zeeland province is indicated as 'relevant', the capacity at the Zeeland municipalities is too limited to combat a large or long-lasting disaster.

At the political level, climate adaptation is an issue as the Municipal Board wants to host a new type of dyke (the 'Delta dyke'), particularly since the Delta Commission has indicated the Oosterschelde as a spill-over, and has futile requested national support as this is too expensive for the municipality. Water nuisance caused by heavy precipitation is not considered to be problematic as the villages can release in the rural parts.

Case 5: Almere

Almere is located on the artificial island of Flevoland which consists of polders in the Ijsselmeer Lake. In the 1930s, this lake was created by the closure of the Zuiderzee (the Ijssel estuary) with the Afsluitdijk Dam. From 1940 onwards, polders were created in the Ijsselmeer Lake. These islands were intended to have an agricultural character, but soon on cities were planned to accommodate the rapidly growing post-war population.

Almere is one of these cities with its first dwellings being occupied in 1976. Almere was designed as a multicentre city, but gradually all grew together. Today, Almere is the seventh municipality in the country and one of Europe's fastest growing cities. Initially, Almere was meant to be an overflow city of Amsterdam. The cities have close contacts resulting in heavy traffic flows in between: bridges and railroad services are now operating at full capacity, which is scheduled to be improved as part of the large-scale development plan *Schaalsprong Almere 2030*. This project includes the construction of 60,000 new houses doubling the population in a 20-year period, making Almere the fourth city of the country.

The original design of the city was based on the back then valid climate scenarios, which now have adjusted because of climate change. Like all municipalities in our study, also Almere is involved into the Water Assessment, the new water policy WB21 and the European Water Framework Directive. Water always played an important role in spatial planning as it is so richly present in Almere. Anticipating to extra precipitation happens 'naturally' because of legal obligations such as the Water Assessment. The municipality aims at the dimensions of sustainability and 'climate proofing' in the Schaalspong implementation.

In the Schaalsprong preparations**,** climate change is one of the scenarios that is being considered. It is considered to be of major relevance for spatial planning and water management. In the spatial development plans, next to an increase of precipitation also drought is considered. No attention is paid to heat as such, as the strong presence of water in and around the city will cool. A certain care for flooding risk is present, but no 'proactive' policy on this is implemented as a sense of urgency is not felt within the organisation.

Case 6: Schiermonnikoog

Schiermonnikoog is the smallest municipality of the country and its village is the most northern one of the country. Tourism constitutes most of the local economy. The 18 kilometres long island is known for its tranquillity and visitors are not allowed to bring their car. Most of the island is a

National Park. Schiermonnikoog received its name from one of the historical owners of the island, a Cistercian monastery in Friesland which reclaimed the Schiermonnikoog polder. From the 17th century up till 1945, the island was privately owned. Some rulers built dykes and planted grasses to prevent dune erosion. The Schiermonnikoog polder is protected by a dyke with a protection level of 1:2,000 (exceeding of the dyke is expected to occur once per 2,000 years).

Given its focus on nature and the fact that the island is gradually 'moving' eastwards because of sand transport, climate change adaptation is generally related to ecology. Already many changes are being observed in nature, but it is not clear if this is related to climate change. A great need is filling the knowledge gap on what impacts can be expected from climate change. In 2007, heavy precipitation after a period of drought caused a heavy mosquito plague. Some tourist 'fled' to mainland and national press attentions worried the local administration for loss of income. Afterwards, some measures were implemented to prevent a future mosquito plague. More importantly, scientific research revealed that a future plague cannot be excluded because of an increasing risk for extreme weather events. Both the municipality and the citizens now are aware of the irregularity of climate change impacts, yet they do not concern for impacts, such as sea level rise. This can be explained by the perception that Rijkswaterstaat has the legal responsibility for flood safety, including the maintenance of the primary water barriers.

Case 7: Terschelling

Located in the same archipelago as Schiermonnikoog also Terschelling is a popular touristic destination. The island counts fifteen hamlets on its territory, yet much of the 30 kilometre long island consists of natural dune area and mud-flats. Cattle are breed in the Terschelling polder at about 20 farms. Ferries maintain regular connections to the Frisian mainland and the island is a busy stop-over for sailors sailing to the UK as the harbour can be reached by seaworthy yachts. The natural dunes lie meters above sea level, yet the Terschelling polder is located below sea level. This low-lying part is protected by a dyke that has a protection level of 1:2,000. The protection of this low lying part is suggested to be of national concern by the Delta Commission 2008.

The locals of Terschelling know the threat of water very well, but trust to be safe for flooding and are also proud to have stood the elements for centuries –this is not to change by climate change. Next to some sewage adjustments, the Terschelling municipality does not take adaptive measures. If these would be taken, the interviewee foresees that these would be focused on tourism (such as sunstroke advice). The municipality has capacity problems to obey its legal duties, but these can be solved by hiring external staff from tourism tax. These capacity problems are no hindrance for climate adaptation –a lack of sense of urgency probably is.

Case 8: Nijmegen

Nijmegen is one of the oldest cities of the country. In the Roman era, Nijmegen was part of the Limes border. It serves as a trades centre ever since. Nijmegen is known for its left-wing civil and political culture. The city was founded on the bank of the river Waal, but today's city mostly is located uphill a lateral moraine. The lower parts declined in the 19th century, but have been upgraded now. These parts used to flood with high Waal discharges. The last flood dates from 1958, when parts of the embankment proved to be weak. In 1993 and 1995 the city faced flooding from extremely high river discharges (see Footnote 3). A new embankment has to keep out extreme river discharges in the future.

Parts of the municipality are located in a polder and face increased risk. This is guarded in a special plan on flooding prevention and dyke breach. In its disaster plan, the risk for flooding is indicated as a 'regular', while climate change impacts are not included. The city's adaptation plans do not appear to include the Safety Department. Its 2008 Climate Action Plan includes both projects on mitigation and adaptation. Waalsprong, a new residential area on the opposite river bank is planned to be developed in the coming years. In this new area, mitigation and adaptation measurements are included.

After the high-water events of 1993 and 1995, a high level of 'water awareness' was present throughout the city (see Box 1). In this context, a front running Water Plan was adopted including future flood prevention and water storage. Nijmegen still has a considerable lead in water policy. The city is now working towards a new Water Plan which also includes the integration of the subsoil for future urban planning. The city made local adjustments in the national plans to move the river dyke near Waalsprong including a new bridge over the Waal River.

Case 9: Millingen aan de Rijn

Millingen aan de Rijn is located on old river dunes along the Rhine and the main road still follows the old Roman river dam system running along the Rhine from Cologne to Leiden. Millingen has historical ties with the Rhine: brickwork factories along the river have provided work for many and today the nature area Millingerwaard draws many visitors. Being a very small municipality, Millingen is about to be merged with the municipality of neighbouring Groesbeek. Its policy department will remain independent, but all other activities are carried out by Groesbeek officers.

During the extremely high waters in 1995, the stability of the river dykes was uncertain, forcing 250,000 people and all livestock to evacuate in one week –the largest post-war evacuation operation in the country. Within a couple of days, the water levels decreased and no dykes breached. Soon the people could return, but until today some still have physiological problems because of the evacuation.

In their practices, the Millingen municipality does not have a strong focus on safety and climate change, despite the close proximity of the Rhine River and the past experiences with flooding. The 1995 evacuation showed a large independency of the local people almost all caring for their own evacuation, probably the reason why evacuation plans have not been updated since. The locals, living in a close-knit community, do not concern for the increased flooding risks. In national efforts to mitigate the flooding risk of Nijmegen and other downstream areas, Millingen received considerable attention as the neighbouring area was selected as a 'calamity polder' (see Roth & Warner 2009).

Regarding climate policy, the municipality is implementing some climate mitigation actions, but adaptation is not considered nor is the political level is interested. This can partially be explained from limited capacity, as the small staff and local administrators have to cover many fields with limited resources.

3.4 Institutional Involvement in Local Climate Adaptation

The framework for institutional involvement as provided in Section 2.5 gives us the opportunity to 'measure' the level of institutional involvement concerned with local adaptation strategies. The case studies showed a remarkable variation in institutional involvement (Table 7). In addition to the explanation of the concerned policy fields provided in Section 2.5, we briefly explain the municipality tasks of health and disaster management, which are also distinguished in Table 5.

A higher frequency of heat waves caused by climate change also affects the domain of public health, which is a municipal responsibility. The municipal health care system is organized in the Public Health Services (GGD 2009). The GGD obtains its knowledge from the National Institute for Public Health and the Environment (RIVM 2009), the leading Dutch centre of expertise in the fields of health, nutrition and environmental protection. This RIVM has published several reports on the health effects of climate change on the Netherlands. Due to its close ties, the GGD appears to be well-aware of effects of climate change affecting the public health, such as an increasing frequency of heat waves and new diseases entering the country. Yet, preventive measures should be assigned by the municipality itself. In the case studies we found only one case which considered public health to be an issue in its climate-adaptation strategy (Breda, see Table 7). A GGD interviewee confirmed that in the region of Twente, no municipality requested the regional GGD for additional measures on health risks, which prevents the development of proactive health measurements at the local level.

Table 7 *Institutional Involvement in Local Climate Adaptation*

Case	*Environ-ment*	*Public space*	*Water*	*Spatial planning*	*Econo-mics*	*Public health*	*Internal*
Utrecht	X	X	X	X			X
Tubbergen			X				
Breda	X	X	X	X	X	X	X
Noord-Beveland			X				
Almere		X	X	X			
Schiermonnikoog	X		X				
Terschelling	X		X				
Nijmegen	X	X	X	X			X
Millingen a/d Rijn	X		X				X

Next to heath waves, climate change also involves an increasing risk of climatic disasters and extreme weather events and disaster management is another important local government task: the mayor is responsible for public order and acts as the commanding officer in disaster management. However, the cases showed no institutional involvement from this policy domain. In the case of the ‘urban veteran at the front’ (Nijmegen), about 20 civil servants constitute the municipal safety department. Many disaster management plans are written and revised here. Yet climate change is considered to be ‘too big and too slow’ to act on. No action is taken since hazardous climate change effects – being extreme weather events and flooding events – are as such not viewed to be ‘new’ but as already being covered in existing disaster plans.

In the following section we concentrate on this local civil preparedness more thoroughly by describing the current role for local government within a multilevel governance model for climate adaptation. The case studies will be discussed according to the four dimensions distinguished in the fourfold table (see Table 1).

3.5 The Current Role of the Local Government in Climate Adaptation

‘Spectators’ run no increased risk of climate change impacts and have no history of large-scale climate impacts before. This combination of low risk and little or no experience provides a certain

baseline picture of local climate adaptation. This baseline offers a starting point to study the concept of climate adaptation and civil preparedness.

In Utrecht, the selected case for 'urban spectators' we found an 'integral approach'[5] to climate change and a proactive way of thinking to adapt to it. The case is in the process of formulating an adaptation policy. Further, the 'urban spectator' is a frontrunner in climate change mitigation strategies. On the other hand, Tubbergen, the selected case for 'rural spectator', shows a 'minimum-level approach'.[6] Interviewees explain this difference in scope from their size. The 'urban spectator' runs economic and societal risks from climate change (because of its huge economic value and a large population), whereas the 'rural spectator' runs low economic and societal risks. Furthermore, as small municipalities are obliged to fulfil the same tasks as larger municipalities, the larger ones have more capacity to focus on voluntary tasks, such as (currently) climate-adaptation strategies.

This general conclusion does not, however, explain the huge differences between the two concerned cases and can perhaps be better understood in context. In its present climate action programme, the 'urban spectator's' Municipal Board[7] stresses the presence of many research institutes working with climate change. This 'favourable' circumstance is surprising since we did not anticipate effects from such a 'coincidence' factor. Yet, this 'favourable' factor might explain best why the 'urban spectator' is so remarkably active, in addition to its relatively high economic and societal risks. There is also a striking difference in political orientation: the rural case has a right-wing Municipal Board, whereas the Municipal Board of the 'urban spectator' (until recently) consisted of left-wing parties with a Green Party alderman responsible for environmental affairs.
Our 'rural spectator' proved to be preparing for climate change impacts on a minimum level. This was to be expected, as the triggers of experience and increased risk are absent and its rural character implies low capacity for voluntary tasks. More striking was the 'urban spectator' which appeared to be very active on climate adaptation. As indicated, we feel that this can be explained by an interactive favourable context of climate research activity and a Green Party alderman.

'Veterans in reserve' are cases that have faced weather-related events in the past, but are now believed to be freed from increased risk, including from climate change impacts. The criteria appear to be contradictory, but we did find some relevant cases that fit into the 'veteran in reserve' category. A sense of urgency was low for both cases, and it was stressed that time is needed to develop an integral organisational awareness. Political support for the 'urban veteran' is ensured by a Green Party alderman responsible for the environment. For the 'rural veteran' case, with a Board to the political right, support was much lower. All in all, the 'urban veteran' emerged as a mitigation frontrunner.

The integral approach of the 'urban veteran in reserve' (Breda) has similarities to the 'urban spectator'; whereas the narrower approach of the 'rural veteran in reserve' (Noord-Beveland) is roughly comparable to the 'rural spectator'. Similar to the 'urban spectator', the 'urban veteran in reserve' has a Green Party alderman responsible for environmental policy and a 'favourable' local context in the form of a regional urban network willing to cooperate in

[5] The concept of an 'integral approach' towards climate change adaptation is chosen to describe a broad, multi-disciplinary view on climate change preparedness; in Table 2, the local approach is visualized in the concerned policy domains.
[6] A 'minimum-level approach' – as opposed to the 'integral approach' – stands for a narrow view on climate change preparedness. In practice, the 'minimum-level approach' means a national-stimulated adjusting of the local sewage system. Table 2 shows all cases being involved in the 'minimum-level approach'.
[7] In the Netherlands, the Municipal Board is the daily management of the municipal organization. The Board consists of a centrally appointed mayor and –depending on the number of municipal inhabitants- between 2 and 8 locally elected aldermen.

progressive climate policy, along with a stimulating provincial actor stressing the need for adaptation. Whereas the 'urban veteran in reserve' stresses the opportunities that climate adaptation brings, the 'rural veteran in reserve' has a more limited view on adaptation. The trigger of experience made no apparent difference for both 'veterans in reserve'. Only in the rural case did we confirm a striking risk perception by an interviewee, not because of memories of the impacts from the 1953 North Sea Flood (see Section 2.1), but because the national government is considering adjusting the coastal defence works surrounding the island in favour of the densely populated parts to the north. Furthermore, disaster management is explained to be inadequate because national funding for this is limited because of the thinly populated area.

Climate-related experiences did not seem to have made much of an impact on the local preparedness level of the 'veteran in reserve' cases. We found the 'urban veteran in reserve' to be very active on climate adaptation, but this appears to stem from a stimulating urban network including an active province, also here combined with an enthusiastic Green Party alderman responsible for the issue. Similarities to the 'urban spectator' are striking. The activities of the 'rural veteran in reserve' are much more limited. Apart from adapting the sewage system to increased precipitation, and a minor role of adaptation in the municipal mitigation activities, the degree of civil preparedness is at a minimal level.

'Recruits at the front' are cases without any experience of climate-related events in the past, but who now face a greater than average risk of climate change impacts in the future. This category thus offers us insights into the impact of projected risk with no major experience of extreme weather impacts. We can thus elaborate on the previous case categories dealing with the impacts of the combinations of 'no risk and no experience' and 'no risk and experience'.

Despite the risk profile of the 'recruit' cases, the urban case interviewees deny running increased risks, mainly because of the national government's promise not to increase the water level of the neighbouring Marker Lake. In a similar manner, the rural case interviewees stressed the national governmental role to protect the population by dykes and dunes. The cases run a much higher risk of flooding compared to municipalities on higher grounds in the eastern or southern parts, but from a local perspective this risk is not perceived as increasing due to climate change.

The 'urban recruit' (Almere) is involved in a large-scale spatial development project involving the construction of 60,000 new houses. These dwellings must be constructed in less-favourable areas, such as below sea-level lying polders or on the Marker Lake. Heavier precipitation and drought are among the scenarios being considered in the development phase. Besides this project, no adaptation initiatives have been undertaken apart from the minimum-level sewage system adjustments. Also the 'rural recruits' (Schiermonnikoog and Terschelling) do not appear very concerned with climate change adaptation. Climate change mitigation is one of the motivations for the joint mitigation project (aiming at 'carbon neutrality' in 2020), but adaptation has no separate role.

The 'recruits' appear to have developed their own perspectives on climate change impacts. While the one is mostly interested in climate change effects on nature, the other focuses primarily on climate change effects and tourism.[8] There is, however, no sense of urgency present and no new climate-related policies are being pursued. This narrow approach can partly be

[8] ECLAT-COAST, another project within the VAM research programme, primarily focuses on tourism (see website at http://www.nwo.nl/martens). The projects investigates the influence of climate and weather on tourist demand in Europe's coastal zones

explained by a lower overall capacity, but a more crucial factor would appear to be the general self-interpretation of the municipality's duties (the 'perceived role'). Both 'rural recruits' emerged as very strict in defining their responsibilities in relation to the responsibilities of other levels of government. Here we see a striking similarity with the 'urban veteran in reserve' that also considers safety and protection from flood as a national governmental task.

Summing up on this dimension, the perception of climate-related risks does not seem to have a significant impact on the cases monitored. In both the urban and rural cases the increased risk for flooding proved to be of less impact at the local level, since the cases feel they already are protected by initiatives from the national government. The rural cases are involved in mitigation and thus interested in climate change, but adaptation strategies appear to be a 'non-issue'. The islanders apparently do not fear the consequences of either heavier precipitation or sea-level rise. The urban case considers climate change (that is: increased precipitation and heat waves) in its enlargement plans, but there has always existed a certain level of risk perception because of its location at five meters below sea level.

As for the 'veterans at the front', both the rural (Millingen aan de Rijn) and urban (Nijmegen) case experienced climate-related events and face an increased risk of more to come. This maximum effect along both dimensions clearly triggers a maximum of local preparedness. Interestingly, we have seen earlier that the effects of a single trigger experience or increased risk do not emerge as significant in explaining adaptation activities. At this stage, the two frontrunners –the 'urban spectator' and the 'urban veteran in reserve'– appear to be influenced by more general internal and external factors, such as a dynamic Green Party alderman and a motivating network of climate change research and interest.

The 'urban veteran at the front' is very proactive on a broad number of adaptation measures involving water, public green areas and urban planning. In addition to activities on climate change mitigation, political support is also institutionalized through a Green Party alderman responsible for environmental affairs. The 'rural veteran at the front' on the other hand is a small-scale frontrunner in waste management differentiation. Both 'veterans' are member of the same regional environmental and waste network that primarily focuses on mitigation. Because of its large impact, the network is dominated by the 'urban veteran at the front' which actively pursues an integral-approach to climate adaptation. The 1993/1995 experiences can explain this pioneering role in addition to the presence of a Green Party alderman as well as being a mitigation frontrunner. Fresh memories of flood experience have proved to provide a perfect 'window of opportunity' for a progressive water plan written by an enthusiastic Green Party alderman.

The 'rural veteran' shows clear memories of the 1995 evacuation, but nobody appears to be frightened by the expectations of more water to come. The national government is 'trusted' to provide protection, and is thus considered to be the 'problem-owner'. This also demonstrates a perceived role of local dependence on the national government to 'solve' increased risks induced by climate change. We see here a clear similarity to the 'rural veterans in reserve' and the 'rural recruits'. The 'rural veteran at the front' does not take any adaptation measures apart from the usual sewage system adjustments. An interviewee stressed his concerns for a broader implementation of adaptation and an adjusted safety policy, but both are seen as lacking political support. For the 'rural veteran at the front' case, therefore, a history of impacts does not appear to lead to markedly increased preparedness.

We have found a very progressive ‘urban veteran at the front’ and a rather passive ‘rural veteran at the front’. The ‘urban veteran at the front’ is very progressive in its civil preparedness because of political support and a context (the river) that triggers action. This corresponds to a pattern we already observed in the other categories. Next to the ‘urban spectator’ and the ‘urban veteran in reserve’ we can add an ‘urban veteran at the front’. The most important triggers in all cases seem to be an active political support by political leaders and a diversity of local contextual factors that support more active adaptive initiatives (the presence of respected climate-research institutions; a well-informed and concerned ‘urban’ network; and an ever hazardous river).

Box 1 *Some interview quotes recorded in the VAM project*

Noord-Beveland Municipality (rural case at increased risk and flooded in 1953): “We are very much aware of the threat of the water. [The municipality] considers this to be a water board task: they should keep our feet dry”

Nijmegen Municipality (urban case at increased risk and partially flooded in 1993): “because of [the high water in] ‘93/95’ a strong water awareness rose. This is now gone”

Millingen aan de Rijn Municipality (rural case at increased risk and evacuated in 1995 because of high water): “Climate change does not mean much to us. If the water gets here, we will make sure that we have left in time”

Breda Municipality (urban case at no increased risk, but a past with flooding events): “We think of drawing in other civil organisations [in our adaptation programme], such as the agricultural association, the recreation association, the Water Board”

Schiermonnikoog Municipality (rural Wadden Island at increased risk and no flooding events in the past): "Because of the mosquito plague in 2007, we all have become aware of climate change impacts. The citizens now know what we can and cannot do”

4 DISCUSSION AND CONCLUSIONS

4.1 Local Preparedness within a Multilevel-Governance System

The water boards are clearly present to fulfil their duty as regional flooding protectors. Most of the cases are on good 'speaking terms' with the concerned water boards so to 'fine tune' local strategies, but mostly it is the water board telling municipalities to meet certain rules for water storage, which includes increasing storage for the extra precipitation caused by climate change. Where primary water dams are involved, the *Rijkswaterstaat* (the executive agency of the Ministry of Transport, Public Works and Water Management) is responsible. Yet, despite its regional presence, the role of *Rijkswaterstaat* in general is experienced to be rather difficult. While local authorities experience the cooperation with the water boards to take place on an equal basis, *Rijkswaterstaat* is felt to be rather distant and incommunicative.

When we enquired as to a potential future role for the local government in climate adaptation, most changes were expected to occur within the municipality organisation. This means taking time for local awareness raising or simply 'waiting' for climate change related events to occur. More external demands are not salient at this moment, except for a general wish for more effective coordination at the national level and some demands for money. The interviews offered a bottom-up perspective on the division of roles in the multilevel governance system (Table 8). The roles listed are those most often expressed by the local informants.

Table 8 *Division of Roles in Climate Change Adaptation within a Multilevel Government*

Governmental level	***Desired role from a bottom-up perspective***
National level	Facilitating and coordinating role: channelling knowledge and exchange of best practices
Regional level	Pioneering and steering role: crucial in the present context (urban veterans and urban spectator). This level is not necessarily represented by the province. It can also be a water board or another supra-local body such as an urban network
Local level	Executive role: awareness raising, local vulnerability assessments, local mitigation plans. Capturing local diversity to supplement top-down governance

The national government is considered to be a coordinator and facilitator. Some interviewees indicated a strong need for national recognition for their adaptation efforts (the 'urban veteran at the front'); or will only start with their adaptation measures if national support is forthcoming (the 'rural veteran in reserve' and 'urban recruit'). Others do not need more national support but expect that the state will upgrade and adapt the dykes (the 'rural recruits'). One interviewee also suggested a national adaptation 'toolbox' with more specific guidelines (the 'urban veteran in reserve'). Another interviewee stressed the need for national attention to be paid to adaptation since that would motivate local administrators to start working with climate adaptation from the top-down (the 'urban veteran at the front').

The importance of the national government setting an example was frequently mentioned. This could be in an international context, with the Netherlands representing 'best practice' on water protection (the 'urban spectator'); but it was also viewed as counting within the Netherlands. From another perspective, however, the responsible ministry of VROM was viewed as failing in

the integration of spatial planning and adaptation, and a wish was expressed that it more actively propagate an interdisciplinary approach (the 'urban spectator'). Some cases experience the national-level government to be 'distant' in both senses of the word (the 'rural recruits', 'rural veteran in reserve', and 'rural spectator'), and a concern over climate change is considered to be part of this distant state (the 'rural spectator', 'rural recruits').

4.2 Key Variables in Local Climate Adaptation

Local preparedness for climate change impacts in the Netherlands is influenced by many internal and external factors. As indicated in the Research Design (Section 1.3), we have employed the following variables in our case selection: *risk* (projected risk of negative climate change impacts), *experience* (history of exposure to a specific type of extreme weather event) and *size* (urban or rural character). During the data gathering the effect of the *local context* also emerged as an important aspect to consider. We have, therefore, added this factor as our fourth variable. We briefly discuss the four variables below, and then proceed to analyse the second research question as to the 'internal' effects of institutional capacity.

The application of the dimensions of the fourfold table (Table 1) was designed to inductively explore the selected case studies as to the effects of experience, projected risk and size on civil preparedness for climate change adaptation at the local government. After discussing this, we move on to analyse the impact of institutional capacity.

The Effect of Risk Perception

To determine the effect of risk perception, low and high risk cases have been studied. When confronting the four low-risk cases with the five high-risk cases, no clear-cut differences can be noticed between the two groups (Table 1). The rural 'spectator' does not feel threatened by climate change impacts (translated into heavier precipitation), while the rural 'veteran in reserve' fears an increased flooding risk but feels protected (and somewhat relieved of responsibility) by higher levels of government. Despite the lack of a clear threat, the low-risk urban cases appeared to be nonetheless very active in the area of climate policy. This can probably be explained by a more favourable political environment, due primarily to Green Party aldermen with designated responsibility for environmental issues. Climate change effects (translated into more precipitation and heat waves) are considered to have great impact on the city and an institutional sense of urgency contributes to higher levels of awareness, concern and action.

The high-risk cases show different individual characteristics, but nonetheless a common institutional awareness of increased risk. Climate change induced risks (interpreted as increased flooding risk) are not perceived as constituting major threats and protection is, once again, expected from the national government. For the high-risk urban cases, both recognise a broad range of climate change effects (heat waves, increased flooding risks, increased precipitation). The major difference here is the sense of urgency: the 'urban recruit' is quite careless on its risk profile, whereas the 'urban veteran' is much more concerned as to its vulnerability. This difference too can be explained from the attitude towards the national government. The 'urban recruit' fully counts on national protection, whereas the 'urban veteran at the front' feels a greater need to act autonomously. This difference can be primarily explained from the experience the 'urban veteran at the front' has.

Risk perception is essential in climate change adaptation. Following Lorenzoni et al. (2007) action on adaptation is taken when: (1) risks are known and (2) resources are available to minimize these risks. However, next to this awareness and the means to take specific measures,

a sense of urgency is also crucial. In virtually all cases a certain risk perception is present. All interviewees showed clear awareness as to the importance of climate change (generally interpreted as: more precipitation, sometimes also increased frequency of heat waves and increased river discharge), but for only some cases was the lack of adaptive means considered to be the next barrier (the 'urban spectator', the two 'veterans in reserve', and the 'urban veteran at the front').

For this reason, in addition to risk awareness and institutional capacity, we must add a further dimension for action: the 'perceived role' of responsibility and potential for local government units. Even though a certain risk perception is present in all cases, this does not imply that the issue is given high priority on the political agenda. Only when the local authority experiences a high risk *and* considers climate adaptation to be one of its tasks, will actual adaptation initiatives be placed on the political agenda. It is only at that point that a sense of urgency arises because of a lack of resources, which in turn creates an additional barrier to adaptation. Both 'urban veteran' cases express a clear sense of urgency and identify in this light the absence of resources to be the major obstacle for taking action.

The Effect of Experience

The impact of experience also emerges from a more general comparison. When confronting the four 'experienced' 'veteran' cases with the five 'non-experienced' 'recruit' and 'spectator' cases, the two groups show distinguishing characteristics. Not surprisingly, the 'veteran' cases show a tendency towards greater preparedness than their less experienced counterparts.

Experience implies a clear perception of vulnerability in the 'veteran' cases, which clearly can affect views on the perceived role of local government in climate change issues. In both 'urban veteran' cases the issue of adaptation has been placed on the political agenda. And in both cases, a Green Party alderman is responsible for municipal climate programmes that include several adaptation measures. The 'rural veteran' cases, on the other hand, do not show marked political attention. Their risk perception is concentrated on a national government dependency for protection. A lack of resources to minimize risks is considered to be a result of national-government rules (for example, poorly developed rescue services for the 'rural veteran in reserve' case).

The non-experienced 'recruit' and 'spectator' cases show no clear sense of risk, except for the somewhat anomalous 'urban spectator' which is highly involved in preparations for climate change adaptation. The 'urban recruit' shows minimal-level preparations that stem from a low political awareness which can be attributed to a lack of experience. Experience was apparently also an issue for one of the 'rural recruits', but due to the special local character of the event in question (heavy rain showers) no political follow-up ensued. Similar to the high-risk rural cases, both 'rural recruits' and the 'rural spectator' look towards the national government to take the appropriate adaptive measures for protection. They perceive, in short, the national government to be the 'problem-owner'. This 'indifferent' attitude can be explained by both a low level of political attention and perceived limited means for climate change initiatives.

Experience also appears more generally in the case comparison to make a difference as it increases the overall effect of risk. If risk is perceived, the factor of experience causes a heightened sense of urgency (for the urban 'veteran in reserve' and both the urban and the rural 'veteran at the front'). Further, if a sense of urgency is present, it appears to lead to a concern over the lack of means. Strikingly, however, both the experienced and non-experienced rural

cases do not see a need to take action themselves, but rather trust the national government for protection.

The Effect of Size

Next to the impacts of risk perception and experience, it appears that an even more determinative factor among the cases is the question of size ('rural-urban' as measured by population). In our sample, urban communities have invariably large populations and rural communities have, in most cases, very small populations. Relating the size variable to vulnerability, there is obviously a greater risk attached to the more populous units, and, not surprisingly, the case studies show a striking difference between urban and rural cases. The rural cases thus tend to depend more strongly on greater governmental involvement for their security, and, more specifically, to expect more from the national and regional levels of governance to avert impacts from climate change. The larger urban cases on the other hand are more generally well-informed as to the effects that will occur, and have greater resources to estimate the impacts. Three of our urban cases thus qualify as 'adaptation frontrunners', although they too are definitely not averse to looking to the national government for expert assistance and funding.

The Effect of Local Context

An emergent effect throughout the study has proved to be the effect of specific local contexts. The study reveals that the local situation exerts a significant impact on the climate change problem. It makes clear that all cases have their own particular situation that is determinative for the effects of climate change impacts. For instance, while the 'veterans at the front' cases are used to preparing themselves for climatic events, the 'urban veteran in reserve' appeared to be similarly involved in climate change adaptation without any clear threat. The 'rural recruit' cases appeared to be less active as expected, but one of these cases had a striking awareness of climate change impacts because of a climate-related incident (mosquito plague). On the other hand, the 'urban recruit' appeared to be only laterally involved with climate change adaptation, despite being situated in one of the lowest parts of the country.

The factors risk and experience did not prove as decisive as anticipated. Next to the major impact of size on the local preparedness for climate change (as shown in the previous section), the factor of local context proves to be the most decisive of all. The case narratives reveal that local communities can be clearly more involved in adaptation activities than can be explained by risk and past experience alone. The factor of size proves to have considerable effect, since we have shown that urban municipalities can be much more involved in climate change adaptation then their rural 'cohorts'. We have proposed to explain this from a perspective of general vulnerability. Having said this, it emerges that the most relevant explanations for local adaptation initiatives seem to be related to the specific local situation. This is the only explanation for the actual adaptation actions taking place at the local level –or their absence. Of the factors considered, only the local context of the 'urban recruit' can explain why this is the only urban case to be active on a limited level. Having thus shown the relevance of the local context, we can now turn to the more 'internal' factor of institutional capacity.

Institutional Capacity and Local Preparedness

In this section, we address the second principal research question: *how far does institutional capacity influence the possibilities and limitations for developing local adaptation strategies, and how can this capacity be expanded*? 'Institutional capacity' is here considered quite broadly. It

refers to governing mechanisms and manpower, but also includes knowledge. In general, we have also here revealed a major gap between rural and urban communities. Small rural communities obviously have less manpower and more limited means of governance to implement their tasks. It is quite normal, for example, to have only one civil servant with responsibility for climate change adaptation. This places clear constraints on the ability to maintain a relevant network and to improve necessary knowledge skills. This in turn can explain low levels of climate change awareness (or at least concern), and thus a limited sense of urgency to implement adaptation strategies. In terms of both the number of inhabitants affected and the more limited economic resources at stake, the overall vulnerability is perceived as small. Whether or not this is a *correct* perception is, of course, another matter.

The analysis also demonstrates the importance of institutional capacity in other ways. Increased capacity means more knowledge and awareness of threat, as well as more 'hands' to work on the issue. While the urban cases that were most active on climate adaptation all stressed the limited means to implement measures effectively, the rural cases tended to stress limited resources as a major barrier for working on climate change problems *at all*. Knowledge is thus a key element in the development of institutional capacity. This includes a general awareness of climate issues and the growing threat of serious climate-related impacts, as well as more hands-on knowledge of local adaptation challenges and the appropriate solutions for reducing and redressing risks. One can, after all, only expect action if a community both knows what the threats are *and* has an understanding of how threats can be met –at what cost to other local priorities. In all of the cases studied, the first level of more general knowledge was more-or-less present. All cases appeared to have their own sources of knowledge of climate change impacts (see Table 9). The second level of knowledge of specific challenges was more limited (mainly the 'urban spectator' and 'urban veteran'), and the third level (potential instruments of adaptation) was only present in the 'urban veteran at the front case' –a case which combines both past experience and perceived future risk.

The availability of advanced knowledge and preparation is most abundantly present at higher levels of governance, most particularly the active work of Water Boards to stress the need for more water storage areas. It has here been pointed out that there is an urgent need for national-level coordination and facilitation. Local communities express a wish to learn from frontrunner examples, yet there is hardly any direct connection between the frontrunners and others. A major capacity for increasing local adaptation awareness and resources should be available here. More effective means of dissemination and top-down/bottom-up communication are necessary to realize the potential. When institutional capacity (in knowledge, means and expertise) is limited, the municipality must rely on higher levels of governance for backup and protection. Where knowledge and manpower have been made available, the potential for more effective action is clearly present. We have observed in this connection a striking capacity difference between the urban and rural cases. In the smaller communities, one civil servant is usually responsible for environment, spatial planning and housing, while in urban cases entire administrative units can be responsible for this.

Table 9 *Channels of Climate Change Knowledge of Local Civil Servants*

Case	***Mitigation frontrunner network***	***Profes-sional networks*** *(Rioned, VNG)*	***Municipal networks*** *(Wadden, B5, MARN)*	***EU projects*** *(Building with CaRe, Future Cities)*	***Higher-level Govern-ment***	***Direct scientific contacts***
Utrecht	X				X	
Tubbergen		X			X	
Breda	X		X		X	
Noord-Beveland				X	X	
Almere					X	
Schiermonnikoog			X		X	X
Terschelling			X		X	
Nijmegen	X		X	X	X	X
Millingen a/d Rijn			X		X	

There remains nonetheless a question as to how decisive capacity can be, since rural communities also tend to have a very different perception of the problems. The role of local administrators and politicians in smaller communities is more limited, with both challenges and solutions usually of a totally different scale (while the 'rural veteran in reserve' plans 60 new houses, the 'urban recruit' builds 60,000). The less active role of small communities also exhibits an important social component. Small communities are most often characterized by stronger social solidarity. They tend to trust their community in solving any future problems. This came clearly to the fore in both the 'rural veterans' and 'rural recruits'. These small communities proved to be relatively indifferent to climate change scenarios, and they tended to trust past experience for coping with extreme weather and flooding. Should the problems grow too large and get out of hand; the national government would be there to take charge. Given their greater vulnerability economically, higher population density, and (most often in the Netherlands at least) greater experience of natural disasters and impacts, it appears that larger urban communities develop their own particular culture of 'joint civil protection'. The 'common memory' is more oriented towards both adaptive preparation and self-help.

We have differentiated adaptive capacity as to *institutional capacity*, *vulnerability*, *risk perception* and the *perceived role*. It is the overall combination and interaction of these elements that determines the general quality and effectiveness of local adaptive capacity. The degree to which all four elements are present and interactive will strongly influence the degree of local preparedness for climate change impacts. If this preparedness is in addition combined with the necessary 'political will' to act, then local adaptation strategies are generally much more robust (as variously manifest for the 'urban spectator', 'urban veteran in reserve', and 'urban veteran at the front').

4.3 Hindering and Driving Factors in Local Climate Adaptation

Climate change adaptation is one of the major political challenges we face today. Its context is very complicated, not only because of the many uncertainties associated with the climate change problem itself, but also because we are dealing with a 'premature' policy domain which lacks national focus on implementation, and which is characterised by a lack of uniform understanding and approach. The political-administrative apparatus must learn to deal with these uncertainties.

Risk control in society is a basic political responsibility. Identifying threats and adapting to risks has been a driving force of political culture and democratic development for centuries (Van de Donk 2008). Today, however, as first formulated by Ulrich Beck (1992) in his concept of 'the risk society', modern life has become so complex that politicians and governments must increasingly rely on science and research for effective decision-making.

There are, moreover, few other areas where this dependency is both more critical and more controversial than in the area of climate change. A recent report for the Netherlands Organisation for Scientific Research points out that: 'a much wider set of structural changes will need to be prepared if the dramatic potential of future climate development is to be anticipated' (NWO 2008: 5). Our analysis clearly shows, however, that, in the area of adaptation, the current channels of knowledge and coordination across different levels of government are fragmented and diffuse. We conclude the chapter, therefore, by broadening our perspective on a future role for local climate adaptation in terms of the barriers to more effective initiatives revealed by the project (Table 10).

Table 10 *Barriers in and Motivations for Local Climate Change Adaptation*

	Internal conditions	***External conditions***
Barriers	- No internal sense of urgency (rural and urban veterans in reserve, urban spectator, rural veteran at the front) - No means (urban veteran at the front) - Knowledge shortage (urban veteran at the front, urban spectator, rural recruit)	- No obligatory character (urban veteran in reserve, rural veteran at the front) - No public sense of urgency (urban veteran in reserve, rural veteran at the front, rural veteran in reserve, urban spectator) - Scope of the scenarios / lack of visualising the climate change problem (urban spectator, urban veteran at the front)
Motivations	- Mitigation experience (urban veteran in reserve, urban spectator) - Green-minded municipal board (urban spectator, urban veteran at the front, urban veteran in reserve)	- Favourable conditions (the 1993/1995 floods, demands of new residential districts) - Existence of innovative networks (MARN, B5, EU projects, the Wadden Isles cooperation)

Conquering the Barriers

Throughout the case studies, most of the barriers mentioned by informants are internal: sceptical colleagues, lack of political support, lack of interest in climate change, and difficulties involved in cooperation between different departments and domains. If a certain sense of urgency has already developed at the local level, most interviewees foresee a lack of capacity to implement adaptation actions. This barrier can also account for the fact that several local administrators, with scarce time to devote to their many areas of responsibility, simply do not have the capacity to go deeper into the climate change challenge. Shortages of staff in general are mentioned as a relatively common barrier in the small municipalities, where working on non-legal tasks such as climate adaptation cannot be prioritized.

There where sufficient adaptive capacity and political support for climate change adaptation is available, several more practical barriers emerge. First, due to their urban situation, cities face major challenges in visualizing and risk-scoping the highly complex and interdependent environment constituted by the urban infrastructure. A further complicating factor is uncertainty as to the functionality of the most effective adaptation solutions. And, even if a 'best-possible solution' does emerge, it must then be decided who is going to make the investment. These implementation barriers can only be overcome by more concentrated coordination efforts within

and across national, regional and local governmental domains. Our study also shows, however, that best practice at the local level can also be a major knowledge input into these multilevel processes.

Besides these institutional barriers, knowledge gaps are also a major hindrance. This involves climate change knowledge in general and its application on the local in particular. In general, uncertainties as to the 'starting point' of climate change impacts were mentioned by several informants. Many of these viewed a lack of effective instruments as a major barrier in climate adaptation, but very few were able to suggest specific means for addressing the problem. Others simply looked for national funding to support adaptation measures, as this would spur local administrators to greater activity on climate adaptation.

When applying climate change knowledge at the local level, major difficulties also arise when trying to downscale and visualizing climate change in combination with the extensive scope of climate change scenarios. Several of the case studies viewed the national scope of the prevailing KNMI as too broad to apply to their adaptation strategies. They feel a need to know the impacts in a manner as detailed as possible in order to prepare as efficiently as possible. Informants also mentioned that predictions as to climate change must be reliable and consensual if they are to convince local administrators to act on climate change. Provincial climate scenarios do not fulfil the need for downscaled knowledge as they are based on the national scenarios.

It is unlikely, however, that this deficiency can be solved in the near future, since the introductory scoping of downscaled models in the project revealed that the degree of resolution for model predictions will not be specific enough for the Netherlands to accommodate individual variance in local-community conditions. This is a technical-methodological issue which clearly requires further multi-disciplinary research (Jacques 2006). While most provinces in the Netherlands already are covered by detailed model predictions, the challenge in the future will be to adapt regional predictions to local-community conditions. Effective adaptation can only take place through the interaction of top-down (climate-related) and bottom-up (socio-economic) modelling (Aall & Norland 2005; Clausen 2007).

Limited attention to climate change adaptation is also mentioned as a general problem. More attention is desired both within the organisation as well as throughout society. Some interviewees foresee changes in the course of time due to an increasing chance of events and due to greater awareness in society. Several also feel that the specific issue of climate adaptation could benefit from more focused legislation. Supported by national law, municipalities could then act more forcefully to implement resource-demanding adaptation measures, particularly for example in new residential areas.

Drivers for Local Climate Adaptation

In addition to the major perceived barriers, we also gained insight into several more positive factors for promoting local climate change adaptation. In a manner similar to earlier studies of 'Local Agenda 21' in Europe (Lafferty & Coenen 2001), the project indicates that local 'firebrands' are of significant importance in a positive direction. The presence of a Green Party alderman in one case (and, more generally, specifically 'environmentally oriented' administrators), was strongly related crucial to the promotion of climate-related initiatives. The factor usually reflected and enhanced positive institutional support for addressing the climate change issue.

Similarly, we also found that the more 'willing' and positively disposed cases were also active in all sorts of networks. This varied from EU projects to urban networks and inter-municipal cooperation. Interviewees actively confirmed that these networks played a key role, as they

enable the local actors to exchange knowledge and best practices, and to share the costs of research and trial projects. Within such stimulating networks, local actors are more motivated to explore climate-adaptation efforts that would otherwise be too ambitious (resource-demanding) for a single municipality.

The 'drivers' revealed show similarities to key implementation factors identified by Bulkely and Betsill (2003) in their analyses of local climate mitigation efforts: (1) a committed individual in a local government that (2) manifests a solid climate-protection policy (preventing GHG emissions), (3) has funding available, (4) has power over mitigation-related domains and (5) – perhaps most crucially – has the political will to act. By adjusting factors (2) and (4) from mitigation to adaptation, this list provides a solid baseline for future adaptation initiatives. On the basis of our study, however, we would also add such local contextual factors as: (6) an awareness of the specifics of local climate change impacts (see Table 5); (7) hands-on experience with emission-preventing policies; (8) attempts to factor risk assessment into long-term policies; (9) experience with previous extreme-weather events; and (10) the size of the municipality population.

4.4 Local Climate Policy: Connecting Adaptation to Mitigation

In the three front running urban cases (Utrecht, Breda and Nijmegen), adaptation is seen as a broadening of the more general accepted climate mitigation policy. In two out of the three cases, adaptation is a topic of the environmental department. In the 'urban veteran at the front' (Nijmegen), where adaptation is more applied already, adaptation is part of the department on public space (water, green, sewage). In cases were adaptation is more low-level, adaptation is sometimes seen as a distinctive pillar (rural spectator). This can be explained from the fact that mitigation is embedded with the environmental domain, whereas adaptation is part of the physical domain that constructs, develops and maintains the municipality. In some cases, the municipal organisation is so small that both domains are united in one officer ('rural recruit' Schiermonnikoog and 'rural veteran at the front' Millingen aan de Rijn), who views both as the two parts of the same climate question.

A striking difference is the sense of urgency between mitigation and adaptation. Interviewees confirmed that mitigation is 'landed' by now and there is no longer the need to convince and motivate colleagues within the organisation. Most of the people know about energy saving, waste differentiation and emissions reduce. Mitigation has become an urgent issue. By contract, adaptation is new and vague. Almost everywhere, a sense of urgency to work on it seems to be absent. Interviewees face difficulties convincing their colleagues and administrators with very broad scenarios surrounded by many uncertainties. There is an urgent need to translate the impact to the local level and to get the impacts visualised. But most of the interviewees stress the need to take the time for this. They expect that the urgency for climate adaptation will grow trough time, triggered by experience or increased knowledge.

These differences in attitude towards mitigation on the one hand and adaptation on the other might be explained from their different 'essences'. Mitigation is about reducing and saving and its effects often can be quite easily measured and thus visualised. Mitigation is considered to be environmentally conscious and sensible – it is 'good'. By contrast, adaptation deals with worst case scenarios and investments based on uncertainties and pioneering scientific research trying to determine the best applicable no regret measures. In extreme, climate change scenarios can be seen as intimidation and adaptation expenditures could be considered as 'money wasting'.

Füssel and Klein (2006: 303) summarise these key differences between mitigation and adaptation policy as shown in Table 11.

Table 31 *Characteristics of Mitigation versus Adaptation*

	Mitigation of climate change	***Adaptation to climate change***
Benefited systems	All systems	Selected systems
Scale of effect	Global	Local to regional
Life time	Centuries	Years to centuries
Lead time	Decades	Immediate to decades
Effectiveness	Certain	Generally less certain
Ancillary benefits	Sometimes	Mostly
Polluter pays	Typically yes	Not necessarily
Payer benefits	Only little	Almost fully
Monitoring	Relatively easy	More difficult

However, despite the complex nature of adaptation implementation, interviewees in the three mitigation frontrunner cases express their belief that the problem of climate change adaptation will gradually 'settle' into a more commonly accepted issue. They frequently pointed out that mitigation was also a hard nut to crack, but that it had now been commonly accepted. There is no longer (at least not in our case studies) a perceived need to convince and motivate colleagues within the local administration. Most citizens are seen as being aware of energy conservation, the separation of waste and a need for emissions reductions. While mitigation has become an urgent issue, the challenge of specific adaptation initiatives is new and surrounded by many uncertainties. In nearly every case, there was little sense of urgency in relation to either vulnerability or preparedness. Those informants who are motivated to act on adaptation issues face difficulties convincing their colleagues and administrators on the basis of broad and uncertain scenarios. They see a clear need for translating the threat of impacts into local consequences, and for heightening the need for risk assessment. They also feel, however, that there is sufficient time to achieve the necessary preparation; and that a sense of urgency will be triggered by either actual experience or increased knowledge.

4.5 Questions for Further Research

To finish this report, we will shed some light on some issues for future research. The findings reported in the previous sections have been investigated by an exploratory method in which the outcomes of our fieldwork as the central main data source. As the data emerging from the work proved to be of major relevance, we have decided to continue our research in this domain. For this reason, we have identified three key issues that will receive more attention in the near future within the framework of local adaptation strategies to climate change in the Netherlands.

Adaptation as a LA21 Successor

The driving factors involved with the implementation of local adaptation strategies show similarities to the implementation process of Local Agenda 21 (LA21). Eckerberg, Coenen & Lafferty (1999: 258-9) revealed that the major characterises of pioneering communities in LA21 implementation have an identifiable pattern:

- An active and politically mobilised population
- Interested and motivated civil servants
- Interested local politicians
- Positive international contacts and networks
- Existing environment-and-development initiatives

This matches the issues raised in Section 4.3 on the relationship between adaptation and mitigation policies. In a follow-up study, we want to determine if and how this pattern corresponds to the implementation of adaptation strategies. We want to improve our understanding of this relationship and we want to determine the specific implantation factors that count for the issue of adaptation when comparing it with the factors for mitigation implementation.

Climate Adaptation as a Risk Mitigation Strategy

Climate change increases the risk for flooding in the Netherlands. By taking the best fitting adaptation measures on time, theses risks can be mitigated or even decreased. Flooding and safety are thus among the major issues raised in preparing the country for climate change. However, our research revealed no involvement of the civil protection department in the case of Nijmegen nor could we observe any adaptation strategies in a case study on Rotterdam (Van den Berg & Coenen 2010). In a follow-up study, we want to focus on the relationship between climate adaptation and civil protection at the local level.

Social Resilience as a Climate Adaptation Strategy

Next to our interests in the preparedness for climate change in Dutch municipalities, we also want to look into the non-governmental preparedness as the combination of both gives us the full picture of how well-prepared the communities really are. After all, while small communities in the current study revealed to be less prepared that their urban counterparts because of low institutional capacity, but the close-knit smaller communities could imply considerable social resilience. For example, the case of ‘rural veteran at the front’ Millingen aan de Rijn showed a limited institutional preparedness while the 1995 evacuation was nevertheless a smoothly running operation. The issue of non-governmental actors has been studied earlier (e.g. Adger 2001). Building on to this, we want to investigate the ‘social potential’ in Dutch communities. This study will have the focus of social resilience as a climate adaptation strategy.

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APPENDICES

I Output of the Project

Van den Berg, M. M (2010). *Climate Change Adaptation in Dutch Municipalities: Risk Perception and Institutional Capacity*. Paper presented at the ICLEI Resilient Cities 2010 Congress, 29 May 2010, Bonn.

Van den Berg, M. M., Lafferty, W. M. & Coenen, F. J. H. M. (2010). Adaptation to climate change induced flooding in Dutch municipalities. In P. Martens and C. Chang (Eds), *The Social and Behavioural Aspects of Climate Change. Linking Vulnerability, Adaptation and Mitigation.* Greenleaf Publishing: Sheffield UK. Forthcoming August 2010.

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Van den Berg, M. M (2009). *Motivations for Local Climate Adaptation in Dutch Municipalities: Climate Change Impacts and the Role of Local Government.* Paper presented at the SENSE Symposium Climate Proofing Cities, 1 December 2009, Volendam.

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Clausen, G. (2007). *Assessing Local Vulnerability to Climate Change: Institutional Dimensions and Cross-National Comparisons*. Paper presented at the 13th Annual International Sustainable Development Research Conference, 10-12 June 2007, Västerås.

II Interviewee Overview

Municipality	*Interviewee*	*Position*
Hengelo	Ms. Nathalie Thoonsen	Sustainability policy officer
Enschede	Mr. Jan Dijk	Environmental policy advisor
Utrecht	Ms. Inge van de Klundert	Environmental policy advisor
Tubbergen	Mr. Bart Horsselenberg	Public space and sewage policy officer
Breda	Mr. Richard Nispen	Climate adaptation project leader
Noord-Beveland	Mr. Tom Vermin	Energy coordinator and project leader
Almere	Mr. Albert Jong	Urban planner
Almere	Mr. Peter Otten	Water policy advisor
Schiermonnikoog	Mr. Theo de Vries	Environment and spatial planning policy officer
Terschelling	Mr. Leo Bouwman	Sustainability officer
Nijmegen	Mr. Ton Verhoeven	Water policy advisor
Nijmegen	Mr. Martin Ruiter	Disaster coordinator
Millingen aan de Rijn	Mr. Peter van Deelen	Environment and spatial planning policy officer
GGD Twente and IJsselland	Mr. Jaap de Wolf	Environmental and health policy advisor

III Case Study Questionnaire

This questionnaire was used in the Dutch language

Introduction

Explanation of CIVILCLIM and the concepts of civil protection, civil protection institutions, crisis/emergency management, flood management

Background interviewee and his/het organization

1) What is your position and what are your tasks/responsibilities?
2) Could you describe the position of your organization within the civil protection system in our country?
3) How does your organization cooperate within the civil protection organization within the country?

Civil protection and institutional changes

4) Have there been major changes within the system of civil protection in the areas of Rotterdam (last decade)?
5) Have there been major changes that have influenced the city's vulnerability for extreme weather events and flooding (last decade)?
6) Do you have documents that could provide us with more insights (political decisions, plans, reports etc)?
7) Was climate change an issue in these changes?

Adaptation to climate change

8) Does climate change have (already) caused new precautionary measures by your organization?
9) What has been done in Rotterdam to map the local vulnerability?
10) Does your organization have special policy on climate change adaptation?
11) Is there a need for change or new institutions to cope with climate change?
12) Is there any political and internal *sense of urgency* for climate change?
13) What role do you see for your organisation and civil protection in general regarding the matter of climate change adaptation?
14) Do you consider climate change adaptation to be a *new* policy field? Why (not)?

'Local' represents the local or site level of implementation. The (X) reflects local or site level effect of the particular adaptation option.

#	***Adaptation option***	***Local***
1	Integrated nature and water management	
2	Integrated coastal zone management	
3	"More space for water", "Water management 21st century" – water storage and water retention	
4	Risk based allocation policy	
5	Risk management as basic strategy	
6	New institutional alliances	
7	Evacuation plans	
8	Make existing and new cities robust-avoid 'heat islands', provide for sufficient cooling capacity	X
9	Change modes of transport and develop more intelligent infrastructure	
10	Design spatial planning – construct new housing and infrastructure	X
11	Re-enforcement of dykes and dams, including 'weak spots'	
12	Stimulate economic activity in other parts (eastern and northern) of the Netherlands	
13	Construct buildings differently in such a way that there is less need for air-conditioning/ heating	X
14	Design houses with good climate conditions (control) – 'low energy'	X
15	Adaptation of highways, secondary dykes to create compartments	
16	Development of more 'intelligent' infrastructure that can serve as early warning indicator	
17	Water management systems: revision of sewer system	X
18	New design of large infrastructure	
19	Increase standards for buildings as to make them more robust to increased wind speeds	X
20	Widening the coastal defence area (in combination with urbanisation and nature)	
21	Spatial planning of locations for power plants (nuclear in particular)	X
22	Relocation of fresh water intake points	X
23	Fresh water storage to flush brackish water out during dry periods	
24	Maintain higher water table to prevent salt water intrusion	
25	Constructing more stable overhead electricity transmission poles	
26	Water management systems: emergency systems revision for tunnels and subways	X
27	Development of cooling towers	
28	Increase sand suppletions along coast	
29	Higher water level IJsselmeer	
30	Design and implementation of ecological networks (The National Ecological Network - NEN)	
31	Increasing genetic and species diversity in forests	
32	Monitoring nature, interpreting changes and informing	
33	Creating public awareness	
34	Lowering the discount factor for project appraisal	
35	Improved air conditioning in nursery homes or hospitals	X
36	Introduction of ecosystem management in fishery	

37	Afforestation and mix of tree species	
38	Educational programs	
39	Water management systems: options for water storage and retention in or near city areas	X
40	Compartmentation of low-lying parts of the Netherlands	
41	Adapted forms of building and construction	X
42	Improvement of vessels	
43	Soil moisture conservation practices	
44	Enhancing capacity of sluices and weirs	X
45	Introduction of southern provenances of tree species and drought resistant species	
46	Acceptation of changes in species composition in forests	
47	Adjustment of forest management	
48	Changes in farming systems	
49	Improvement of health care for climate related diseases	
50	Design infrastructure for recreation and tourism – coastal areas	
51	Water management and agriculture	X
52	Sluices	X
53	Land use change	X
54	Water storage on farmland	X
55	Choice of crop variety and genotype	
56	Adjusting crop rotation schemes and planting and harvesting dates	X
57	Establishment and management of protected areas	
58	Implementation of effective ‘agri-environmental’ schemes	
59	Adapt to mitigation strategies	
60	Insurance	
61	Private insurances against inundations and/or drought related damages	
62	Measures for preventing climate related diseases	
63	Reduce wastewater discharge during drought periods	
64	Restoration of ecosystems directly depending on water quantity and quality	
65	Regional adaptation strategies for the fen meadow area	
66	Irrigation	
67	Allow transgression of sea in wide dune areas, allow wash over of dykes	
68	Protection of vital objects	
69	Protection of vital infrastructure	
70	Reduction salt water tongue	X
71	Reconnecting water systems in Delta area (e.g. Volkerak Zoommeer and Oosterschelde)	X
72	Adaptation strategies to salinization of agricultural land	
73	Adapt regulations such that a higher discharge temperature is allowed	
74	Moving power plants to coast (cooling water)	X
75	Building stronger wind turbines	
76	Development and growing of crops for biomass production	X
77	Planting of biomass crops	
78	Development of financing mechanisms	
79	Retention of winter precipitation in forests	
80	Use improved opportunities for generating wind energy	
81	Use improved opportunities for generating solar energy	

82	Reallocation of mussel nursery plots	
83	Floating greenhouses	
84	Adjusting fishing quota	
85	Artificial reefs along the coastline & development nature conservation values	
86	Relocation or mobilization of farms	
87	Artificial translocation of plant and animal	
88	Adaptation of target species and fishing techniques	
89	De-salinisation	X
90	Self sufficiency in production of roughage	
91	Limiting the import of timber	
92	Subsoil drainage of peat lands	
93	Aquaculture on former grassland	X
94	Eco-labelling and certification of fish	
95	Reclamation of (part of) southern North Sea	
96	Abandoning of the whole of low-lying Netherlands	

Adopted from Van Ierland et al. 2007.

V Profiles of the Case Selection

Case 1: Utrecht

Key Numbers Utrecht

Inhabitants	299,484 (January 1 2009; CBS)
Land area	95 km2 (and 4 km2 water area; Gemeente op Maat 2006, CBS)
Population density	2,947 (Gemeente op Maat 2006, CBS)
Location	Province of Utrecht
Geography	River clay soil (bodemdata.nl)
Economics	13,525 enterprises: 175 agriculture/forestry/fishery, 1,660 extraction/ industry, 8,930 commercial services, 2,760 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits	6,990 (January 2009; CBS)
Climate impacts	Increase of extreme weather events, temperature rise
Risk map indication	Partial risk of flooding

Municipal Organisation Utrecht (situation before March 3, 2010)

Board	Mayor and seven aldermen (3 PvdA, 2 VVD, 1 CDA, 1 CU)
Council	45 members (14 PvdA, 8 GL, 5 VVD, 5 SP, 4 CDA, 3 D66, 3 Leefbaar Utrecht, 2 CU, 1 Burger en Gemeenschap)
Officials	1,600

Relevant Documents Utrecht

- Gemeente Utrecht (2008). *Utrecht creëert nieuw energie. Werkprogramma 2008-2011.*
- Gemeente Utrecht (No date). *Crisisbeheersingsplan Gemeente Utrecht 2005-2009*.

Case 2: Tubbergen

Key Numbers Tubbergen

Inhabitants	20,999 (January 1 2009; CBS)
Land area	147 km2 (Gemeente op Maat 2006, CBS)
Population density	140 (Gemeente op Maat 2006, CBS)
Location	Twente, province of Overijssel
Geography	sandy soil (bodemdata.nl)
Economics	1520 enterprises: 690 agriculture/forestry/fishery, 225 extraction/ industry, 480 commercial services, 130 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits	70 (January 2009; CBS)
Climate impacts	Increase of extreme weather events, temperature rise
Risk map indication	Risk of forest fires; no risk of flooding

Municipal Organisation (situation before March 3, 2010)

Board	Mayor and three aldermen (2 CDA, 1 PvdA)
Council	19 members (12 CDA, 3 PvdA, 4 VVD/Gemeentebelangen)
Officials	160 staff

Relevant Documents Tubbergen

- Gemeente Tubbergen (2007). *Milieubeleidsplan 2005-2010.*
- Gemeente Tubbergen (2004). *Uitvoeringsprogramma klimaatbeleid*.
- Gemeente Tubbergen (2008). *Programmabegroting 2009.*

Case 3: Breda

Key Numbers Breda

Inhabitants	171,946 (January 1 2009; CBS)
Land area	126.8 km2 (and 2.4 km2 water area; Gemeente op Maat 2006, CBS)
Population density	1,339 (Gemeente op Maat 2006, CBS)
Location	Province of Noord-Brabant
Geography	Sandy soil (bodemdata.nl)
Economics	8,860 enterprises: 335 agriculture/forestry/fishery, 1,260 extraction/ industry, 5,655 commercial services, 1,610 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	3,520 (January 2009, CBS)
Climate impacts	Increase of extreme weather events, temperature rise
Risk map indication	Completely no risk of flooding

Municipal Organisation Breda (situation before March 3, 2010)

Board	Mayor and 6 aldermen (2 PvdA, 2 CDA, 1 Breda'97, 1 Groenlinks)
Council	39 members (11 PvdA, 8 CDA, 7 VVD, 4 SP, 3 Breda'97, 3 GL, 2 D66, 1 LB/PvhZ)
Officials	2,200

Relevant Documents Breda

- Gemeente Breda (2005). *Plan Crisismanagement: Rampenplan van de gemeente Breda.*
- Gemeente Breda (2009). *Breda gaat voor een beter klimaat: Uitvoeringsprogramma Klimaat 2009 – 2012.*
- Gemeente Breda (2008). *Steek positieve energie in het klimaat. Breda: een CO2-neutrale stad in 2044.*
- Gemeente Breda (2007). *Structuurvisie Breda 2020: Stad in evenwicht.*
- BN/DeStem (2009). *Lof voor beleid klimaat*. (Newspaper article 24 June 2009)

Case 4: Noord-Beveland

Key Numbers Noord-Beveland

Inhabitants	7,325 (January 1 2009; CBS)
Land area	86 km2 (and 34km2 water area; Gemeente op Maat 2006, CBS)
Population density	84 (Gemeente op Maat 2006, CBS)
Location	Isle of Noord-Beveland, province of Zeeland
Geography	Clay soil (bodemdata.nl)
Economics	540 enterprises: 140 agriculture/forestry/fishery, 70 extraction/ industry, 235 commercial services, 95 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	50 (January 2009, CBS)
Climate impacts	Increase of extreme weather events, temperature rise, sea level rise
Risk map indication	Risk of flooding

Municipal Organisation Noord-Beveland (situation before March 3, 2010)

Board	Mayor and three aldermen (1 CDA, 1 VVD, 1 SGP)
Council	13 members (3 PvdA, 3 CDA, 3 Noord-Bevelands Belang, 2 VVD, 2 SGP)
Officials	60-70 staff (40 local governmental offices)

Relevant Documents Noord-Beveland

- Gemeente Noord-Beveland (2005). *Rampenplan gemeente Noord-Beveland 2005 – 2009.*

Case 5: Almere

Key Numbers Almere

Inhabitants	185,937 (January 1 2009; CBS)
Land area	130 km2 (and 118 km2 water area; Gemeente op Maat 2006, CBS)
Population density	1,369 (Gemeente op Maat 2006, CBS)
Location	Province of Flevoland
Geography	Sea clay soil (bodemdata.nl)
Economics	7,380 enterprises: 130 agriculture/forestry/fishery, 1,095 extraction/ industry, 4,675 commercial services, 1,480 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits	3,670 (January 2009 CBS)
Climate impacts	Increase of extreme weather events, temperature rise, sea level rise
Risk map indication	Risk of flooding

Municipal Organisation Almere (situation before March 3, 2010)

Board	Mayor and 4 aldermen (2 PvdA, 1 VVD, 1 CDA/CU)
Council	39 members (12 PvdA, 7 VVD, 4 Leefbaar Almere, 4 SP, 3 GroenLinks, 3 CDA, 2 Almere Partij, 2 CU, 1 D66, 1 Verenigde Senioren Partij)
Officials	1,600 officers

Relevant Documents Almere

- Gemeente Almere (2008). *De Almere Principles, voor een ecologisch, sociaal en economisch duurzame toekomst van Almere 2030.*
- Royal Haskoning (2009). *Almere, verkenning gevolgenbeperking – risicozonering en verandering van schade door de Schaalsprong.*
- Waterschap Zuiderzeeland (2009). *Water in de structuurvisie*
- Randstad Urgent (2007). *Schaalsprong Almere 2030.*
- Gemeente Almere (2006). *Rampenplan Gemeente Almere 2005 – 2009: Herziene versie.*
- Gemeente Almere (2009). *Ontwerp Programmabegroting 2010.*

Casus 6: Schiermonnikoog

Key Numbers Schiermonnikoog

Inhabitants	944 (January 1 2009; CBS)
Land area	41 km2 (and 158 km2 water area; Gemeente op Maat 2006, CBS)
Population density	24 (Gemeente op Maat 2006, CBS)
Location	Wadden Sea, province of Fleveland
Geography	Sandy soil, some sea clay (bodemdata.nl)
Economics	90 enterprises: 10 agriculture/forestry/fishery, 10 extraction/ industry, 55 commercial services, 15 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	0 (Gemeente op Maat 2006, CBS)
Climate impacts	Increase of extreme weather events, temperature rise, sea level rise
Risk map indication	Partial risk of flooding

Municipal Organisation Schiermonnikoog (situation before March 3, 2010)

Board	Mayor and 2 aldermen (1 Schiermonnikoog's Belang, 1 Plaatselijk Belang)
Council	9 members (3 CGS, 3 Schiermonnikoog's Belang, 3 Plaatselijk Belang)
Officials	20

Relevant Documents Schiermonnikoog

- Gemeente Schiermonnikoog (No date). *Schiermonnikoog 2010; authentiek, leefbaar en ondernemend. Raadsprogramma Periode 2006 – 2010*
- Gemeente Schiermonnikoog (2009). *Bestemmingsplan Schiermonnikoog – Dorp.*
- Gemeente Schiermonnikoog (2009). *Milieubeleidsprogramma 2009*.

Case 7: Terschelling

Key Numbers Terschelling

Inhabitants	4,739 (January 1 2009; CBS)
Land area	87 km2 (and 587 km2 water area; Gemeente op Maat 2006, CBS)
Population density	54 (Gemeente op Maat 2006, CBS)
Location	Wadden Sea, province of Friesland
Geography	Sandy soil; some sea clay and peat (bodemdata.nl)
Economics	420 enterprises: 55 agriculture/forestry/fishery, 45 extraction/ industry, 280 commercial services, 40 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	20 (January 2009 CBS)
Climate impacts	Increase of extreme weather events, temperature rise, sea level rise
Risk map indication	Risk of flooding

Municipal Organisation Terschelling (situation before March 3, 2010)

Board	Mayor and 2 aldermen (1 VVD, 1 Plaatselijk Belang)
Council	11 members (3 PvdA, 3 VVD, 3 Plaatselijk Belang, 2 CDA)
Officials	80

Relevant Documents Terschelling

- Gemeente Terschelling (2009). *Milieuprogramma 2009.*
- Minsterie van VROM (2007). *Ontwikkeling van de wadden voor natuur en mens: Deel 4 van de planologische kernbeslissing Derde Nota Waddenzee.*
- Gemeente Terschelling (2008). *Begrotingskrant 2009.*
- Deltacommissie (2008). *Samen werken met water. Een land dat leeft, bouwt aan zijn toekomst. Bevindingen van de Deltacommissie 2008.*

Casus 8: Nijmegen

Key Numbers Nijmegen

Inhabitants	161,675 (January 1 2009; CBS)
Land area	53.6 km2 (and 4.0 km2 water area; Gemeente op Maat 2006, CBS)
Population density	2,979 (Gemeente op Maat 2006, CBS)
Location	Rivierenland, province of Fleveland
Geography	Sea clay, river clay and sandy soils (bodemdata.nl)
Economics	6,540 enterprises: 100 agriculture/forestry/fishery, 920 extraction/ industry, 4,105 commercial services, 1,415 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	5,120 (January 2009; CBS)
Climate impacts	Increase of extreme weather events, temperature rise
Risk map indication	Risk of flooding

Municipal Organisation Nijmegen (situation before March 3, 2010)

Board	Mayor and 5 aldermen (2 PvdA, 2 GroenLinks, 1 SP)
Council	39 members (11 PvdA, 7 SP, 6 GL, 5 CDA, 4VVD, 2 D66, 1 VSP, 1 Nijmegen Nu, 1 Gewoon Nijmegen, 1 Stadspartij Nijmegen)
Officials	2,000

Relevant Documents Nijmegen

- Gemeente Nijmegen (2008). *Stadsbegroting 2009-2012.*
- Gemeente Nijmegen (2009). *Actieplan klimaat 2008-2012.* Retrieved from http://www.onsgroenehert.nl at 15 april 2009.
- CBS (2008). *Gemeente Op Maat 2006: Nijmegen.* Voorburg/Heerlen: Centraal Bureau voor de Statistiek.
- Raadswerkgroep Klimaat (2007). *Kadernotitie klimaat: Een goed klimaat voor verandering.*
- Gemeente Nijmegen (2005). *Rampenplan deel 1: organisatie rampenbestrijding. Nijmegen. Inwerkingtreding 1 juli 2005.*
- *Samen sterk: Bruggen bouwen aan de Waal.* Raadsinitiatiefvoorstel Coalitieakkoord 2006 – 2010 PvdA-SP-GroenLinks. 14 april 2006
- Gemeente Nijmegen et al. (2001). *Waterplan Nijmegen: Stad aan de Waal.*
- Gemeente Nijmegen (2009). *Startnotitie gemeentelijk rioleringsplan III (2010-2016).*

Case 9: Millingen aan de Rijn

Key Numbers Millingen aan de Rijn

Inhabitants	5,850 (January 1 2009; CBS)
Land area	8.7 km2 (Gemeente op Maat 2006, CBS)
Population density	671 (Gemeente op Maat 2006, CBS)
Location	Rivierengebeid, Provincie Gelderland
Geography	River clay soil (bodemdata.nl)
Economics	220 enterprises: 20 agriculture/forestry/fishery, 40 extraction/ industry, 125 commercial services, 35 non-commercial services (Gemeente op Maat 2006, CBS)
Benefits (WW)	70 (January 2009 CBS)
Climate impacts	Temperature rise, extreme weather events, river flooding
Risk map indication	Yes, partial risk of flooding

Municipal Organisation Millingen aan de Rijn (situation before March 3, 2010)

Board	Mayor and 2 aldermen (1 PvdA, 1 VVD)
Council	11 Members (5 PvdA, 2 CDA, 2 GJS, 1 VVD, 1 OPM)
Officials	Two departments; spatial planning and environmental policy are combined in *Bouwen en Wonen*; 36 employees

Relevant Documents Millingen aan de Rijn

- Brandweer MUG (2008). *Beleidsplan Brandweerzorg en Hulpverlening 2008-2011.*
- GGD Regio Nijmegen (2007). *Samen investeren in gezondheid. Concept beleidsplan GGD Regio Nijmegen 2008-2011.*
- Gemeente Millingen aan de Rijn (2008). *Milieujaarprogramma 2009: Millingen duurzaam.*
- Gemeente Millingen aan de Rijn (2009). *Nota Recreatie en Toerisme 2004-2010: Het 'kloppend' Hart van de Gelderse Poort.*
- Gemeente Millingen aan de Rijn (No date). *Bestemmingsplan Millingen.* Retrieved from http://webservice.crotec.nl/module3/gmaps.asp?project=millingen at 30 June 2009.
- MARN (No date). *Energiek op weg naar een beter klimaat. Regionaal klimaatprogramma 2007-2010 MARN regio.*