STATISTICS NETHERLANDS, THE HAGUE

CLIMATE CHANGE ADAPTATION

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Abstract

This study looks at the current situation of climate change adaptation in the Netherlands. The study was commissioned by, and executed on behalf of, Statistics Netherlands in cooperation with the Municipality of Zwolle. The purpose of this study is to establish an overview of what information and data is already present, and what has yet to be identified and/or gathered.

The research scope was narrowed down so that it would only cover the sector of water and spatial management in the region of Zwolle. The study's main question is formulated as follows: what data is available in the databases of Statistics Netherlands in relation to climate change adaptation and the sector of water and spatial management, what data does the Municipality of Zwolle already poses in relation to this sector, what data does the Municipality need to implement climate change adaptation strategies, and how can these two parties proceed in the future to gather and make valuable use of this data?

The study can roughly be divided into three parts; prioritization of the effects of the four climate trends on the sector of water and spatial management, research into these prioritized effects on the sector of water and spatial management, and research on what data is missing according to experts and professionals from the work field in relation to these prioritized effects. Based on this study an advice will be formulated in a separate report.

The study used the National Adaptation Strategy (2016) and the Regional Adaptation Strategy (2017) as framework. These reports describe a total of 44 climate change trends that affect the sector of water and spatial management. In order to focus the research efforts, the effects were prioritized by experts and professionals operating in the Zwolle region and/or working for Statistics Netherlands into the five most ''urgent''. Using semi-structured individual interviews with experts and professionals from Statistics Netherlands, Province of Overijssel, Municipality of Zwolle, Advisory Bureaus, Local Water Boards and those involved with setting up the Regional Adaptation Strategy, the main findings per effect are identified as follows:

1. *Increase in Peak Discharge and Flooding of Flood Defences* – The main data sources are regionally located, and the responsibility lies predominantly with local Water Boards. Enough data is available due to the high impact this effect could have on the city and its surrounding area. Information and data on precipitation figures is considered crucial in tackling this issue.
2. *Excessive Water due to Limited Drainage by Regional Water Systems* – The main data sources are regionally located, and Province and Municipality are responsible. There is a lot of data available, but data gaps can be identified. The combination of physical and monetary data, and the dimensioning of the regional water systems are identified as important data needs.
3. *Increase in Problems Water Discharge by Regional Waters* – The main data sources are regionally located, and the responsibility lies mainly with the local Water Boards. Information and data on how the river banks are currently being used are considered important data needs. As well as more data on pumping stations and the value of real estate in the area.
4. *Decrease in Freshwater Availability* – The main data sources are located on national and regional level. This is partly due to the problem solving of the issue exceeding Municipality or Province boundaries. For example, the possibility of storage opportunities for fresh water in other areas. Data on how the current freshwater supply is being distributed and how other regions use their supplies are considered important data needs.
5. *More Heat Stress and Summer Smog in Urban Areas* – The main data sources are located on national and regional level. Not a lot of data is available, but institutions and organisations are increasing their efforts in tackling this issue. How does our city planning result in heat stress and summer smog is where the data needs lie with this issue.

Keywords: Climate Change Adaptation, Statistics, Data, Water and Spatial Management, Zwolle

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Introduction

According to the United Nations Framework Convention on Climate Change (2014) the term global warming is formulated as follows: ''Global Warming is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (United Nations Framework Convention on Climate Change, 2014). Climate change is a gradual process and includes many uncertainties, but we know that regardless of our efforts, the climate will change. The term climate change can be discussed from two perspectives. On one side there is climate mitigation, which is any action taken to permanently eliminate or reduce the long-term risks and hazards of climate change. On the other side there is climate adaptation, which refers to the ability of a system to adjust to climate change to moderate potential damage, to take advantage of opportunities, or to cope with the consequences (GlobalGreenHouseWarming, n.d.). The focus of this study has been on adaptation. The Netherlands is vulnerable for the effects of climate change, but its knowledge makes it possible to be a frontrunner when it comes to climate change adaptation. Currently there is a lot happening in this country; scientific research, policy making, and actions taken by social organisations, businesses and citizens. These activities all contribute to a more climate resilient Netherlands in the future (Nationale Klimaat Adaptiestrategie, 2016).

On European level countries are currently assessing their vulnerabilities and risks when it comes to climate change, and with it a substantial amount of policies has been put in place. On national level the National Climate Change Adaptation Strategy was presented that targets the country of the Netherlands. On local level, the province of Overijssel designed the Regional Climate Change Adaptation Strategy, using the same diagrams that were being used for the national version. In both the National and Regional Adaptation Strategies, four climate change trends are discussed that have effect on nine different sectors. These are outlined in figure 1.1.

Figure 1.1 The Four Climate Trends and Nine Sectors

Source: National Climate Change Adaptation Strategy (2018, p 11)

The governmental organisation Statistics Netherlands (Centraal Bureau voor de Statistiek or abbreviated CBS in Dutch), based in The Hague is curious to find out what statistics are already available regarding climate change adaptation. This has mostly to do with the fact that there is a growing need for statistical data on the topic, and an inventory of such data needs have not been done before by Statistics Netherlands. Statistics Netherlands is cooperating with the Municipality of Zwolle, a city in the Netherlands in which multiple climate change adaptation activities are already being implemented. An example of this is the recently opened Climate Campus. The Climate Campus is a partnership of more than 40 parties that are committed to making the city of Zwolle and the Delta area more resilient to climate change, now that the effects of climate change are becoming increasingly noticeable throughout the Netherlands and in the rest of the world (Climate Campus, n.d.). Therefore, the deliverable of this study will be an inventory of data availability and needs on climate change adaptation activities, and an advice in the form of an advisory report. Moreover, the focus of the study will be on local level, studying the topic from the perspective of the region of Zwolle. The compilation of statistical data itself is out of the scope, as the inventory should only describe what data is already available and what is needed. With the time and scope of the study in mind, it was decided to focus solely on the sector of water and spatial management.

The structure of the report and its individual components will be as follows: Chapter 1 will dive deeper into the already existing literature on the topic of climate change (adaptation) and its relation to statistical data. Chapter 2 aims at describing the research methodology, comprising of the research methods, data gathering and analysing techniques, and quality assurance aspects of the study, in addition to a theoretical framework. In Chapter 3 the research results are presented, according to their respective research phases. This section also contains the research's conclusion. Chapter 4 will then focus on the contributions of the research to the Advisory Report, and its limitations. Lastly this report will include appendices that have been referred to in this report. Among other relevant information, the appendices include protocols, participant profiles and interview summaries.

Problem Definition
The problem definition, research objective and research questions are based on the literature review and theoretical framework (figure 1.2) presented in chapter 1 on the following page.

There is currently no data inventory on climate change adaptation in relation to the sector of water and spatial management. Statistics Netherlands has data relevant to the topic but is not actively mapping out what kind of data this includes. The Municipality of Zwolle is implementing climate change adaptation activities and will do so even more in the future and will want to make use of multiple information sources, including that in the data bases of Statistics Netherlands, but is curious to know what kind of data this entails. This means that there is a knowledge gap between what is available on one side and requested on the other side.

The statistical framework that is based on the results of this study will provide the organisation and the regionally located organisations and institutions with a prioritized list of climate change effects for the sector of water and spatial management that they can focus their efforts on, in addition to an overview of data relevant to the sector and a step by step guide on how to acquire the missing data through the establishment of collaborations.

Research Objective
Create an overview that includes what data is available and what data is needed in relation to climate change adaptation for the sector of water and spatial management. This product will function as a clear overview of what data is available and what not and includes an advice on how to proceed in the future, on both national and local level.

Research Question
The main research question is defined as follows:

What data is available in the databases of Statistics Netherlands in relation to climate change adaptation and the sector of water and spatial management, what data does the Municipality of Zwolle already poses in relation to this sector, what data does the Municipality need to implement climate change adaptation strategies, and how can these two parties proceed in the future to gather and make valuable use of this data?

The sub-questions are formulated as follows:

- What data on climate change adaptation relevant to the sector of water and spatial management is available in the data bases of Statistics Netherlands?
- What data on climate change adaptation relevant to the sector of water and spatial management is available in the region of Zwolle?
- What data would the Municipality of Zwolle need to develop successful adaptation strategies?
- How can Statistics Netherlands and the Municipality of Zwolle proceed to gather data that can help in designing climate change adaptation strategies?

Chapter 1 - Review of Literature

This chapter aims at exploring the literature relevant to the topic of the study. ''The Earth's climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago marking the beginning of the modern climate era and of human civilization.'' (NASA, Global Climate Change – Vital Signs of the Planet, n.d.). It is stated that ´´the current warming trend is of significance because most of it is extremely likely (greater than 95 percent probability) to be the result of human activity since the mid-20th century and proceeding at a rate that is unprecedented´´ (NASA, Global Climate Change – Vital Signs of the Planet, n.d.). We can observe that the evidence for rapid climate change is compelling; global temperature is rising, oceans are becoming warmer, ice sheets are shrinking, glacial retreat, decreased snow cover, rising sea levels, decline of artic sea ice, extreme weather conditions, and ocean acidification to name just a few.

Climate change, also called global warming, refers to the rise in average surface temperatures on Earth. An overwhelming scientific consensus maintains that climate change is due primarily to the human use of fossil fuels, which releases carbon dioxide and other greenhouse gases into the air (Takepart, n.d.). ''There is broad-based agreement within the scientific community that climate change is real. The U.S. Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration concur that climate change is indeed occurring and is almost certainly due to human activity.'' (Takepart, n.d.). It is clear, based on over a century of scientific investigation, that humans are responsible for most of the climate change we have seen over the last 150 years (National Centre for Science Education [NCSE], 2017). Humans are not the only suspects according to the National Centre for Science Education. The climate has already been changing throughout earth's history, even before humans came to existence.

With the inevitable thought that climate change is happening, it is critical to look at what lies ahead (NASA, Global Climate Change – Vital Signs of the Planet, n.d.). Climate change is one of the most complex issues that our current society is facing. Because we are already committed to some level of climate change, responding to climate change involves a two-pronged approach:

- Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere (mitigation).
- Adapting to the climate change already in the pipeline (adaptation).

Mitigation can be described as follows: ''mitigation, reducing climate change, involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing sources of these gases (for example, the burning of fossil fuels for electricity, heat or transport) or enhancing the sinks that accumulate and store these gases (such as the oceans, forests and soil). The goal of mitigation is to avoid significant human interference with the climate system, and "stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (United Nations Framework Convention on Climate Change, 2014)''. Adaptation is described as ''Adapting to life in a changing climate. It involves adjusting to an actual or expected future climate. The goal is to reduce our vulnerability to the harmful effects of climate change (like sea-level encroachment, more intense extreme weather events or food insecurity). It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions)'' (NASA, Global Climate Change – Vital Signs of the Planet, n.d.).

While mitigation is certainly doing its part in tackling the climate change issues, adaptation needs to be more incorporated into our way of working if we want to make a longer lasting difference. Solving this issue does not only mean reducing our greenhouse gas emissions or place solar panels on every house. It also means adapting our current society for what is to come. ''The Earth's climate has been relatively stable for the past 12,000 years and this stability has been crucial for the development of our modern civilization and life as we know it. Modern life is tailored to the stable climate we have become accustomed to. As our climate changes, we will have to learn to adapt. The faster the climate changes, the harder it could be.'' (NASA, Global Climate Change – Vital Signs of the Planet, n.d.). The Netherlands has the potential to be a frontrunner in the field of climate change adaptation. ''Although climate change is expected to continue, its negative impacts for the Netherlands appear manageable. Here, most climatic changes will take place more gradual than in many other regions, thus enabling citizens, companies and authorities to adapt. Furthermore, current policies focus attention on important aspects of climate change, such as the risk of flooding, drought and precipitation extremes.'' (PBL Netherlands Environmental Assessment Agency, 2013). The Royal Netherlands Meteorological Institute (2017) argues that various effects of climate change can already be observed in the Netherlands. Some of these effects are positive, such as increases in agricultural productivity and the number of fine days for recreation. Others are negative, such as higher risk of river and water drainage flooding (because of intense precipitation) and declining surface water quality (water temperature, algal growth) and biodiversity.

Although global warming is often accosted with negative effects, it is important to note that the increase in temperature can also have a positive effect on our society and well-being (Costinot, Donaldson, Smith, 2016). Costinot et al. argue that the agricultural sector in The Netherlands has the possibility to have a comparative advantage like more southern located European countries. Some crops will be able to grow much more healthily. On the down side the effect could be that other crops disappear. Warmer weather conditions can also have a positive effect on the tourist sector. The Dutch climate can be more attractive compared to other countries in Europe. More people would visit the Netherlands which has a positive effect on the tourist section.

The National Climate Adaptation Strategy designed in 2016, is created to provide insights into what the most important effects of climate change are, and which one of these effects ask for immediate action. It elaborates on stimulating new and already existing initiatives (activities undertaken to adapt to climate change) and broadening those already existing initiatives. This document builds further on a decade of climate adaptation policies in The Netherlands and tries to connect different parties to foster cooperation and create a coherent approach to the issue at hand. Its goal is to make The Netherlands structurally less vulnerable to climate change by the year 2050 (Nationale Klimaatadaptiestrategie, 2016, p6). In the NAS four climate change trends are highlighted that have effect on nine different sectors. These have been presented in figure 1.1 in the introduction as well. These four climate trends have effect on all parts of society. It can be gradual changes, like the increase of the average temperature, but it can also be about changes in frequency and intensity, like what is happening with heat waves. The main message of the National Climate Adaptation Strategy is to highlight the importance of climate change, but not only focus on the negative consequences, but also focus on the possibilities that climate change adaptation can provide. It is happening, what can we do about it, and how can we use it to our advantage. Appendix 6 includes the diagrams that present the information gathered for the National and Regional Climate Change Adaptation Strategies. It visualises the effects of the four climate trends on different aspects of the nine sectors (Nationale Klimaatadaptiestrategie, 2016). A report that builds further on the sector of water and spatial management and its importance in relation to climate change adaptation is the Delta Plan on spatial adaptation 2018. The goal of this program is to adapt to climate change in relation to water security, salt water availability and adaptation of the living space. This provides interesting literature on what is already done throughout The Netherlands. It is requested from local governments, provinces and water boards to latest 2019 have researched the vulnerability of The Netherlands to weather extremes by using stress tests (Deltaplan Ruimtelijke Adaptie, n.d.).

A safe and sustainable delta (a specific area of branches of a river, before it flows into the sea or a large lake), is not a guarantee according to Delta Plan on spatial adaptation. 60% of our country can be flooded and this is categorized as one of the five most disruptive disasters for our society. In 2010 The Netherlands began a unique approach to these challenges (Deltaplan Ruimtelijke Adaptie, n.d.). A national approach with a lot of space for different parties like governments, businesses, social organisations and citizens. In September 2014 they presented approaches and strategies to the House of Representatives which included structural decisions on how to work on the Delta and in the upcoming decades.

Also, important to consider is the economic repercussions flooding can have on the Dutch economy. About a third of the Dutch economy is in danger should a flooding occur (Van Rossum, Schenau, 2009). About 2 million jobs happen to be situated in affected areas with a compiled earning of over 180 billion Euro's. We are now ten years further and the rate at which global warming expands suggest these numbers might be even bigger now. The total reported economic losses caused by weather- and climate-related extremes in the EEA members countries over the 1980-2015 period amounted to over 433 billion euros (Climate Change Adaptation and Disaster Risk Reduction in Europe, 2017). The largest share of the large share of the total losses (70%) have bene caused by a small number of events (3%) (Van Rossum, Schenau, 2009). Hail for example is responsible for significant damage (Climate Change Risk Adaptation and Disaster Risk Reduction in Europe, 2017). According to the EEA Report, three hailstorm events in Germany in July and August 2013 caused around 4.2 billion Euros in combined damage to buildings crops, vehicles, solar panels, greenhouses and other infrastructure. This was due to a heat wave in late July with temperatures more than 35 degrees. Also, in recent years a series of storms between the waters of England and France in December 2013 and February 2014. There has been extensive coastal flooding and damage to coastal structures, including buildings, harbours and sea walls. The costliest damage was to the main railway line to the south-west of England, a section of which was washed away. The repairs cost for this was 25 million, but the indirect economics cost arising from the closure of this section of the railway has been estimated at 65 million to 1.4 billion Euros (Climate Change Risk Adaptation and Disaster Risk Reduction in Europe, 2017).

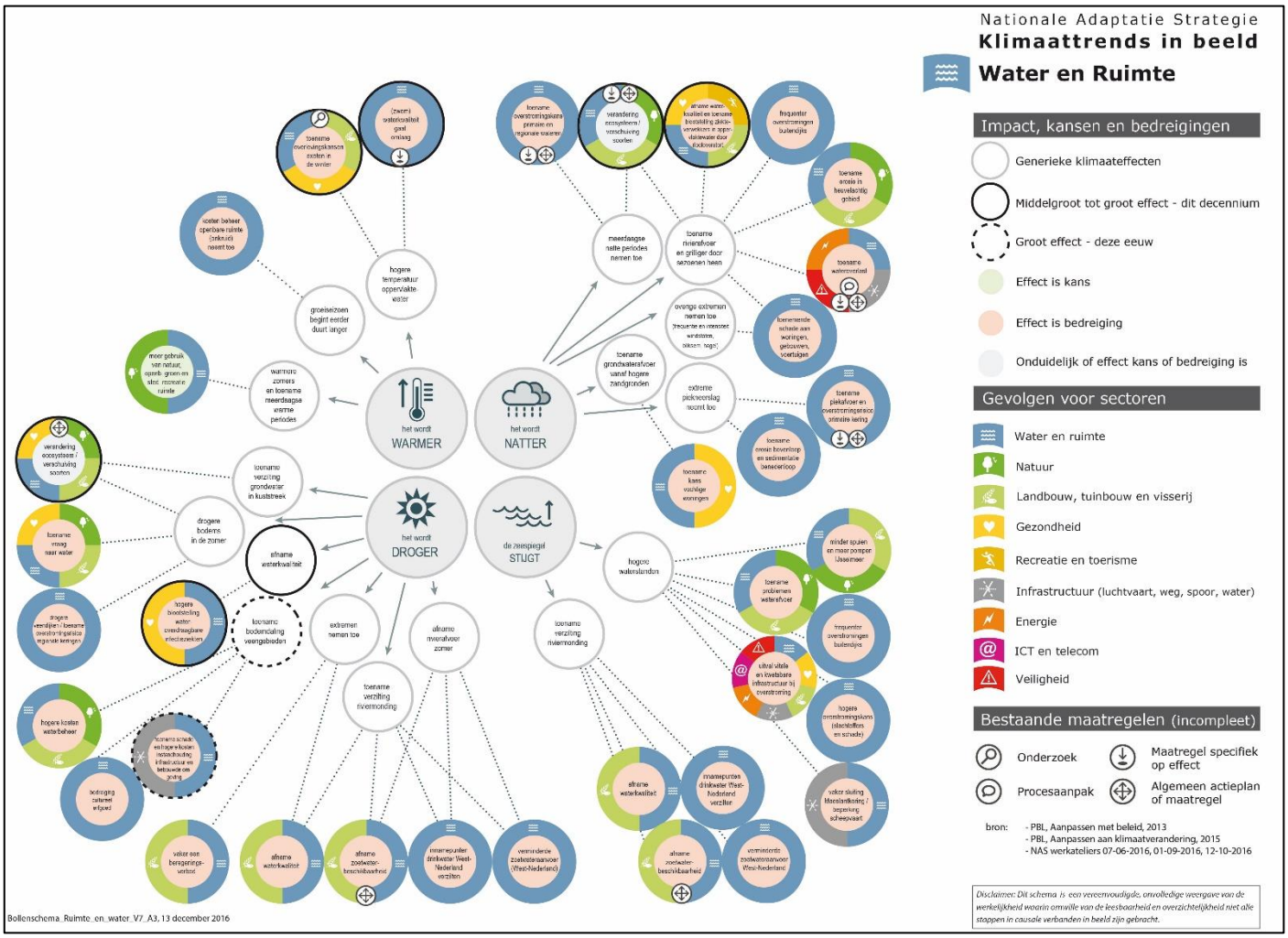
Another spear point in climate adaptation is the coordination of national level indicators. People are working on the issue, they are implementing strategies, they communicate these strategies with other organisations, institutions and governments. But if we want to work as effectively as possible, coordination and the subsequent creation of indicators are needed. ''There are growing demand for the establishment of national-level indicator sets for monitoring CCA and DRR actions in Europe. Progress in implementing the SFDRR will be monitored through an agreed set of indicators, while the UNFCCC is considering how best to track adaptation efforts at national level. The sustainable development goals (SDG's) will also require countries to report on progress. The European Commission will prepare adaptation preparedness scoreboards for each EU member'' (Climate Change Risk Adaptation and Disaster Risk Reduction in Europe, 2017). As we can see the European Commission is actively pushing climate change adaptation in their programs.

In the Netherlands a program has been created for carrying out stress tests to see how climate proof certain areas are (In Dutch ''Handreiking voor de uitvoering van een stresstest klimaatbestendigheid''). It is a report that helps with setting up and executing research on climate resistance and to adapt to these climate changes. Such a stress test focuses on answering the question as to how good we can prevent climate damage, or in case when it is inevitable, how good we are in minimizing this damage. This is basically a framework provided as solution to find out where the problems are and how we can fix these problems. This can be applied to certain sectors or a certain area. This stress test is divided into two phases; a vulnerability scan and an adaptation planning. The vulnerability scan is meant to get an insight in what places are vulnerable for climate change, the urgency of the problem, possible adaptation strategies and possible policies. After this scan plans and regulations can be made to make sure that areas are more resistant to climate change. This is part of the adaptation planning (Handreiking voor de uitvoering van een stresstest klimaatbestendigheid, 2014).

It is as well important to emphasize on the relevance of statistics in relation to climate change adaptation. To make sure the right adaptation strategies are being implemented and correctly monitored, statistics are needed. Knowing what data is available, and what not gives organisation, institutions and municipalities insight into how they can implement climate change adaptation strategies. According to the United Nations Statistics Division; ''most of the literature about climate change is focused on analytical and policy aspects. The guidance available about data and statistics for the measurement of climate change is mainly about methodologies to estimate GHG emissions. However, work is increasingly being conducted to develop methodologies on the other aspects. They include climate change evidence and impacts, quantification of the occurrence of disasters, their magnitude and different impacts, as well as adaptation efforts'' (United Nations Statistics Division, 2017).

Considering the different aspects of the literature and the place of this study within that framework, the diagram as depicted in figure 1.2 has been used as theoretical framework. This diagram has been constructed for the National Climate Change Adaptation Strategy published in 2016, and functions as starting point of this study. The focus of this study lies with the data needs of the five prioritized effects of the sector of water and spatial management which are depicted in figure 1.2, instead of the topic of climate change adaptation itself. As this diagram is already available, it has been agreed to use this as theoretical framework. The individual diagrams per climate change trend can be found in appendix 6.

Figure 1.2 Theoretical Framework Sector Water and Spatial Management



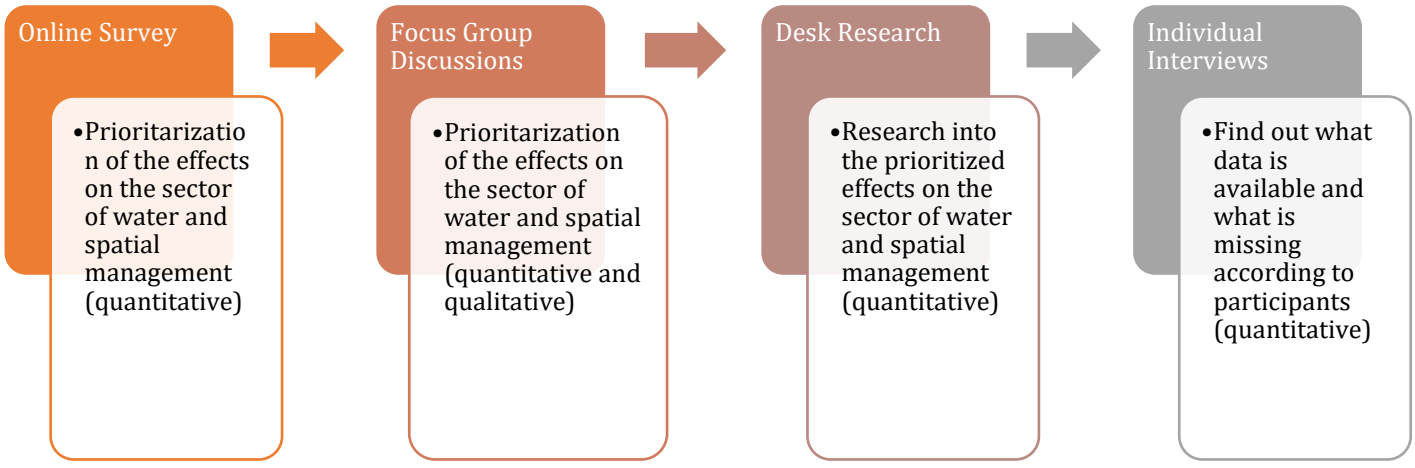
Source: National Climate Change Adaptation Strategy (Meijs, S et al., 2016).

Chapter 2 - Research Methodology

The type of research that was used in this study is a mixed method approach; meaning that both quantitative- and qualitative research methods have been used. Mixed methods research has become an increasingly used and accepted approach to conduct research. Keeping in mind the complicated nature that the topic of climate change adaptation entails, a mixed method approach was able to provide otherwise neglected information and more in-depth knowledge that would not have been collected with the use of only one method. Due to the complicated nature of the topic the organisation has hired two interns to carry out research on the same topic. Whereas this study focused on the sector of water and spatial management, the other study focused on the sector of agriculture. The first phase of the research which included the online survey and focus group discussions was carried out in a combined form. These sessions were structured in such a way that participants were able to fill in the survey for either one or both sectors, depending on their expertise. This was decided as both interns used the network of Statistics Netherlands and that of the Municipality of Zwolle and did not want to overwhelm possible participants.

The research can be divided into three parts; prioritization of the effects of the four climate trends of the sector of water and spatial management, research into these prioritized effects of the sector of water and spatial management, and research on what data is missing according to experts and professionals from the work field in relation to these effects. The methods that have been used to provide an answer for each of these parts are respectively an online survey and focus group discussions, desk research and individual interviews. Conducting focus group discussion with experts from the field in the Municipality in Zwolle and Statistics Netherlands was meant to offer participants the possibility to fill in the online survey with, if necessary, assistance from the researcher and had as purpose to foster discussions among participants. Figure 2.1 showcases the data gathering techniques in addition to descriptions on how they have been used. See appendix 1 and 2 for templates and protocols.

Figure 2.1 Data Gathering Techniques



Quantitative Research Techniques

The online survey has been used during this research as it would be very time consuming to prioritize the 44 effects of the four climate trends on the sector of water and spatial management by having individual interviews. The online survey included a wide variety of experts and professionals (15 in total, next to the participants off the focus group discussions) and offered them the opportunity to give their opinions and motivations on the topic. The survey was send using e-mail among a pre-determined group of participants. A full list of participants and their functions can be found in the appendix 4.

The use of focus group discussions was initially meant to offer the participants the possibility to fill in the online survey with, if necessary, assistance from the researcher and had as purpose to foster discussions among participants. The aim of the focus group discussions was to foster cooperation in solving the presented tasks. The face to face contact during the first focus group discussion at the Municipality of Zwolle on 12th of March motivated the participants to actively engage in filling in the survey. It was then decided to organize two additional sessions with a total of 12 participants on the 21st and 22nd of March at Statistics Netherlands. Due to a low response to the online survey, which was probably due to the time participants needed to invest in the survey, these discussions replaced a part of the data gathering process. This research technique is originally meant to be qualitative research, but for this study it was used to promote the online survey, which is a quantitative research technique. However, since a discussion was included in each session, it can also be partially considered qualitative research.

Desk research has been used during the study to 1 - research the prioritized effects based on and in addition to the results of the online survey and focus group discussions to define terms and guidelines that have been used for the individual interviews, and 2 – provide the study with extra information on what is already being done in relation to the topic. The first part of the desk research was applied after the online survey and focus group discussions had been completed, and before the individual interviews were to be conducted. The second part of the desk research was carried out simultaneously with the individual interviews.

Qualitative Research Techniques

The individual interviews have been used with the intent to get more in-depth knowledge of what kind of data is available or whether any data is available at all. This included both data from within Statistics Netherlands and organisations and institutions in the region of Zwolle. Moreover, using interviews the participants were able to express their opinion on whether they considered this data to be adequate. These interviews were able to build further on the five prioritized effects and the first part of the desk research and therefore aimed at getting a better overview of the situation as it was. A total of 10 individuals have been interviewed during this study. See Appendix 3 for interview protocols.

Sampling

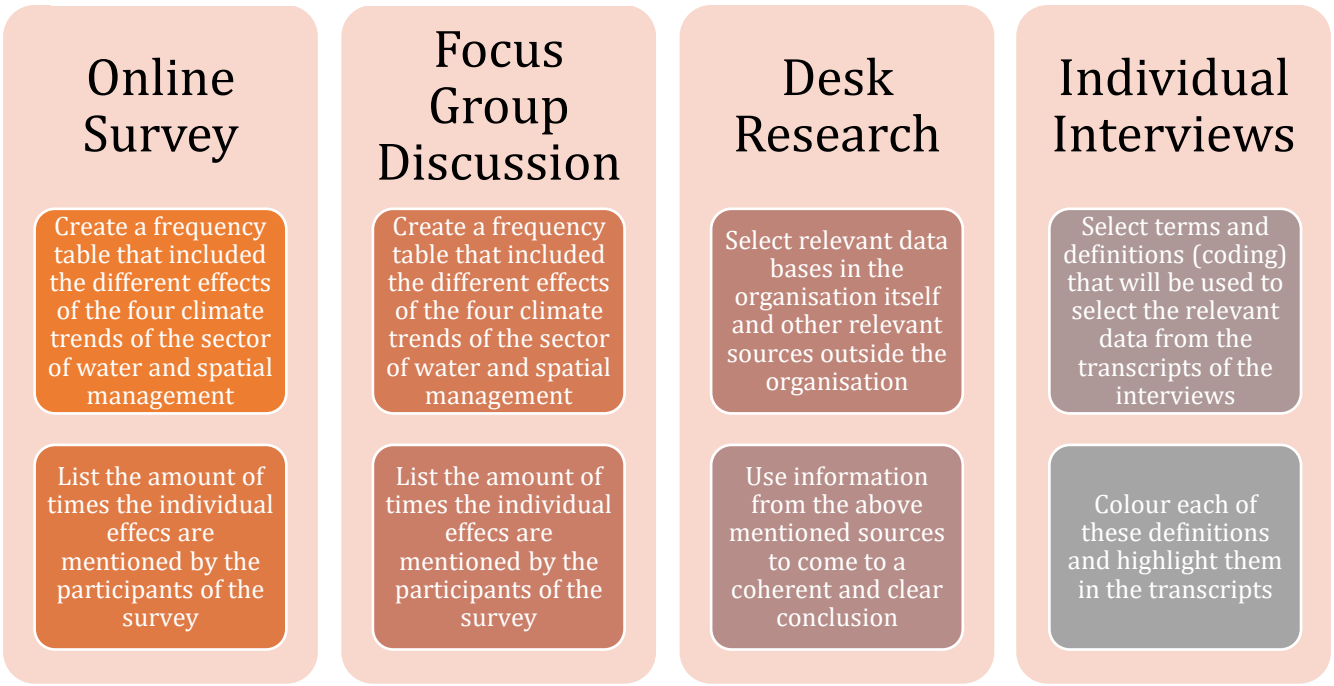
The sample group for the online survey needed to be both representative and able to be a generalization of the total population group. Initial orientation meetings with the in-company mentor of Statistics Netherlands and contact person from the Municipality of Zwolle have resulted in a list of experts and professionals that could be approached for the survey. The Municipality of Zwolle is already frequently organizing focus group discussions to get a better insight into what current issues are in relation to climate change adaptation, and what is being done regarding these issues. After the success of the focus group discussion in Zwolle, the same principle was applied for employees of Statistics Netherlands, with two different sessions being organized there as well. 15 people have been asked to fill in the survey all operating or working in the region of Zwolle, working in the Municipality, Regional Adaptation Plan, Water Systems and Security, Waterschap Drents Overijsselse Delta, and Consultancy Firms. 10 people participated in the first-, and 12 in the second and third focus group discussions. With the research time and scope in mind, it was decided to conduct an additional 10 interviews with experts and professionals from Statistics Netherlands and organisations and institutions in the region of Zwolle. Potential interviewees were selected based on their willingness, availability and connection with the topic of climate change adaptation and the sector of water and spatial management.

Data Analysis

Figure 2.2 represent the individual research methods that were used during the study and the data analysis techniques that were used for each of these methods. For the online survey the 44 effects have been filled in in a table with the corresponding amount of times they have been mentioned and in which place. The results from the focus group discussions have been added to this.

The results of the individual interviews have been transcribed and analysed using coding. These codes have been coloured respectively to a topic of the research.

Figure 2.2 Data Analysis Techniques



Quality Assurance

Two of the most prominent criteria for the evaluation of business and management research are reliability and validity (Business Research Methods, 2013). Reliability is related to whether the results of the research that is conduced can be considered reliable. Other researchers should be able to perform the same experiment under the same conditions and generate the same results. Validity is concerned with the integrity of the conclusions that are generated from the research. Validity is related to how the design is structured and encompasses all the steps of the scientific research method and relates to the research methodology.

For this research the reliability and therefore reproducibility is an interesting and questionable factor. The topic of the research is continuously changing, and we are not able to say that climate change effect that we now label as urgent, will be as urgent in the future. Would this research have been conducted ten years ago, participants would have had different priorities. The same thing can be applied when the research would be carried out ten years in the future. However, should the research be applied somewhere in the upcoming five years for the same sector then the results will be similar. The use of botch qualitative and quantitative research methods adds to the reliability. As for the validity, the instruments and procedures that were used have measured that what they were supposed to measure. This is due to the use of a wide variety of experts and professional that operate in the sector of water and spatial management and a research methodology that includes different methods and techniques. A total of 35 people has in one way or another participated in this study and this greatly adds to the validity. Should the same structure be used to study other sectors the results can be generalized.

Chapter 3 – Research Results

This chapter aims at describing and illustrating the research's results. Phase I consists of the results and analysis of the online survey and focus group discussions and focuses on the prioritization of the climate change effects of the sector of water and spatial management. The results are discussed per climate trend and summarized in table 3.5. Phase II consists of desk research, and the focus lies on researching what data is already available in relation to the five prioritized effects. Phase III consist of the results and analysis of the individual interviews. The results are discussed per prioritized effect and an overview is given in table 3.6.

Phase I – Prioritization of Effects

The first phase of the research included determining what effects are considered a priority according to experts and professionals working in or on the Municipality, Regional Adaptation Plan, Water Systems and Security, Waterschap Drents Overijsselse Delta, and Consultancy firms, based on the effects of the four climate trends as they were discussed in the Regional Climate Change Adaptation Strategy. As explained in the previous chapter an online survey has been constructed and digitally send to a predetermined list of experts and professionals. The complete list of participants can be found in Appendix 3. Additionally, focus group discussions were used to give the participants the option to fill in the online survey on paper and discuss the results with each another. Due to low survey response, the focus group discussion results eventually replaced a part of the online survey results.

Due to the complicated nature of the topic the organisation has hired two interns to carry out research on the same topic. Whereas this study focuses on the sector of water and spatial management, the other intern focused on the sector of agriculture. The online survey and focus group discussion have been structured in such a way that participants were able to fill in the survey for either one or both sectors, depending on their expertise. This was mainly done as both interns used the network of Statistics Netherlands and that of the Municipality of Zwolle and did not want to overwhelm the participants with double surveys and meetings.

For the sector of water and spatial management, a total of 25 respondents can be identified either having filled in the survey online or on paper during one of the focus group discussions. Based on the gathered data we can draw some preliminary conclusions:

- There is no significant difference between response from respondents of the region of Zwolle and respondents from the Central Agency of Statistics. However, those working in the region of Zwolle were more inclined to give extensive descriptions as to what their reasoning was behind their choices. It can be assumed that this is a consequence of the survey focusing on effects that are identified in the Regional Climate Change Adaptation Strategy, which aims at the region of Zwolle, therefore those working in that area have more specific knowledge on the current situation.
- Since in the Regional Climate Change Adaptation Strategy the four climate trends are separately visualised with their effects on the nine sectors (as discussed in the NAS), there is overlap between the individual effects. It can be difficult and challenging to prioritize five effects from a total of 44 effects, while some of these are very much alike. To make it easier for the participants to fill in the survey the option to merge some of the effects was proposed. However, the results would only be taking into consideration should the respondent have elaborated on why he or she did this.

The results of the online survey, including those from the focus group discussions, can be found in table 3.1 till table 3.4. Each of the four climate trends are visualised in a separate table. The left column represents the main effect in Dutch, and the middle column in English. The right column represents the results from the survey. The position that this effect has been given in the top five of the individual participant has been specified in between brackets. The effects that have a line through them are the effects that have not been mentioned in any of the surveys and will therefore be left out from further research.

Table 3.1 focuses on the 13 effects that come from the climate trend ''it will become wetter''. Both the Dutch and English translations have been given in addition to the results. The effects ''Decrease in concentration contaminants (dilution)'', ''More exposure to water transmittable pathogens due to water in the streets'', and ''Increase in sedimentation watercourses'' have not been mentioned any time by any of the respondents. The effects ''Increase in flooding'', ''Loss of vital and vulnerable infrastructure'', and ''Increase in peak discharge and flooding of flood defences'' have been mentioned the most by respondents. We can see that the effects that occur due to excessive amounts of water in a specific moment of time are mentioned more frequently.

Table 3.1 The Effects of the Climate Trend ''It will Become Wetter''

Het wordt natter / It will become wetter			
Number	*Main Effect (Dutch)*	*Main Effect (English)*	*Survey Results*
1.	Toename kans op vochtige woningen	Increased chance of humid homes	(2) (5) (4) (5) (4)
2.	~~Afname concentratie verontreinigingen (verdunning)~~	~~Decrease in concentration contaminants (dilution)~~	N/A
3.	Toename wateroverlast door beperkte afvoer regionaal watersysteem	Increase in flooding due to limited drainage of regional water systems	(1) (2) (3) (1) (1)
4.	Verandering ecosysteem/ verschuiving soorten	Change in ecosystem / shift of species	(4) (4) (3)
5.	Slechtere waterkwaliteit door afspoeling, erosie en overstort van rioolwater	Worse water quality due to run-off, erosion and overflow of sewage water	(2) (5) (3) (2) (1) (5)
6.	Toename wateroverlast	Increase in flooding	(1) (3) (1) (3) (2) (1) (1) (1) (3) (2)
7.	~~Meer blootstelling aan water overdraagbare ziekteverwekkers door water op straat~~	~~More exposure to water transmittable pathogens due to water in the streets~~	N/A
8.	Toename (letsel)schade personen, groen, (agrarische) gebouwen, voertuigen	Increase in (injuries) damage to people, green areas, (agriculture) buildings and vehicles	(2)
9.	Uitval vitale en kwetsbare infrastructuur	Loss of vital and vulnerable infrastructure	(1) (1) (1) (1) (2)
10.	Negatief effect op toerisme en vestigingsklimaat bedrijven	Negative impact on tourism and business climate	(5)
11.	~~Toename sedimentatie waterlopen~~	~~Increase in sedimentation watercourses~~	N/A
12.	Frequenter overstromen buitendijks	More frequent overflow of the outer dikes	(1)
13.	Toename piekafvoer en overstromingskans keringen	Increase in peak discharge and flooding of flood defenses	(1) (3) (2) (1) (1) (1) (2) (4) (1) (1) (2) (3)

Table 3.2 focuses on the 9 effects that come from the climate trend ''it will become hotter''. Both the Dutch and English translations have been given in addition to the results. The effects ''More use of nature, public green spaces and urban recreational space'', '' other or dying species (because of an increase in heat loving aquatic species)'', and ''Other usage of public space (weeds)'' are not mentioned by any of the respondents. The effect '' More heat stress and summer smog in built-up area (more sick people, hospitalization and deaths)'' is mentioned the most by respondents and is arguably the only effect that is of any importance regarding the climate trend of it becoming hotter.

Table 3.2 The Effects of the Climate Trend ''It will Become Hotter''

Het wordt warmer / It will become hotter			
Number	*Main Effect (Dutch)*	*Main Effect (English)*	*Survey Results*
14.	Meer hittestress en zomersmog bebouwd gebied (meer zieken, ziekenhuisopnamen en doden)	More heat stress and summer smog in built-up area (more sick people, hospitalization and deaths)	(3) (4) (5) (2) (4) (3) (3) (5) (2) (2) (2)
15.	Opwarming (drink) water (meer kans op legionella)	Warming up of (drinking) water, and more chance of legionella	(5) (3) (4) (5)
16.	Hoger watergebruik en piekverbruik	Higher water use and peak consumption	(5) (4) (4)
17.	~~Meer gebruik van natuur, openbaar groen en stedelijke recreatieruimte~~	~~More use of nature, public green spaces and urban recreational space~~	N/A
18.	Toename (overlevingskans) insecten en exoten in winter	Increase (survival rate) of insects and exotics in winter	(3)
19.	Kwaliteit (zwem)water verslechterd (o.a. meer ziekteverwekkers in water)	Quality (swimming) water detoriating (because of more pathogens in the water)	(4) (5)
20.	Meer insecten die ziekteverwekker kunnen overdragen (b.v. muggen)	More insects that can transmit pathogens (e.g. mosquitoes)	(4)
21.	~~Andere of uitstervende soorten (o.a. toename warmte minnende aquatische soorten)~~	~~Other or dying species (because of an increase in heat loving aquatic species)~~	N/A
22.	~~Ander beheer openbare ruimte (onkruid)~~	~~Other usage public space (weeds)~~	N/A

Table 3.3 focuses on the 13 effects that come from the climate trend ''it will become dryer''. Both the Dutch and English translations have been given in addition to the results. The effects ''Threat of cultural heritage'' and ''Shift of ecosystem and species'' are not mentioned by any of the respondents. The results are a little bit more divided for this trend as the effects ''Dryer peat dikes and increase flood risk of flood defences'', ''Increased demand for water'', and ''Decrease in freshwater availability'' received almost equal amount of points.

Table 3.3 The Effects of the Climate Trend ''It will Become Dryer''

Het wordt droger / It will become dryer			
Number	*Main Effect (Dutch)*	*Main Effect (English)*	*Survey Results*
23.	Toename schade infrastructuur en bebouwde omgeving	Increase in damage to infrastructure and built environment	(2)
24.	~~Bedreiging cultureel erfgoed~~	~~Threat of cultural heritage~~	N/A
25.	Drogere veendijken/ toename overstromingsrisico keringen	Dryer peat dikes and increase flood risk of flood defenses	(3) (1) (1)
26.	Toename vraag naar water	Increased demand for water	(4) (1) (2) (2) (5)
27.	~~Verandering ecosysteem/ verschuiving soorten~~	~~Shift of ecosystem and species~~	N/A
28.	Vaker een beregening verbod	More often a watering ban	(4)
29.	Afname stabiliteit kades en beschoeiing	Decrease in stability quays and facing	(5) (1)
30.	Meer zuivering drinkwater door hogere concentraties verontreinigingen	More purification of drinking water due to higher concentrations contaminants	(2) (4)
31.	Hogere blootstelling water overdraagbare infectieziekten	Higher exposure to water communicable diseases	(5)
32.	Water minder bruikbaar of meer voorzieningen voor nodig	Water less useful or more facilities needed	(2) (4) (3)
33.	Verlies aan soorten en Habitats (op land en in water)	Loss of species and habitats (on land and in water)	(4) (4) (3)
34.	Verminderde wateraanvoer (vanuit IJssel)	Reduced water supply (from IJsel)	(2)
35.	Afname zoetwaterbeschikbaarheid	Decrease in freshwater availability	(2) (2) (4) (4) (2) (4)

Table 3.4 focuses on the 9 effects that come from the climate trend ''the sea level rises''. Both the Dutch and English translations have been given in addition to the results. Compared to the other trends, there are more effects that are not mentioned in this trend that in others. Partially as well since some effects mentioned in this trend are mentioned in others as well. Therefore, they did not receive points again. The effect ''increase in problems water discharge from regional waters'' stand out among the other trends.

Table 3.4 The Effects of the Climate Trend ''The Sea Level Rises''

De zee spiegel stijgt / The sea level rises			
Number	*Main Effect (Dutch)*	*Main Effect (English)*	*Survey Results*
36.	~~Afname waterkwaliteit door minder doorspoelen~~	~~Decrease water quality due to less flushing~~	N/A
37.	~~Verminderde zoetwater aanvoer Overijsel~~	~~Reduced freshwater supply in Overijsel~~	N/A
38.	~~Afname zoetwaterbeschikbaarheid~~	~~Decrease in freshwater availability~~	N/A
39.	Stijging grondwaterpeil rondom IJssel en Vecht	Rise in groundwater level around the IJsel and the Vecht	(3) (2) (2) (3) (4) (5)
40.	Toename problemen waterafvoer vanuit regionale wateren	Increase in problems water discharge from regional waters	(1) (1) (1) (1)
41.	~~Inzet IJsselmeer voor zoet water~~	~~Use of Ijselmeer for fresh water~~	N/A
42.	Aanpassen regionaal watersysteem vanwege hogere waterstanden	Adjust regional water systems because of higher water levels	(4) (2) (3) (5) (3) (4) (3) (5) (4)
43.	~~Vaker sluiting Ramspol en kering Zwarte Water/ beperking scheepvaart~~	~~More frequent closure of Ramspol and flooding defenses Zwarte Water / restriction of shipping~~	N/A
44.	~~Afname fysieke ruimte buitendijks voor bedrijven en wonen~~	~~Decrease physical space outside the dikes for companies and living~~	N/A

Some of the effects are not mentioned in any of the respondents answers but are incorporated in other effects that the respondents feel cover the same context. This is elaborated on as well in the participant feedback, and these comments are already integrated in table 3.5. The effects that are not mentioned will from now on be disregarded. There are more number one positions than there are respondents, this is because some respondents placed more than 1 effect on number 1. To specify the afore displayed effects, a point system will be put into place. If the effect has been put on place 1, it will receive 50 points, place 2 is 40, place 3 is 30, place 4 is 20, and place 5 is 10. The amount of point will add up, and from this table 3.5 has been constructed. The total amount of points per effect can be seen between brackets, with the second number the amount of times the effect has been selected as number one by the respondents of the survey.

Based on table 3.5 we can state some general conclusions.

- At first glance we can see that the climate trends ''it will become wetter'' and ''sea level rises'' include the biggest amount of prioritized effects, with each having respectively 10 and 11 effects.
- The trends ''it will become dryer'' and ''sea level rises'' each have 4 number 1 positions, and the trend ''it will become warmer'' has none. However, in the latter of these trends, there is one effect that jumps out: more heat stress and smog in the summer. This effect has been listed a total of 11 times in the top five of the respondents but was not deemed important enough to make it to number one.
- It can be stated that the climate change trend ''it will become wetter'' has been the most important trend for most survey respondents. This trend includes effects that together have gathered a total of 20 number 1 positions.
- A similar situation is happening with the effect '' Increase problems water discharge from regional waters''. It has only been mentioned four times, but all four of these are number 1.

Table 3.5 Survey Results per Trend

	It will become wetter	*It will become hotter*
	1. Increase in peak discharge and flooding of flood defenses **(500/6)** 2. Increase in flooding **(420/5)** 3. Loss of vital and vulnerable infrastructure **(240/4)** 4. Increase in flooding due to limited drainage of regional water systems **(220/3)** 5. Worse water quality due to run-off, erosion and overflow of sewage water **(180/1)** 6. Increased change of humid homes **(100/0)** 7. Change in ecosystem / shift of species **(70/0)** 8. More frequent overflow of the outer dikes **(50/1)** 9. Increase in (injuries) damage to people, green areas, (agriculture) buildings and vehicles **(40/0)** 10. Negative impact on tourism and business climate **(10/0)** 11. Decrease in concentration contaminants (dilution) **(0/0)** 12. More exposure to water transmittable pathogens due to water in the streets **(0/0)** 13. Increase in sedimentation watercourses **(0/0)**	1. More heat stress and summer smog in built-up area (more sick people, hospitalization and deaths) **(310/0)** 2. Warming up of (drinking) water, and more chance of legionella **(70/0)** 3. Higher water uses and peak consumption **(50/0)** 4. Quality (swimming) water detoriating (because of more pathogens in the water) **(30/0)** 5. Increase (survival rate) of insects and exotics in winter **(30/0)** 6. More insects that can transmit pathogens (e.g. mosquitoes) **(20/0)** 7. More use of nature, public green spaces and urban recreational space **(0/0)** 8. Other or dying species (because of an increase in heat loving aquatic species) **(0/0)** 9. Other usage public space (weeds) **(0/0)**
	It will become dryer	*Sea level rises*
	1. Decrease in freshwater availability **(180/0)** 2. Increased demand for water **(160/1)** 3. Dryer peat dikes and increase flood risk of flood defenses **(130/2)** 4. Water less useful or more facilities needed **(90/0)** 5. Loss of species and habitats (on land and in water) **(70/0)** 6. Decrease in stability quays and facing **(60/1)** 7. More purification of drinking water due to higher concentrations contaminants **(60/0)** 8. Increase in damage to infrastructure and built environment **(40/0)** 9. Reduced water supply (from IJsel) **(40/0)** 10. More often a watering ban **(20/0)** 11. Higher exposure to water communicable diseases **(10/0)** 12. Threat of cultural heritage **(0/0)** 13. Shift of ecosystem and species **(0/0)**	1. Adjust regional water systems because of higher water levels **(210/0)** 2. Increase in problems water discharge from regional waters **(200/4)** 3. Rise in groundwater level around the IJsel and the Vecht **(170/0)** 4. Decrease water quality due to less flushing **(0/0)** 5. Reduced freshwater supply in Overijssel **(0/0)** 6. Decrease in freshwater availability **(0/0)** 7. Use of IJselmeer for fresh water **(0/0)** 8. More frequent closure of Ramspol and flooding defenses Zwarte Water / restriction of shipping **(0/0)** 9. Decrease physical space outside the dikes for companies and living **(0/0)**

The Five Prioritized Effects
The five most important effects based on the results of the survey and the point point system that has been put into place are:

1. Increase in Peak Discharge and Flooding of Flood Defences
2. Excessive Water due to Limited Drainage by Regional Water Systems
3. Increase in Problems Water Discharge by Regional Waters
4. Decrease in Freshwater Availability
5. More Heat Stress and Summer Smog in Urban Areas

Increase in Peak Discharge and Flooding of Flood Defences
This effect is a result of the trend ''it will become wetter''. What it entails is that due to more frequent periods of rain, and more extreme and intense periods of rain, more water needs to be discharged by the rivers. Especially in the province of Overijssel and more specifically the region of Zwolle, this is a big problem. For example, in Kampen, a city nearby Zwolle, a bypass has been constructed to give the main river ''the IJssel'' more space (Ruimte voor de Rivier – Ijsseldelta, n.d.). It has frequently happened in the past that the quay in the city centre of Kampen needed to be reinforced with steel plates to stop the high-water levels from flooding into the city and cause damages.

The flood defences protect the country of the Netherlands against flooding, as 60% of the country is vulnerable to it (Rijksoverheid, n.d.). The Netherlands has over 3.700 km of flood defences, including dunes, dikes, dams and storm surge barriers. Recently, on the third of January 2018 the five biggest flood defences closed at the same time for the first time, due to high water levels and heavy rain fail. Without these defences, the region of Zwolle, including most of its nearby cities, would be under water. This recent occurrence highlights the importance of the disastrous consequences this effect can have on the region.

Excessive Water due to Limited Drainage by Regional Water Systems
This effect is a combination of two other effects; ''Excessive water'' and ''Limited drainage by regional water systems''. For the sake of the research we will therefore combine these two effect and name this effect ''Excessive Water due to Limited Drainage by Regional Water Systems''.

Longer periods and more extreme and intense periods of rain and limited drainage by regional water systems are two sides of the same coin so to say. The problems due to excessive water can vary from damages to agriculture, to damages to infrastructure, more water-borne deceases due to water in the streets, and increasingly worse water quality. Excessive water also results in problems with the regional water systems, hence the combination of the two effects. Especially the complicated nature and the vast consequences it can have on bigger as well as smaller scale highlight the importance of this effect. Interesting to notice here as well is the link with other climate change effects and the possibility to combine solutions. Wageningen University & Research for example studies the causes of heavy precipitation and looks for solutions to deal with this phenomenon (Groene Daken, 2016). More green in the city could be a solution: this ensures that water can be drained to the bottom more quickly. Storage of water is also important, because not only the number of heavy showers increases, also periods of drought become longer. Which is another important consequence of climate change.

Increase in Problems Water Discharge by Regional Waters
This effect is strongly connected to the earlier two mentioned effects. Due to excessive rainfall and longer periods of rain, there is no place for the enormous amounts of water to be discharged. The water boards oversee the regional waters and have recently made the decision to increase the water level of the IJssel Lake with at least 20cm, up to 50cm if necessary in summers (Rijkswaterstaat, n.d.). This is part of a measure taken to help increase the availability of fresh water, which we will come back to later. Moreover, it is providing the regional waters with a place to store the amounts of water in periods of excessive rain.

If the regional waters are not able to get rid of excessive water, then the regional water systems will have the same problem, which will in turn increase the problems of the previous two effects. There are large pieces of land in between the regional waters and the dikes that are not always being used to their full potential. At this moment it is mostly being used for agricultural purposes, but it can also be used for recreational purposes. By doing so these parts of land can be used recreationally and given back to the river if it needs more space due to large amounts of water.

Decrease in Freshwater Availability

Enough fresh water is crucial for the stability of dikes and urban development, as well as the drinking water- and electricity supply. Water-dependent sectors, such as the agriculture, shipping and many industries, depend on freshwater for their production. These sectors represent a value of over €193 billion (direct production) and have a share of approximately 16% in the national economy (Deltacommissaris, 2017). Watery nature, the environment in the city and public health also depend on sufficient fresh water. A decrease in freshwater availability can cause major problems. According to the National Water Plan, there is sometimes less freshwater available than the demand. In the future this is expected to occur more often due to climate change, salinization and socio-economic developments such as population growth and economic growth.

The government's policy is aimed at retaining the current foundation for fresh water supply, also in the long term. The aim is to maintain supply levels in areas receiving water from the main water systems. This includes a critical view of water demand and the possibilities for retaining water as much as possible and storing it in the region itself. In areas without supply, the goal is to make a turnaround from an approach aimed at disposal to an approach that also focuses on proper conservation and better utilization of freshwater. As was mentioned earlier the water boards have recently made the decision by the to increase the water level of the IJssel Lake with at least 20cm, up to 50cm if necessary in summers (Rijkswaterstaat, n.d.). This is part of measure taken to help increase the availability of fresh water.

More Heat Stress and Summer Smog in Urban Areas

In recent years the weather is getting more extreme, mainly in summer periods. Higher temperatures and longer periods of hot days contribute to higher temperatures in urban areas and in turn summer smog as well. According to scenarios designed by the KNMI, in 2050 the average summer temperature is 1.0 to 2.3 ˚C higher than in the period 1981-2010 (Koninklijk Meteorologisch Instituut, 2017) Furthermore, heat waves will occur more frequently. Residents of cities are more vulnerable to heat stress, because in the city it is almost always warmer than in the surrounding area.

This heat stress can lead to reduced thermal comfort, sleep disturbance, behavioural change (greater aggression) and reduced labour productivity. Heat stress can also lead to serious heat-related diseases such as: skin rash, cramps, fatigue, strokes, kidney failure and breathing problems. Sometimes heat stress can even cause mortality, as is in recent years often the case with elderly people (Better health channel, 2017).

Phase II – Data Availability on European, National and Local Level

This phase of the research has been carried out simultaneously with the individual interviews. The purpose is to provide the study with extra data on what is already being done on the topic of climate change adaptation and more specifically the sector of water and spatial management in the region of Zwolle. Multiple data sources and documents show that there is substantial information available on the topic of climate change adaptation. We make a distinction between actions on European, national and local level.

''Climate change is happening now and is expected to continue: temperatures are rising, rainfall patterns are shifting, ice and snow are melting, and sea level is rising. Extreme weather and climate related events resulting in hazards such as floods and droughts will become more frequent and intense in many regions. Impacts and vulnerabilities for ecosystems, economic sectors, and human health and well-being differ across Europe. Even if global efforts to reduce emissions prove effective, some climate change is inevitable, and complementary actions to adapt to its impacts are needed'' (Europe Environment Agency – Climate Change Adaptation, 2016). According to the Europe Environment Agency the countries that have signed up to the United Nations Framework Convention on Climate Change (UNFCCC) have agreed that by doing so they will limit the global mean temperature increase since pre-industrial times to less than 2 °C (Europe Environment Agency – Climate Change Adaptation, 2016). According to the Europe Environment Agency, the number of EEA member countries that have adopted a national adaptation strategy has increased since then (Europe Environment Agency – Climate Change Adaptation, 2016), which we will talk about later.

Moreover ''At global, European and national level there is an emerging need to enhance coherence between climate change adaptation (CCA) and disaster risk reduction (DRR) by taking account of their similar objectives and differences. Successful coherence in knowledge base, policies and measures of CCA and DRR reduces both duplication of efforts and lack of coordination at the various levels of governance, contributing to better preparedness and response to disasters, and to sustainable development'' (Climate Change Risk Adaptation and Disaster Risk Reduction in Europe, 2017). They argue that disaster risks and losses are very interesting for policymakers and citizens because we see them more in recent years and will do more so in the future because of projected demographic development and land use change in combination with expansion of residential and economic activities in areas that are vulnerable for disasters and future climate change effects (Climate Change Risk Adaptation and Disaster Risk Reduction in Europe, 2017). This shows that the European Union is not only mapping out policies and regulations for climate change mitigation but also climate change adaptation. They connect different aspects of the topic with each other and stimulate countries to actively participate.

In the National Climate Change Adaptation Strategy, it is argued that ''The Netherlands is particularly susceptible to the effects of climate change. At the same time, our knowledge and expertise enable us to play a prominent role in climate adaptation. Much is happening in terms of research, policy development and practical projects by private sector companies, civil society and engaged individuals'' (Nationale Klimaatadaptiestrategie, 2016). This document stems from state of the art research on various possible scenarios. In this report four climate trends that have effect on four different sectors are depicted. These have been mentioned in the literature review as well.

The province of Overijssel has designed a regional version of the national climate change adaptation plan as well. ''The climate adaptive designing of Overijssel is a responsibility of many parties. Municipalities, water boards and provinces have been asked to identify vulnerabilities and to develop strategies for climate-proof design. Fortunately, there are already many initiatives and programs that shape climate adaptation in Overijssel. A number of these examples can be seen in the Regional Adaptation Plan. The Regional Adaptation Plan (abbreviated to: RAP) is therefore aimed at making it clear at regional level what - in addition to existing initiatives - additional efforts are needed to organize Overijssel climate adaptively'' (Regional Adaptation Strategy, 2017). In this report seven urgent themes have been identified, these are: more heat and water in the city and surrounding villages, Overijssel less accessible, more frequent dropouts of vital and vulnerable functions, Sustainability of agricultural sector, changing nature, limited availability of usable water, increase in flood risk.

''17% of our economy depends on fresh water. The sea level rises, the bottom falls and the extremes increase again. We want to continue to properly protect the population and economic values that have grown in recent decades. The Netherlands places great demands on flood risk management, freshwater availability and climate-proof design'' (Deltaprogramma, n.d.). In 2010, the Netherlands started to solve these issues by urging for a national approach with input for and involvement of regional parties (governments, industry, civil society organisations and citizens). Then in 2014 it was able to submit a proposal for so called Delta Decisions and strategies, and at the end of 2014, the national government laid down these as a policy in the National Water Plan. (Deltaprogramma, n.d.). This approach has provided the delta area with something to hold onto while working on their climate change adaptation strategies. They state that ''The present Delta Program 2018 shows that the implementation of the Delta Plans is well 'on schedule'. ''The planned measures are largely achieved within the agreed time and agreed budget. Since the 1st of January 2017, the legal embedding of the new standards for flood risk management and associated instruments has become a fact: an important milestone and a condition for raising the protection against high water in the coming decades in accordance with the new standard'' (Deltaprogramma, n.d.).

Another example is a program on freshwater availability in the east of the Netherlands. ''It becomes warmer and drier in summer. In the East Region, streams and other watercourses will be drained and groundwater levels may decrease. Not only does it become drier, but heavy (rain) showers will also occur more often in the summer. Those showers can cause flooding's. Longer and more severe periods of drought can lead to economic damage, for example for shipping, agriculture and energy supply. And landscape and nature values will also cause damage'' (Zoetwatervoorziening Oost-Nederland, 2017). They argue that ''It is now time to tackle the freshwater issue. To be able to cope with the current water shortages and to be able to anticipate the effects of climate change in the future, research is needed. What is the current situation, what are the consequences of climate change and what actions are needed for the short (2015) and the long term (2050)'' (Zoetwatervoorziening Oost-Nederland, 2017). The project on The Freshwater Supply East Netherlands is trying to answer these questions.

''Water Flows'; the strategical water agenda of the Municipality of Zwolle is complementing on this topic. They state that Zwolle has participated in the IJssel-Vecht delta area development, and this regional partnership has focused on identifying the tasks and developing long-term perspectives. (Zwolle Stroomt, 2015). ''In the coming years, cooperation within the IJssel-Vecht Delta will focus on the implementation of the Delta Decisions. Zwolle translates the numerous values of water into three central objectives to remain an attractive city in the delta in the future: 1 - Safer and more robust, 2 - More sustainable and more efficient, 3 - More attractive and lively'' (Zwolle Stroomt, 2015). The following section will add to these findings and present the individual interview results.

Phase III – Data Availability and Data Needs on National and Regional Level

The third phase of the research aims at finding out what is already being done in relation to the five prioritized effects, what data is available both at Statistics Netherlands and instances in the region of Zwolle, what data is deemed most important, and what next steps are needed to acquire this missing data or in tackling the issue at hand. Short summaries on what is discussed in the interviews can be found in appendix 4. The results will be presented separately for each of the effects.

Increase in Peak Discharge and Flooding of Flood Defences

In general, the respondents of the interviews have stressed the importance of an increase in peak discharge and the flooding of the flood defences, with the latter being considered crucial. They note as well that this effect contains two problems, as opposite to how it is presented now, which influence one another. They argue that excessive amounts of water can results in peak discharge and therefore result in the flooding of flood defences.

The respondents that work for Statistics Netherlands have indicated that there is no specific data available in relation to peak discharge, but there is data present that focuses on the total discharge. This is data that shows the total discharge for a full year. They can see whether there is variation over the years and make figures based on this data. They are not provided with data on discharges per month or day, so they are not able to measure peak discharges. The data that they do have comes from the Department of Waterways and Public Works[1] and the local Water Boards[2], who are also the responsible organisations when it comes to this effect. A part of this data is also provided for by the Royal Netherlands Meteorological Institute[3]. This institution provides specific data on for example rainfall each day, week, month or year. This data is complemented with data on where this rain falls, how long rain periods last and how this relates to a year prior.

As the responsibility and monitoring of peak discharges lies with regional institutions, much more data is available with for example Department of Waterways and Public Works and the local Water Board. For example, near Kampen (a city a few kilometres from Zwolle), a measurement point has been established that records the beats of the river, so they know how much water is flowing through that part of the river in a specific moment in time. This data is gathered and organized in a data bases that also includes data form measurement point elsewhere in the region, province or country. This data base is called ''Water Base''. These regional institutions have data on the discharges of the local water as well. Those working for Statistics Netherlands argue that if they want to make use of this data, they can request it. However, if they want to be involved with the problem solving of the issue they almost always end up in work area of the local Water Boards.

Again, on regional level a significant amount of data is available in relation to the flooding of flood defences. Respondents argue that they have more grip on topics such as that of the flood defences and one respondent stated that ''we already have flood defences and dikes since the beginning of the 12th century''. Models that record the total amount of discharged water have been created and a lot of money has been invested in the dike reinforcements and the concept of space for the river. Every flood defence has a certain flood probability and they have been adapted to these probabilities over the years by the Department of Waterways and Public Works. The National Information System on Water and Flooding[4] is one of the institutions that also address this topic. This institution contains map layers for professionals of Water Boards, the Department of Waterways and Public Works, safety regions and partners with vital and vulnerable infrastructure (such as network operators). These map layers are used for the preparation for water crises and flooding's in the Netherlands.

Those working for Statistics Netherlands state that there is barely any data available in their data bases in relation to the flood defences and possible flooding of said defences. They do argue that this makes sense since the responsibility lies with regional institutions and organisations. What Statistics Netherlands did acquire in the past is data on the economic consequences of these possibly flooded areas. What would the effect be on the Gross Domestic Product should such an event occur?

Multiple respondents have noted that they see precipitation figures as a crucial point in managing peak discharges in the future. Better monitoring of these peak discharges can give more insight in how to deal with the issue. One concept is already being implemented in the city district of Stadshagen in Zwolle. Multiple measuring devices are currently being put in place to get an overview of the rain fall and their peak discharges. Another important aspect is the trend of working with maps and the usefulness of working with them. Moreover, the connection between cause and effect has been emphasized upon. What is the effect of hardening on peak discharge. One important tool that has been mentioned several times is the Stress Tests. A stress test is a test form in which the stability of a whole is tested. It is tested with a heavier load than usual, often to the point that the system fails. The purpose of this is to investigate what happens and where the boundary lies.

According to the respondents the next steps would first involve the inclusion of The Department of Waterways and Public Works, the local Water Board, Royal Netherlands Meteorological Institute, The National Information System on Water and Flooding and possible also the National Institute for Public Health and the Environment. An extensive inventory of what data needs can already be met with current data needs can then give some more insight. These institutions can together decide where to acquire the missing data from and who would be responsible for this data.

Excessive Water due to Limited Drainage by Regional Water Systems

For this effect, respondents have again noted that a distinction should be made between two separate issues. On the one hand there is the issue of limited drainage by regional water systems, and on the other hand there is the excessive water problem. Excessive water can include more often rain, longer periods of rain and more extreme periods of rain. The problems that this can cause vary from damages to property, agriculture, business and vital and vulnerable infrastructure. Limited drainage by regional water systems only adds to this problem.

Those working at Statistics Netherlands have indicated that almost no data in relation to this effect is available in their data bases. However, what they sometimes come across is the effects of excessive amounts of water on properties. They acquire this data through insurance companies and use this for publishing purposes. The importance of precipitation figures is again mentioned as well. This data can be found at the Royal Netherlands Meteorological Institute. This institution delivers information on the amount of water that falls every day, week, month or year, where this fall and how long these periods last. The Royal Netherlands Meteorological Instituted has also established different measurement spots throughout the city. With this information they can draw up an overview that the Municipality can use while adapting their so called ''hot spots'' where water problems occur. The use of Stress Tests is again mentioned in locating these areas and it is argued that the region of Zwolle is a frontrunner in using this program.

The Water Boards have already carried out different studies on the drainage of water in Zwolle, which have resulted in calculations and figures. However, most data related to the regional water systems come from the Municipality. Respondents that work for the Municipality of Zwolle, and other respondents as well, have also highlighted the importance of a greener city. They argue that making the city greener has the potential to solve a part of the problem that excessive water poses. Some areas in Zwolle are famous for having an overload of buildings and paved grounds, with almost no green to be found. Adapting these spots into green areas with green roofs, green façade's, more planting, water storage areas and less paving and pavement would already help a great deal in dealing with this issue.

What is being done as well is the calculation of rain showers with different degrees of severity. This data is put into systems that define calculations on which areas of the city are most sensitive to heavy rain falls. The Municipality can then see what the water height is, which buildings are hit during periods of rainfall and even the square meters that are connected to these places are visualised. A recently new concept in the Municipality is the use of what they call a ''sas-bak''. This is essentially a program that contains different maps of rain showers per day, city maps, height and depth maps, maps that show where the green areas are located, maps that show the areas that could potentially be flooded if one of the flood defences would collapse etc. What is also included in the system is an overview of what project are currently being implemented or will be so in the future. If one certain street has a lot of problems with excessive water, and a certain project is going to be carried out in that same area, the water problem can be tackled simultaneously with the project that will be carried out in the first place. This system helps with that. All information that the people that have access to this system find relevant can be added.

The issue with local water systems has also been highlighted by some respondents. Sewer systems are being used by two different types of water; wastewater and rainwater. Wastewater is water that is no longer usable for the user and that this user wants to get rid of. The term waste water is mainly used for dirty water. Rainwater is regarded as clean water as part of the sewage system because it can be discharged into surface water without too many measures (depending on the origin). The dimensioning of the sewer systems is the responsibility of the Municipality. Some newer city districts have separate sewer systems that require two pipes: one for waste water and one for rainwater. With separate sewers, all rainwater goes directly to ponds or ditches. The waste water goes to a pumping station. Using these systems can help a great deal with solving the excessive water problem. Wastewater can be discharged at any time. And during periods of heavy rainfall the sewer systems will not experience as much pressure.

As crucial data in solving this issue, the combination of physical and monetary data has been mentioned regularly. Physical data includes how much water has fallen and how high the water levels are. Monetary data is more focused on the damages this has caused to property. For example, whether there have been companies that went bankrupt due to water damages. Combining this data could give more insights. Data on whether houses contain cellars are also considered important and will be even more so in the future. If the Municipality can gather this data and keep a more standardized approach for the whole area, this could be very useful to take into consideration as well.

Increase in Problems Water Discharge by Regional Waters

This effect is heavily connected to ''increase in peak discharge and flooding of flood defences'' and ''excessive water due to limited drainage by regional water systems'', the earlier two mentioned effects. Due to excessive rainfall and longer periods of rain, there is no place for the enormous amounts of water to be discharged. For example, on some occasions the regional waters must dispose of water into the IJsel, but it simply is not able to because the water level of the IJsel is also be very high, which results into excessive amounts of water that have no place to go. As a result, the pieces of land that surround the regional waters will flood.

Those working for Statistics Netherlands acknowledged that there is almost no information or data related to this effect available in their data bases. This is very much a regional problem, and most data is available at the regional Water Board. What Statistics Netherlands do have is data related to supply and disposal of regional waters. They are aware of the amounts of water that come into the country through the main rivers and how much water is being disposed into the ocean. But this is data for the whole country and is therefore not very specific. Those working at Statistics Netherlands do express interest into receiving more of this data, but also acknowledge that the responsibility of this topic lies with the local Water Boards. There is also not much that Statistics Netherlands is able to do regarding this topic, because they would enter the territory of the Water Boards. They are responsible for the local water ways and everything that comes with it.

Those working for the Water Boards also acknowledge the problems of water discharge by regional waters. They argue that enough data is available as to what the discharges of the regional water are, but also see that more needs to be done. The rivers need more space and one of the respondents that work for the Municipality of Zwolle also acknowledge the potential that the river banks have in tackling this issue. These river banks could be used for recreational purposes during times that the water levels are low and can be used as storage for excessive waters when the water levels are high. In doing so the excessive amounts of water can be discharged at times that the regional water levels are more suitable for this.

As crucial data regarding this effect, multiple respondents have stated the importance of information on how the river banks are currently being used. The potential of these areas of land have been discussed earlier as well. Some even believe that the Department of Waterways and Public Works is not living up to these standards.

Moreover, the availability of data regarding pumping stations is considered important. A pumping station is a device for bringing water from a lower level to a higher level. It brings or keeps water in a certain area on a certain level. It has also been mentioned that if we want to look at the potential that the river banks have in solving the problem of excessive water, we also need to know what the value is of real estate in that area.

One concept that is already being put into place is the Bypass near Kampen. This project is part of a program called ''Space for the River''. ''Space for the River IJsseldelta'' is one of the 34 projects of the national program Rijkswaterstaat Space for the River, which makes the river area in the Netherlands safer and more beautiful. There is a risk of flooding due to high water levels on the IJssel for Zwolle, Kampen and the hinterland. To be able to continue to guarantee water safety in this area in the future, it is necessary to give the IJssel more space. Two precautions have been put in place for this. The summer bed of the IJssel is being lowered and a high-water channel is being built, also known as the Reevediep, and a new branch of the IJssel, south of Kampen, towards the Drontermeer.

Decrease in Freshwater Availability
Enough fresh water is crucial for the stability of dikes and urban development, as well as the drinking water- and electricity supply. Water-dependent sectors, such as the agriculture, shipping and many industries, depend on freshwater for their production. Interview respondents have highlighted and acknowledged the importance of this effect and the problems it can potentially cause in the future.

Those working at Statistics Netherlands identify multiple data sources that are related to the topic of freshwater availability. The reason for this is that the problem of freshwater availability is a result of multiple other problems or is being influenced by other factors. One of these factors is irrigation. Statistics Netherlands has data on irrigation that includes data on the number of farmers that use irrigation, where they are located, and in which periods they use this. These farmers can use irrigation in periods that drought is very common. use of irrigation means that the provision of freshwater must be called upon which in turn limits its availability. In such a situation the use of freshwater as drinking water has priority. Statistics Netherlands also has information on the use of water in general throughout the country, among them the region of Zwolle. Sometimes this even includes water usage per month. This is relatively specific data. Those working at Statistics Netherlands do see room for improvement on that aspect.

Data on groundwater surface water is also available in their databases. Groundwater is all water that is present in subsoil, in soils and rocks. Usually this water comes from precipitation, after it reaches the surface it directly or indirectly infiltrates in the ground. A program that complements on this data is the Rural Groundwater Register. The Rural Groundwater Register is a national registration of all groundwater permits and reports for groundwater abstractions, infiltrations and open soil energy systems in the Netherlands. In addition, since September 2013, the Rural Groundwater Register has included data on obliged and licensed closed soil energy systems. The Municipality of Zwolle is a front runner in keeping this database alive, so that it can help them keep an overview of what is currently going on in the region. Statistics Netherlands does have some information that is derivative from this register, but this data has not been updated since 2014.

One of the respondents also noted that important to take into consideration is not only quantity but also quality. Even if we solve the issue of freshwater availability, this does not say anything about the quality of said availability. This is not data that Statistics Netherlands can offer but is more something the National Institute for Public Health and the Environment is working on.

Another program that deals with the issue of freshwater availability is Freshwater supply East Netherlands. This program is a collaboration between different institutions, organisations and other relevant stakeholders that all want to improve the fresh water availability in the East of the Netherlands. They have identified bottlenecks and are working on solutions to improve on these components. Among the involved stakeholders are Municipalities and local Water Boards. One of the solutions that have already been presented is heightening the maximum level of water in the IJselmeer. By adjusting the water level, the Department of Waterways and Public Works can respond better to extreme droughts and the need for fresh water. A fluctuating water level management makes it easier to regulate fresh water during dry and wet periods, by raising or lowering the summer level. This example also addresses another important aspect that was highlighted by respondents. It was often noted that the solution is not just one that can be found in the region itself. Perhaps the need for freshwater will exceed Municipality- and even Provincial borders. Freshwater basins in areas in which the freshwater availability problem is not as urgent can be used to store water for areas in which the problem is indeed immediate.

Again, the usefulness of Stress Tests is emphasized upon while tackling this specific freshwater availability problem. These tests can give good insight as to where fresh water is most needed and where these resources can be gathered from. From the complete top five of prioritized effects it is acknowledged by respondents that for this effect the most data is available. But much more needs to be done as this could potentially have great repercussions in the future. Statistics Netherlands could sit in and potentially even join some of the already existing programs or formulate new ones.

More Heat Stress and Summer Smog in Urban Areas

In recent years the weather is getting more extreme, mainly in summer periods. Higher temperatures contribute to more heat in urban areas and in turn summer smog as well. The heat stress that is a result of this phenomenon can lead to reduced thermal comfort, sleep disturbance, behavioural change (greater aggression) and reduced labour productivity. Heat stress can also lead to serious health-related diseases such as: skin rash, cramps, fatigue, strokes, kidney failure and breathing problems. Sometimes heat stress can even cause mortality, as is in recent years often the case with elderly people.

All of those that participated in the individual interviews and were asked about the topics of heat stress and summer smog indicated that much is already being done. The Municipality of Zwolle has carried out Stress Tests to identify areas in which heat stress is a regularly occurring issue. Institutions and organisations in the region of Zwolle have as well acknowledged that the issue is to be taken seriously. They also stated that again a distinction between two components should be made; heat stress and summer smog. The main difficulty however lies with the term of heat stress itself. It is not something that can be easily measured nor defined. The fact that there are multiple relatively easy to be implemented solutions already available, but are not carried out, also surprised some of the respondents. Transforming concrete walls with more green. Adapting roofs with gardens. More lakes and ponds. Restructuring streets and the planting off grass, trees and planters. All these concepts can help the average temperature in the city to decrease instead of increase. Also, interesting to mention here is the strong correlation with the solutions provided for the problems of the effect ''Excessive Water due to Limited Drainage by Regional Water Systems''.

Another participant also emphasised the effects of this problem on the agricultural sector. He argues that the focus is currently on heat stress in the city, but not so much on what heat stress does to rural areas, and for example the consequences for animals. There are societal and economic ramifications to this as well. The Municipality of Zwolle is currently also funding research of the University of Amsterdam, which is a collaboration between eight Municipalities and the Water Boards on a yet to be carried out research. Purpose is to get more insight into the underlying reasons for heat stress and summer smog, and the results for the city and its inhabitants. This research goes much deeper than just looking at heat maps. During the research the researchers also look at the heat changes during the day, in which places these changes occur and how this is all related to one another.

Statistics Netherlands is also focusing more and more on the reasoning behind, and the consequences of heat stress and summer smog in urban areas. They are actively mapping out what the temperature differences are and transform these numbers into statistics, but also argue that this is not hard data that can help solve the problem. The National Institute for Public Health and the Environment is even more involved with this field, and there is already collaboration between them and Statistics Netherlands. If heat stress is being researched more actively, researchers should also take mortality rates into account. Often there is a strong correlation between warmer- and longer heat periods, and mortality rates of mainly elderly people. More recently another extreme with cold has also resulted in the deadliest week in Dutch history since at least World War II. In the future we also need to look at the way we build our cities, or better said our urban development. Incorporating the consequences of the effect of climate change in the way we built our city, can help us solve some of these problems, among them heat stress and summers smog. New designs and developments can help with this. For example, placing new homes on poles instead of concrete foundations. This will result in better ventilation in cities. Our perspective at architecture needs to be adapted to the demands of the future.

As crucial data respondents noted that the issue of heat stress and summer smog, and its relation to specific data is not that easily identified. Due to the still not so specific definition of heat stress in cities, it is much harder to identify one specific data source that could help solve the problems. It rather consists of multiple components like the amount of green in cities, the amount of lakes, rivers and ponds, the number of paved roads, and to what extend concrete buildings influence heat island in cities. Data combining and putting that data is one systems to be used by multiple institutions is one of the frequently givens solutions. Statistics Netherlands can play a role in this and make it more country grounded.

Conclusion

In conclusion we can say that much is already being done on the topic of Climate Change Adaptation. On European level, national level, and local level policies and regulations have been implemented that focus on making specific areas more climate change resistant. The city of Zwolle and its surrounding area are a frontrunner in adapting to continuously more extreme climate conditions. Institutions, organisation, province and Municipality all have their priorities straight and know what they must work on. They are aware of the problems, where they are situated and how they should deal with it in the future. However, the topic of climate change adaptation is so dispersed and divided into different themes that there is much more a need for collaboration than need for data.

This study aimed at finding out what data is available, what data the different instances possess, and what data they need to implement well-functioning climate change adaptation strategies. A lot of sufficient data is already available, both on national and local level. What kind of data is needed is also clear due to elaborate studies that have focused on climate change adaptation in the past few years. Where this data is situated is perhaps a more relevant question we need to ask ourselves. Which brings us to our last question; How can Statistics Netherlands and the Municipality of Zwolle proceed to gather data that meet the needs of developing climate adaptation strategies? Collaboration is the key. All stakeholders need to sit together and discuss the topic face to face. We have identified the problems, but what are the solutions? What are the individual and specific steps from the moment that we have identified the issue till the moment that the issue is solved. Who is involved in the process? What is their role? This study has filled in the literature gap as it was defined in the literature review. Compare the current situation with how we want it to be in the future and define steps on how we can get there.

These questions formulate the core of the advisory report for Statistics Netherlands, which is based on the results of this study. In this report the successes and failures of the research will be discussed. This report will have as focus to elaborate on what possible next steps could be.

Table 3.6 Overview of Results Individual Interviews

Overview of Results					
Question ↓ Answer →	*Increase in Peak Discharge and Flooding of Flood Defences*	*Excessive Water due to Limited Drainage by Regional Water Systems*	*Increase in Problems Water Discharge by Regional Waters*	*Decrease in Freshwater Availability*	*More Heat Stress and Summer Smog in Urban Areas*
What is currently being done related to this effect?	Statistics Netherlands has some data available, mainly on total discharges. Local institutions have more data, for example through measurement points, flood probabilities, and water maps.	Almost no data is available at Statistics Netherlands. The only data that they come across is data on damages due to this effect. Local institutions have data on rain showers, water systems, and drainage.	Almost no data is available at Statistics Netherlands. They only have data regarding supply and disposal of water in the country through rivers. More is available on local level, for example a project that gives more space to the rivers.	Statistics Netherlands have multiple data sources that touch upon this topic, for example irrigation and water usage. On local level groundwater surface data is available, as well is a program on freshwater supply in the east of the Netherlands.	Statistics Netherlands has no data available right now but is working on this already. On local level some initiatives have found their ground and are starting to launch their ideas, but this is still not so concrete.
What data is according to the expert or professional needed to implement well-functioning climate change adaptation strategies related to this effect?	Information and data on precipitation figures is considered crucial. The usefulness of Stress Tests should also not be underestimated.	The combination of physical and monetary data, and the dimensioning of the regional water systems.	Information and data on how the river banks are currently being used. Also, more data on pumping stations and their role in this problem, and the value of real estate in the area.	Data on how the current freshwater supply is being distributed and how other regions use their supplies. Can some water be stored by one province and be used by another?	How does our city planning results in heat stress and summer smog? Where are the most urgent places located in the city? The relation to agricultural sector.
Is the expert convinced that this is enough and quality data?	Yes, overall speaking there is enough data. But due to safety concerns more can be done in the future.	A lot is already available, but respondents argue that more needs to be done.	There is a lot of data available, but as to what extend this is valuable remains unclear. Regardless, more needs to be done.	From all effects, respondents noted that most data are known regarding this effect. However, Statistics Netherlands could help with making it more generalized.	There is not enough data available now, but multiple initiatives are put in place to close the knowledge gaps.
According to the expert, what actions need to be taken to acquire more data?	Express data needs with all involved stakeholders. Can current data needs be met, and if not, where do we get this data from?	Creating awareness of the problem. Then prioritize where the hot spots are located. Identify sources more data is needed on.	Where do the priorities lie, how urgent are they, and who is involved are questions that first need to be answered.	Use the Stress Tests to get an overview. Again, where do our priorities lies and how can provinces help each other.	We need to incorporate climate change in the way we structure our cities. Identify what causes heat stress and summer smog.

Additional Comments

Collaboration and Connection
In a significant number of interviews one thing was specifically mentioned by respondents that they found relevant to be mentioned in the professional product; the collaboration between different institutions and organisations on complicated and interrelated topics like climate change adaptation (strategies).

The Department of Waterways and Public Works, Local Water Boards, The Royal Netherlands Meteorological Institute, The National Institute for Public Health and the Environment, Municipalities, Provinces and other stakeholders all participate in solving one of the most pressing concerns that our society is facing; climate change. They all try to identify where the problems come from, where they are exactly situated, and what can be done about them on both short term and long term. Because the problem solving of this massive issue is so spread out over different institutions and organisations, they have lost track of who is focusing on what component(s) and is using what kind of data in the process. Respondents argue that it is not the problem that different stakeholders do not communicate with one another, because they do, it is more that the search for incorporating climate change into their organisations and giving it a place within that organisation is still an ongoing challenge.

Moreover, it was often mentioned that different institutions or organisations are working on the same problem but are not aware of each other that they are. The concept of the ''Sas-Bak'', that was discussed earlier is one of the innovative concepts that is providing a solution to this problem. This system includes different maps of a specific region that show variables like extreme heat or excessive water and numerous projects that are being carried out throughout said area. This helps with keeping an overview and working more efficiently and cost effective in the future. Some people within the Municipality of Zwolle are currently implementing this concept.

Water Quality
The importance of water quality has been mentioned earlier during the explanation of effect ''Decrease in Freshwater Availability''. Even if we solve the issue of freshwater availability, this does not say anything about the quality of said availability. This aspect of the topic is quite interesting; it was not mentioned by any of the respondents, except for one, and scored quite low if we look back at the survey part of the research. This is odd considering that there could be serious health related issues connected to bad water quality. In the end everything that is being done is for the safety of the public.

Subsidies
During the online survey, focus group discussions, individual interviews and desk research, multiple solutions to some of the earlier presented climate change effects have been presented. To solve the problem of excessive water and the problem of heat stress in urban areas, green roofs, facades, parks, ponds, fields of grass and trees can be implemented. These are relatively easy ways to solve a large part of the problem, but individual households and companies are often quite hesitant to use these concepts, because it is expensive. Subsidies by Municipalities or Governments could help solve this issue but are so far not really making a difference and differ greatly between different Municipalities in the country. Some Municipalities have subsidies, and some do not. The amount of the subsidies also varies between Municipalities. A nation-wide subsidy concept has the potential to alter this and provide citizens with the incentive to invest in clean energy sources.

What you see versus what you experience

Most of the effects that are presented in the National Climate Change Adaptation Strategy and the Regional Climate Change Adaptation Strategy are effects that people are directly by affected. We can see the consequences should they happen. For example, excessive water hinders us in our day to day lives as the streets will be flooded. If the regional water systems cannot deal with all the water, we can see the consequences of that in the cities. If the flood defences won't hold, entire cities would be under water. And If there is are long periods of warm or warm weather, we quite soon realize we do not have enough water. Heat stress falls a little bit out of this frame, as we often think we do not experience any consequences. This is even though research shows that due to warm wetter people live shorter and the death rates are much higher than in a normal week. This is something that needs to be considered when new climate change adaptation strategies are being presented.

Public Health

Everything that institutions, organisations, Municipalities and Governments do is for the people. The reason as to why everyone is worrying about the repercussions of climate change is the consequences it can have on humans. It is therefore interesting to see that during the online survey, the focus group discussions and the individual interviews, only one participant mentioned the importance of public health. Every solution that we come up with to tackle one or more of the earlier mentioned effects should be focused on improved the health of those that are being influenced by it. This should be one of the most important components if, or we should rather say when, we look at climate change adaptation strategies. This aspect is also connected to the issue with heat stress that was discussed before. Research shows that death due to warmer weather has become a serious problem in recent years, should this issue then not be a spear point in policies and regulations of governments?

Chapter 4 – Contributions and Limitations

Contribution of Research to Advisory Report

The purpose of the advisory report is to give the organisation, in this case Statistics Netherlands an overview of the current situation of climate change adaptation in the region of Zwolle, and a general outline of how this topic is incorporated into the organisation of Statistics Netherlands. The research as presented in this research report has contributed to this question in the following ways.

The research has provided the organisation with new insights into the sector of water and spatial management. Starting point of the research was the regional climate change adaptation strategy, which has been derived from the National Climate Change Adaptation Strategy. Research has provided a top five of most important or urgent effects in the sector of water and spatial management, so that the organisation is aware of where the priorities are situated. These prioritized issues give the organisation a starting point to focus on. Experts and professionals from both within the organisation and in the region of Zwolle have had the chance to express their opinions and motivations.

In depth interviews with experts and professionals from both Statistics Netherlands and institutions and organisation in the region of Zwolle have contributed to adding information on the earlier five prioritized effects. The questions of what data is available, what data is missing and what data do they consider missing have been tried to be answered. This information will provide the organisation with an in-depth overview on where they specifically need to prioritize their efforts should they decide to gather more data.

It will also shed light on the current situation of Statistics Netherlands in relation to the topic of climate change adaptation. What is the organisation already doing? Where can they improve on? What information do local institutions want to get more insights in? What is the role of Statistics Netherlands in providing this information, if any at all? The same counts for the Municipality of Zwolle and the region of Zwolle. What are they currently doing in relation to this topic? Which issues are more urgent and ask for fast solutions? Where can they improve on? What information do institutions and organisation still need to implement good climate change adaptation strategies? Based on this we have been able to identify what the next steps are that Statistics Netherlands and the Municipality, organisations and institutions in the region of Zwolle need to follow so that climate change adaptation can succeed.

Moreover, the research has provided the organisation with an incentive to improve itself and can use the advisory report and underlying basis of research as a product to show stakeholders and/or partners that they are working on the topic of climate change adaptation and will continue to do so in the future. This brings us back to the issue that was presented in the introduction; ''This has mostly to do with the fact that there is a growing need for statistical data on the topic, and an inventory of such data needs have not been done before by Statistics Netherlands.''. Statistics Netherlands is complying with this demand and showing what they are doing and what not.

Finally, we should mention the cross-organisational character of the topic. This refers to how will the researcher safeguard that the product is not only useful for the internship organisation, but also for the work field. It has already been explained that not only Statistics Netherlands has been involved in this research. It has been a collaboration with the Municipality of Zwolle. Due to the complicated nature of the topic the first phase of the research included the prioritization of the effects for the sector of water and spatial management. These results and the subsequent addition of data gathered from the individual interviews have provided not only the earlier two mentioned stakeholders, but also other organisations or institutions operating in the region of Zwolle on matters that relate to the sector of water and spatial management. They now are aware of where they need to prioritize their efforts, and what type of data is still missing and needs to be gathered.

Research Limitations

This study includes limitations that limit the reliability and validity of the research. They are:

- During the creation of the National Climate Change Adaptation Strategy and the Regional Climate Change Adaptation Strategy, it could have been the case that the people involved in creating the diagrams were more biased. This is out of reach of the research but can still be considered a limitation, as it forms the basis of the research. These participants operate in a certain sector or area and they might want to push their own interest instead of those of the whole field. For example, should someone be concerned with the water quality, then he or she would have labelled this as most urgent, since this is most urgent to him or her. This remains a question. The same argumentation can also be applied to the research itself. It could have been the case that the respondents of the survey were biased.
- Related to the limitation mentioned prior, there is also the chance that the people involved with creating the diagrams do not accurately represent the whole situation. They are not a reliable sample group so to say. Especially the national strategy has such a broad range, that it is possible not everyone was included in the discussion, which can result in faulty conclusions. The people that were present and had the most to say, were heard more than those that did not speak up. Again, the extend of this, or whether this has happened at all, is not known. But it is certainly important to take into consideration.
- Unlike a researcher that has months, years or even a lifetime to research a certain topic, the researcher in this case only had three months to research the topic of climate change adaptation strategies. This study only focuses on one sector out of nine. It can therefore not be considered a complete inventory on climate change adaptation data. This also applies to the individual effects per sector. Out of the 44 effects available for the sector of water and spatial management, only five were included in the research.
- The focus group discussion, online survey and individual interviews were all conducted in Dutch. The language in which the research report and advisory report are written are English. It is important to note that some words may have been lost in translation or were intended to have a slightly different meaning. Overall speaking this is not to be a problem.
- Response to the online survey was quite low. Out of the 15 people that were contacted only three responded. Luckily the focus group sessions discussed the same survey, and therefore made up for the low response.
- Lack of prior research studies on the topic. Overall speaking we can say that a lot of research has been conducted on the effect of climate change and more specifically climate change adaptation. However, the scope of this specific study only included the effects in the region of Zwolle. Moreover, the research only focused on five of the in total 44 effects. Not a lot of research has bene conducted on these specific topics as they apply to a very specific area. Therefore, there is no prior research to which we can compare the results of this study.

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Appendices

Appendix 1 – Survey Protocols

Online Survey Protocol E-mail Format (Dutch)

Survey Water en Ruimte
https://goo.gl/forms/FLmBceqMRD1GU4up1
Survey Landbouw, Tuinbouw en Visserij
https://goo.gl/forms/Qlg35zotEf3kOtQf2

Beste …,

Wij zijn twee vierdejaarsstudenten van de opleiding Global Project and Change Management op het Windesheim Honours College in Zwolle. Op dit moment zitten wij in onze afstudeerperiode, en ons afstudeeronderzoek wordt uitgevoerd in samenwerking met het Centraal Bureau voor de Statistiek (CBS), gemeente Zwolle en Climate Campus Zwolle.

Als afstudeeropdracht doen wij onderzoek naar wat de databehoeften zijn horend bij het onderwerp klimaatadaptatie. In de 'Nationale Adaptatie Strategie' (zie ruimtelijkeadaptatie.nl/nas) worden vier klimaattrends beschreven die effect hebben op negen sectoren:

- Het wordt warmer
- Het wordt natter
- Het wordt droger
- De zeespiegel stijgt

Via Andreas van Rooijen zijn wij naar u gerefereerd als potentiële participant in ons onderzoek. Voor twee sectoren, 'Landbouw, Tuinbouw en Visserij' en 'Water en Ruimte', vragen wij u om een survey in te vullen. U kunt voor een of beide sectoren de survey invullen, afhankelijk van uw expertise. Bij voorkeur richt u zich op Zwolle, de IJssel-Vechtdelta of elders in provincie Overijssel. Alle informatie wordt op prijs gesteld.

Het invullen van een survey zal niet meer dan 20 minuten in beslag nemen. Er zal vertrouwelijk met uw gegevens worden omgegaan en de resultaten worden geheel anoniem verwerkt. Graag ontvangen wij uw reactie voor vrijdag 23 maart.

Wij zijn ons er bewust van dat de afbeeldingen die bijgevoegd zijn in de survey niet op alle computers duidelijk leesbaar is. Daarom zijn de benodigde bollenschema's bijgevoegd in deze mail.

Voor vragen of opmerkingen over de survey 'Water en Ruimte' kunt u mailen naar Pascal Kist (pascal-kist.kist@student.windesheim.nl). Over de survey 'Landbouw, Tuinbouw en Visserij' kunt u een mail sturen naar Harm Jan Haasjes (harm-jan.haasjes@student.windesheim.nl).

Met vriendelijke groet,

Harm Jan Haasjes
Pascal Kist

Online Survey Protocol E-mail format (English)

Survey Water and Spatial Management
https://goo.gl/forms/FLmBceqMRD1GU4up1
Survey Agriculture
https://goo.gl/forms/Qlg35zotEf3kOtQf2

Dear ….,

We are two fourth year students of the study Global Project and Change Management at Windesheim Honours College in Zwolle. Currently we are in our graduating period, and we are doing our graduation internship in collaboration with the Municipality of Zwolle, Statistics Netherlands and the Climate Campus Zwolle.

For our graduation internship we do research as to data needs in relation to the topic of climate change adaptation. In the National Climate Adaptation Strategy (see ruimtelijkeadaptatie.nl/nas) four climate trends are mentioned that have effect on nine different sectors:

- It will become hotter
- It will become wetter
- It will become dryer
- The sea level will rise

Andreas van Rooijen has referred to you as a potential participant in our research. For two sectors; water and spatial management and agriculture, we ask you to fill in a survey. You can do this for one or both, depending on your expertise. Our preference is that you aim at the region of Zwolle, IJssel-Vechtdelta, or another part of the province while filling in the survey. All information will be valued equally.

Filling in of the survey will take no more than 20 minutes of your time. The information that you provide us with will be dealt with confidentially. All answers will be viewed anonymously. We hope to get your response before the 23rd of March.

We are aware that the pictures that are attached to the survey won't be readable for everyone. We have therefore attached the original pictures as attachment in this email as well.

For questions or remarks about the survey ''Water and Spatial Management'' you can e-mail Pascal Kist (pascal-kist.kist@student.windesheim.nl). For questions or remarks about the survey ''Agriculture'' you can e-mail Harm Jan Haasjes (harm-jan.haasjes@student.windesheim.nl).

With kind regard,

Harm Jan Haasjes
Pascal Kist

Online Survey Protocol (Dutch)

Introductie

Allereerst wil ik u hartelijk bedankt voor uw deelname aan dit onderzoek.

Hieronder zullen vier bollenschema's worden gepresenteerd. Ik wil graag van u weten welke vijf effecten het meest urgent zijn, aan de hand van vier bollenschema's. Hierbij kijkt u alleen naar de effecten die gevolgen hebben op sector Water en Ruimte (blauwe bollen). Hierbij is de bedoeling de klimaateffecten te prioriteren van 1. (meest urgent) naar 5. (minst urgent van de vijf). Geef bij elk effect een toelichting over waarom u het urgent vindt, welke databehoeften bij dit effect wel, en welke (nog) niet vervuld worden.

Houd er tijdens het invullen van de vragen rekening mee dat er vier bollenschema´s zijn, waarvan we van u verwachten in totaal vijf te prioriteren. Mocht u vinden dat een aantal effecten op elkaar lijken, dan mogen deze worden samengevoegd.

Nogmaals hartelijk dank voor uw deelname aan dit onderzoek.

Met vriendelijke groet,

Pascal Kist

Vragenlijst

- Bollenschema wordt gepresenteerd
- Experts worden gevraagd de effecten te prioriteren van 1 tot 5, waar 1 het meest belangrijk is en 5 het minst
- Experts worden gevraagd een toelichting te geven op elk van deze sectoren
    - Waarom urgent?
    - Welke databehoefte wordt wel vervuld?
    - Welke databehoefte wordt (nog) niet vervuld?
- In de laatste vraag kunnen eventuele op of aanmerkingen worden gegeven

Online Survey Protocol (English)

Introduction

First, I would like to thank you for taking part in this research.

Below you can find four ''bollenschema's''. I would like to ask you to prioritize the effects that are shown and translate them into a top five. While doing so you only look at the effects that influence the sector of water and spatial management (blue balls). It is the intention to prioritize these effects from 1 (most urgent) to 5 (least urgent of the five). Please explain each of your choices, what data needs are being met for this effect, and what data needs are not being met for this effect.

Keep in mind while filling in the questions that there are four different ''Bollenschema's''. We expect you to prioritize five in total. In case you feel like some effects are like one another, you can merge them together and create your own effect. Please state this as well as the reason why you did this.

Again, your participation in this research is highly appreciated.

With kind regards,

Pascal Kist

Question List

- ''Bollenschema's'' are being presented
- Experts will be asked to prioritize them from 1 till 5, with 1 being the most urgent and 5 being the least urgent.
- Experts are asked to explain each of the effects they place in their top 5.
    - Why is it urgent?
    - What data need is already being met?
    - What data need is not yet being met?
- The last question will be the option for the participants to give remarks.

Appendix 2 - Focus Group Discussion Protocols

Focus Group Discussion Briefing (Dutch)

Wij zijn twee vierdejaars studenten van de opleiding Global Project and Change Management op het Windesheim Honours College in Zwolle. Als afstudeeropdracht doen wij onderzoek voor het Centraal Bureau voor de Statistiek, in samenwerking met de gemeente Zwolle. Wij onderzoeken wat de data behoeften zijn op het gebied van klimaatadaptatie in de regio Zwolle. In opdracht van de Staatssecretaris van Infrastructuur en Milieu is in 2016 de Nationaal Adaptatie Strategie samengesteld. In dit rapport worden vier klimaat trends beschreven die effect hebben op negen sectoren:

- Het wordt warmer
- Het wordt natter
- Het wordt droger
- De zeespiegel stijgt

Omdat het onderwerp klimaatadaptatie nog vrij breed is, hebben we besloten ons te focussen op twee sectoren, namelijk Landbouw, Tuinbouw en Visserij, en Water en Ruimte. Ook hebben we in overleg met CBS en de gemeente Zwolle besloten om dit onderzoek niet op nationaal schaalniveau uit te voeren, maar op regionaal schaalniveau.

Het product dat wij uiteindelijk gaan leveren is een inventarisatie van data behoeften omtrent klimaatadaptatie. Wij gaan kijken welke data er al is, en welke data nog gegenereerd moet worden, zodat er in de toekomst daadkrachtige klimaatadaptatie strategieën kunnen worden geïmplementeerd in de regio Zwolle.

Aangezien de tijd die we voor dit onderzoek hebben gelimiteerd is, willen wij er eerst achter komen bij welke klimaatfactoren de hoogste urgentie is. Deze willen wij bepalen door middel van een korte vragenlijst. In deze vragenlijst vragen wij welke factoren momenteel het belangrijkst zijn binnen de sector van Landbouw, en/of Water en Ruimte om op te focussen.

Focus Group Discussion Briefing (English)

We are two fourth year students of the study Global Project and Change Management at Windesheim Honours College in Zwolle. As graduation assignment we do research for Statistics Netherlands, in Cooperation with the Municipality of Zwolle. We research what the data needs are in climate change adaptation in the region of Zwolle.

Commissioned by the Secretary of State of Infrastructure and Environment the in 2016 published National Climate Adaptation Strategy was requested. In this report four different climate trends are being described that have effect on nine different sectors.

- It will become hotter
- It will become wetter
- It will become dryer
- The sea level will rise

Because the topic of climate adaptation being quite big, we decided to focus ourselves on two sectors; ''Water and Spatial Management'' and ''Agriculture''. In consultation with Statistics Netherlands and the Municipality of Zwolle it was also decided to execute this research on regional level, from the perspective of the Municipality of Zwolle.

The product that will deliver in the end is a data inventory of data needs in relation to climate change adaptation. We will look at what data is already there, and what data still needs to be generated, so that in the future decisive climate adaptation strategies can be implemented in the region of Zwolle.

Considering that the time that we have for our research is limited, we first want to find out what climate factors are of the highest urgency. We hope to determine that through a short survey. In this survey we ask what effects are currently most urgent with the sectors of ''Water and Spatial Management'' and ''Agriculture'', so we can steer our research in that direction.

Focus Group Discussion Presentation (Dutch)

Slide 1

Wij zijn twee studenten van de opleiding Global Project and Change Management op het Windesheim Honours College in Zwolle. Wij zitten nu in ons laatste jaar en als afstudeeropdracht doen wij onderzoek hier bij het Centraal Bureau voor de Statistiek. Dit is in samenwerking met de gemeente Zwolle, en voor onze stage zijn we bezig met het onderzoeken wat de data behoeften zijn op het gebied van klimaatadaptatie in de regio Zwolle.

Slide 2

De basis van ons onderzoek zit in de Nationale Klimaat Adaptatie Strategie, welke in 2016 in opdracht van de Staatssecretaris van Infrastructuur en Milieu is samengesteld. In dit rapport worden vier klimaat trends beschreven die effect hebben op negen sectoren. Elk van deze vier trends heeft op de een of andere manier effect op de individuele sectoren.

Omdat het onderwerp klimaatadaptatie nog vrij breed is, hebben we besloten ons te focussen op twee sectoren, namelijk Landbouw, Tuinbouw en Visserij, en Water en Ruimte. Dit is gedaan in overleg met partijen binnen het CBS, de gemeente Zwolle en het Urban Data Center.

Ook hebben we in overleg met CBS en de gemeente Zwolle besloten om dit onderzoek niet op nationaal schaalniveau uit te voeren, maar op regionaal schaalniveau. Dus zoals eerder gezegd wat zijn de data behoeften op het gebied van klimaatadaptatie in de regio Zwolle.

Daarbij maken wij gebruik van de Regionale Klimaat Adaptatie Strategie, welke gebaseerd is op de nationale versie.

Slide 3

Ons onderzoek bestaat uit drie delen. Eerst willen we door middel van een online survey de verschillende effecten prioriteren. Vervolgens door individuele interviews proberen we erachter te komen welke data belangrijk is. Daarna gebruiken we deze informatie voor deskresearch waarbij we gaan kijken naar welke data al beschikbaar is in de databases van het CBS. Dit zal uiteindelijk worden verwerkt in een adviesrapport voor het CBS hoe zij (of andere statistische autoriteiten) de zogenoemde data gaps kunnen dichten.

Aangezien de tijd die we voor dit onderzoek hebben gelimiteerd is, willen wij er eerst achter komen bij welke klimaatfactoren de hoogste urgentie is. Deze willen wij bepalen door middel van een korte survey. In deze survey leggen wij de vier klimaat trends uit en de effecten die deze hebben op de sector Landbouw, Tuinbouw en Visserij, en de sector Water en Ruimte, door middel van bollen schema's. Aan jullie willen we vragen deze effecten per sector the prioriteren van 1 tot 5.

Slide 4

We hebben daarvoor een schema waar dit kan worden ingevuld en waar ook een korte uitleg kan worden gegeven waarom deze keuze is gemaakt. Het is belangrijk dat de top 5 klimaateffecten (volgens u) in rangorde worden opgeschreven. Houd er rekening mee dat we 5 effecten willen hebben van de in totaal 4 bollen schema's. Mocht je vinden dat sommige effecten kunnen worden samengevoegd, dat kan dit. We zouden het dan wel fijn vinden als dit wordt aangegeven.

Focus Group Discussion Presentation (English)

Slide 1

We are two students of the study Global Project and Change Management at Windesheim Honours College in Zwolle. We are currently in our last year and as graduation assignment we do research here at Statistics Netherlands. This is in cooperation with the Municipality of Zwolle, and for our internship we are researching what the data needs are in the field of climate change adaptation in the region of Zwolle.

Slide 2

The basis of our research is incorporated in the National Climate Change Adaptation Strategy, which was commissioned by the Secretary of State of Infrastructure and Environment in 2016. In this report four climate trends are described that have effect on nine different sectors. Each of these trends has in one way or another effect on these individual sectors.

As the topic of climate adaptation is still quite big, we decided to focus ourselves on two sectors; ''Water and Spatial Management'' and ''Agriculture''. In consultation with Statistics Netherlands and the Municipality of Zwolle it was also decided to execute this research on regional level, from the perspective of the Municipality of Zwolle.

While doing so we will use the Regional Climate Adaptation Strategy, which is based on the National Climate Adaptation Strategy.

Slide 3

Our research is divided into three parts. First, we would like to prioritize the different effects using an online survey. After this we want to find out what data is really considered important and relevant using individual interviews with experts and professionals. After this we will use this data to research the data bases of Statistics Netherlands and see what data is already available and what is still missing. This will eventually be incorporated into an advisory report for Statistics Netherlands and the Municipality of Zwolle (or other authorities), in which we formulate ways to close the data gap.

Considering that we only have limited time for our research, we first want to find out for which effects the urgency is the highest. We will determine this using a shot survey. In this survey we will explain the four climate trends and the effects that they have on the sector of ´´Water and Spatial Management´´ and ´´Agriculture´´. We would like to ask you to prioritize these effects.

Slide 4

To make things easier we created a table in which this can be filled in, as well as an explanation for doing so. It is important that the top 5 are presented according to their importance, with 1 being the most important and 5 the least. Keep in mind we need 5 effects out of the four ´´Bollenschema´s´´ in total. In case you feel like some effects are like one another, you can merge them together and create your own effect. Please state this as well as the reason why you did this.

Focus Group Discussion Table

Water and Spatial Management			
Nr	**Climate Trend**	**Climate Effect**	**Explanation**
1	…….	…….	……
2	…….	…….	……
3	…….	…….	……
4	…….	……..	……
5	…….	……..	……

Appendix 3 – Individual Interview Protocols

Individual Interview Protocol (Dutch)

Voor dat we beginnen, is het goed als ik dit gesprek opneem zodat ik dat later nog weer kan gebruiken om informatie uit te halen?

Het doel van onze research is het uitzoeken welke data er nodig is om goed functionerende klimaat adaptatie strategieën te implementeren in de regio van Zwolle, en in hoeverre deze informatie al beschikbaar is binnen de databases van het CBS.

Een tijdje geleden ben je benaderd om mee te doen aan het ons onderzoek, en tijdens een interactieve sessie hebben we geprobeerd een aantal effecten gerelateerd aan de sector water en ruimte te prioriteren. Dit is voor mij erg handig geweest want ik heb daardoor de in totaal 44 effecten voor deze sector kunnen afschalen naar 5. Wat ook zeker nodig was gezien de tijdsperiode van mijn stage.

Daarbij zijn een aantal effecten volledig wegevallen en een aantal samengevoegd om tot de volgende 5 te komen:

- Toename piekafvoer en overstromingskans keringen
- Toename wateroverlast
- Toename problemen waterafvoer regionale wateren
- Afname zoetwaterbeschikbaarheid
- Meer hittestress en zomersmog bebouwd gebied

Dit is het eerste gedeelte van ons onderzoek geweest, en nu is het doel om uit te vinden welke data er al beschikbaar is en welke nog nodig zijn, gerelateerd aan deze effecten.

1. Kun je me om te beginnen wat over jou vertellen, wat doe jij hier bij het CBS, wat is jouw achtergrond, hoelang werk je hier al?
2. Zoals de top 5 hier is beschreven ben je het daarmee eens? Zijn dit in jouw ogen de meest belangrijke effecten van klimaatverandering in de sector water en ruimte in de regio van Zwolle?
3. Wat wordt er op het moment al gedaan gerelateerd aan deze problemen? (voor alle effecten)
4. Wat voor data zou er volgens jou nodig zijn om goede adaptatie strategieën te implementeren gerelateerd aan dit effect? (voor alle effecten)
5. Wat voor data is er aanwezig bij het waterschap of voor zover jij weet andere instanties in Zwolle gerelateerd aan dit effect? (voor alle effecten)
6. Zou je zeggen dat dat voldoende data is?
7. Wat voor acties moeten er in werking worden gezet om meer data te krijgen?
8. Wat zie jij als cruciale data?
9. Zijn er nog andere dingen die jij kwijt wilt?

Individual Interview Protocol (English)

Before we start, would it be okay for you if I record this interview, so I can make sure I won't miss any information later?

The purpose of our research is finding out what data is needed to implement well-functioning climate change adaptation strategies in the region of Zwolle, and to what extend this data is already available in the data bases of Statistics Netherlands or other instances in Zwolle.

Some time ago you have been approached and invited to participate in our research, and during an interactive session you, among others, have tried to narrow down different effects of four climate trends for the sector of ''Water and Spatial Management''. This has been very useful for me because of it I have been able to narrow down 44 effects to the 5 most important effects. This was very much needed considering the timeframe of my internship.

Some effects have completely fallen away, and some have been merged together to get to the following 5 prioritized effects:

- Increase in Peak Discharge and Flooding of Flood Defences
- Increase in Problems due to Excessive Water
- Increase in Problems Water Discharge by Regional Waters
- Decrease in Freshwater Availability
- More Heat Stress and Summer Smog in Urban Areas

This has been the first part of our research, and now it is our goal to find out what data is already available, and what data is still needed, related to these effects.

1. To start off, can you tell me a little bit about yourself? What do you do here in (company name)? What is your background? How long have you been working here?
2. The way the top 5 is described here, do you agree with it? Are these 5 effects in your eye the most important ones in the sector of water and spatial management?
3. What is currently being done related to these effects? (repeat question)
4. What data is according to you needed to implement well-functioning climate change adaptation strategies related to these effects? (repeat question)
5. What data is currently already present in (company name) in relation to these effects? (repeat question)
6. Would you say this is enough and quality data? (repeat question)
7. What actions need to be taken to acquire more data? (repeat question)
8. What do you see as crucial data? (repeat question)
9. Is there something else you want to mention? (repeat question)

After our research is finished we will hand over and advisory report, would you be willing to receive a copy of that?

Research Participant Profile

Overview Respondents Research Climate Change Adaptation Strategies		
Focus Group Discussion 12th of March		
Name	*Institution*	*Description Company*
Andreas van Rooijen	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Winny Pijl	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Mark Heideveld	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Annemiek Wiegman	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Ciska Waalewijn	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Edith Camerik	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Christian Voortman	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Rienko Baarslag	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.

Peter van Saane	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Paula Bijlsma	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region. It is responsible for carrying out task it is assigned from the government. The participants of the focus group discussion are all part of a workgroup related to climate change.
Focus Group Discussion 21st of March		
Name	*Company*	*Description Company*
Niels Schoenaker	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Cor Graveland	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Marius Reitsema	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Wim de Rooij	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Kees Baas	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Cor van Bruggen	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Focus Group Discussion 22nd of March		
Name	*Company*	*Description Company*
Sjoerd Schenau	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Roel Delahaye	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Rixt de Jong	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Patrick Bogaart	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.

Cor Pierik	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Arthur Denneman	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Individual Interviews Week 14 and 15		
Name	*Company*	*Description Company*
Cor Pierik	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Kees Baas	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Marcel Tonkes	Province of Overijssel	The province decides in principle whether cities and villages can expand, where business parks and office parks may be constructed.
Bas Kolen	Advisory Bureau HKV	The company gives advice on matters related to water security and water norms. Have also been involved with creating the Delta program.
Mirjam Groot Zwaaftink	Province of Overijssel	The province decides in principle whether cities and villages can expand, where business parks and office parks may be constructed.
Toin Lambrechts	Drents Overijselse Waterschap	Water boards are concerned with the management of the water and the care for the technology that has to keep the water under control (water management)
Mark Heideveld	Municipality of Zwolle	The Municipality of Zwolle is responsible for the day to day activities in the region.
Pieter Lems	Drents Overijselse Waterschap	Water boards are concerned with the management of the water and the care for the technology that has to keep the water under control (water management)
Cor Graveland	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.
Sjoerd Schenau	Centraal Bureau voor de Statistiek (CBS)	Centraal Bureau voor de Statistiek is based in the Netherlands and is concerned with collecting, analysing, reforming and publication of statistics in favour of the government, science and companies.

Appendix 4 – Concise Summary Interviews

Cor Pierik

Working on publications in the Environmental department of Statistics Netherlands, Cor Pierik agrees with the top five as presented during the session. For him everything that has to do with water is to be considered more of a problem than everything that has to do with drought. Especially everything in relation to flooding earned high places in his eventual top five. This is also since he is part time farmer as well, active in the region of Zwolle. As he is not working with specific data, he is not fully aware of the data sources CBS has to offer. He also sees the necessity of institutions working together in solving these issues.

Kees Baas

Kees Baas is working in the Environmental department of Statistics Netherlands as well. He is more specifically involved with topics surrounding water, from water quality to water management. He generally agrees with the top five as presented during the interview but does miss the effects related to water quality. He argues that most data can be found at regional institutions that operate in the region of Zwolle. Statistics Netherlands receives this data and then combines it with information of specific households.

Marcel Tonkes

Marcel Tonkes is working for the province and is also active in the organisation of the Delta Plan Adaptation Strategy. He is one of the experts who were involved with creating the Regional Climate Change Adaptation Plan, based on the National Climate Change Adaptation Plan published in 2016. He is accepting of the top five, but critical of the number one; Increase in Peak Discharge and Flooding of Flood Defences. He argues that there is already a lot being done regarding this effect and is more inclined to put excessive waters on top. This effect is hurting society a great deal more than flooding for instance.

Bas Kolen

Working as director of HKV Advisory Bureau on water and water safety, Bas Kolen has expressed interest in the topic of the research. He has also been involved with the water safety and spatial planning aspects of the Delta Program. He thinks that there is still much to be questions in relation to the diagrams that are used as starting point for the research. He believes that participants will look at it from their own professional background. They will therefore not acknowledge what is of highest concern, but more what concerns them. He argues that we should distance ourselves from these diagrams and sees them more as an attempt to put everything together, even though a lot of important aspects are still missing.

Mirjam Groot Zwaaftink

Mirjam Groot Zwaaftink is working for the province with water safety as expertise and where she is mainly focused on working with the flood defenses. She generally agrees with the top five as presented during the interview and believes a lot of data is already available with different instances in the region. However, she does note multiple times that due to the decentralization of some issues, the data and information is spread out over a large field of expertise, and it is therefore often quite hard to get an overview of where this data is. She argues that this is a point for improvement.

Toin Lambrechts

Toin Lambrechts is working for the ''Drents Overijselse Waterschappen'' and is policy advisory on different aspects. He is currently working on the design of regional flooding defenses. As he has not been able to fill in the online survey, this will be the first time he sees the diagrams. He recognizes the top five effects and is not surprised these have come forward. He argues that a lot of data is already available at the water boards, but that more cooperation between institutions is needed. Transferring data to solve multiple problems at the same time would be the goal.

Mark Heideveld

Mark Heideveld is working for the municipality and is focused on management of public spaces. He argues that public health is the most important point to keep in mind when experts or professionals or even institutions or cooperation's look at climate change. His own top five is a little different of the top five that came out of the survey. He does agree with the presented effects, but also emphasizes on the importance of water quality in all of this. He states that effects like excessive water can be seen by everyone, and it therefore looks more important to them. Whereas water quality might even be more important, but society is not aware of it.

Pieter Lems

Pieter Lems is working for the ''Drents Overijselse Waterschappen'' and is a part of the policy department. He is mainly concerned with creating policies that relate to spatial adaptation. Part of that is anticipating on a situation in which the flood defenses cannot hold the water anymore. He is also engaged in bringing the message of certain problem to society. How can we make them aware is a question he is working with? He is happy that ''Increase in Peak Discharge and Flooding of Flood Defences'' is the number one problem as appointed by the experts and professionals, but also points out that these are very physical problems. He would like to see the focus shift more to what comes after.

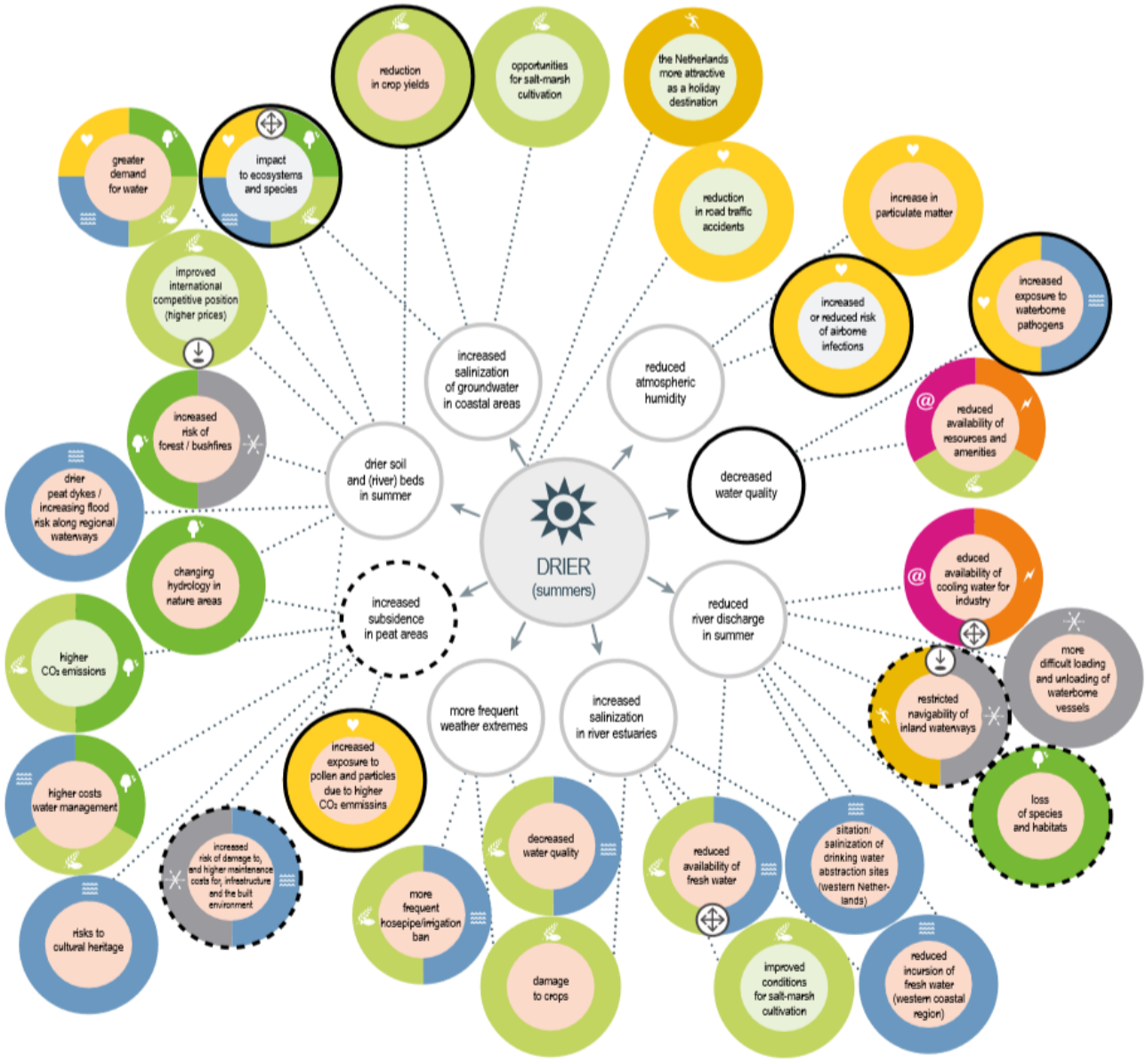
Cor Graveland

Working at Statistics Netherlands, Cor Graveland is concerned with the environmental accounts. He agrees with the top five as presented during the interview, as it is very much alike to his own top five prioritized effects. He was able to give a concise overview of the different data source that Statistics Netherlands has access too and emphasises on the different connections Statistics Netherlands is trying to make with other institutions like the Delta Commission.

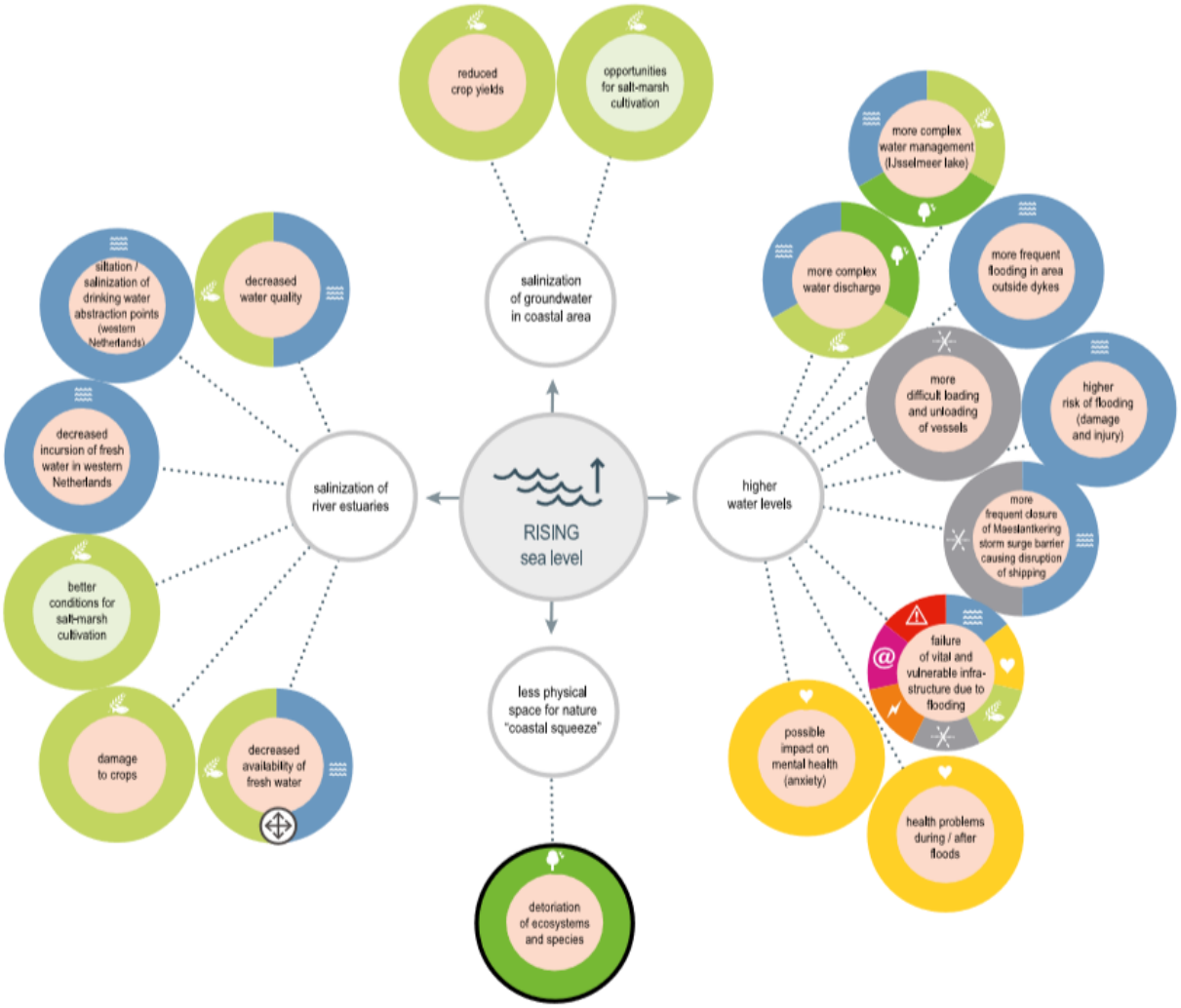
Sjoerd Schenau

Working at Statistics Netherlands, Sjoerd Schenau is concerned with the environmental accounts. He is more specifically focused on topics that relate to the sector of water. He agrees with the top five as it was presented during the interview and acknowledged the fact that these issues are a real problem in the region of Zwolle. Hr was able to give a lot of input and extra information about the sector of water and gave some suggestions as to where I could find more data. Moreover, he was very clear in what the role of Statistics Netherlands could be in relation to the topic of climate change (adaptation), and what the role of the regional institutions would be.

Appendix 5 – National Climate Change Adaptation Strategy Diagrams


DRIER
(summers)
drier soil and (river) beds in summer
increased salinization of groundwater in coastal areas
reduced atmospheric humidity
decreased water quality
reduced river discharge in summer
increased salinization in river estuaries
more frequent weather extremes
increased subsidence in peat areas
reduction in crop yields
opportunities for salt-marsh cultivation
the Netherlands more attractive as a holiday destination
reduction in road traffic accidents
increase in particulate matter
increased or reduced risk of airborne infections
increased exposure to waterborne pathogens
reduced availability of resources and amenities
educed availability of cooling water for industry
more difficult loading and unloading of waterborne vessels
restricted navigability of inland waterways
loss of species and habitats
sitation/ salinization of drinking water abstraction sites (western Nether-lands)
reduced availability of fresh water
reduced incursion of fresh water (western coastal region)
improved conditions for salt-marsh cultivation
damage to crops
decreased water quality
more frequent hosepipe/irrigation ban
increased exposure to pollen and particles due to higher CO2 emmissins
increased risk of damage to, and higher maintenance costs for, infrastructure and the built environment
risks to cultural heritage
higher costs water management
higher CO2 emissions
changing hydrology in nature areas
increased risk of forest / bushfires
drier peat dykes / increasing flood risk along regional waterways
improved international competitive position (higher prices)
greater demand for water
impact to ecosystems and species


WETTER
(rainfall)
increase in length of continuous wet periods
increase in peak precipitation
higher atmospheric humidity
increased groundwater drainage from higher sandy areas
increased river discharge, less predictable across seasons
increase in other forms of extreme weather (high winds, lightning, hail)
impact to ecosystems and species
crop damage
soil compaction
increased risk of flooding in primary and regional waters
new patterns of exposure to pathogens
increase or decrease in crop diseases and pests
increased incidence of mould and dust mite allergies
opportunities for wet nature
increased risk of damp in homes
increased erosion along upper reaches and increased sedimentation elsewhere
more frequent flooding in area outside dykes
increased peak discharges and flood risk in primary waterways
restricted navigability on inland waterways
increased erosion in hilly areas
increased risk of flooding
increased incidence of interior mould and mildew
more accidents (but of lesser severity)
decrease in water quality and increase in exposure to pathogens in surface water due to overflow of raw sewage
more rapid deterioration of infrastructure
reduced operability of infrastructure
greater damage to homes, buildings and vehicles
increased risk of power outages
increased risk for outdoor events
damage to buildings, glasshouses and crops
negative effect on tourism and attractiveness as business location


reduced crop yields
opportunities for salt-marsh cultivation
salinization of groundwater in coastal area
siltation / salinization of drinking water abstraction points (western Netherlands)
decreased water quality
decreased incursion of fresh water in western Netherlands
salinization of river estuaries
better conditions for salt-marsh cultivation
damage to crops
decreased availability of fresh water
RISING sea level
less physical space for nature "coastal squeeze"
detoriation of ecosystems and species
more complex water management (IJsselmeer lake)
more complex water discharge
more frequent flooding in area outside dykes
more difficult loading and unloading of vessels
higher risk of flooding (damage and injury)
higher water levels
more frequent closure of Maeslantkering storm surge barrier causing disruption of shipping
failure of vital and vulnerable infra-structure due to flooding
possible impact on mental health (anxiety)
health problems during / after floods

Glossary

1. Department of Waterways and Public Works is part of the State of the Netherlands and manages the National waters. The emphasis is on the quantity of water.
2. The Water Boards already existed before the State and its Provinces were established. They manage the Local water, whereas the Waterways oversee the sea defences and the dikes of the great rivers.
3. The Royal Netherlands Meteorological Institute provides reliable and consistent measurements, data and prognoses that form the basis for important decision making that keep the Netherlands safe.
4. National Information System on Water and Flooding creates map layers for the preparation for flooding's in the Netherlands.
5. The National Institute for Public Health and the Environment collects knowledge on combating infectious deceases, keeping people healthy, providing good care, monitoring the safety of consumers and promoting a healthy living environment.