

# Climate Change Adaptation

Next Steps by Pascal Kist



# Acknowledgements

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**Centraal Bureau  
voor de Statistiek**



# Abstract

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This report contains an advice for the organization on how to proceed in the future with data needs on climate change adaptation. The research on which this advisory report is based was commissioned by, and executed on behalf of, Statistics Netherlands in cooperation with the Municipality of Zwolle and looks at the current situation of climate change Adaptation in The Netherlands.

The main question this study has tried to answer is 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 effect, 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 presented data is acquired using a mixed methods research design, containing both quantitative and qualitative research methods. The research techniques that have been used during the research are an online survey, focus group discussions (partly instead of the online survey), desk research, and individual interviews.

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 the 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 prioritized effects.

This report gives an overview of the five most urgent effects of climate change on the sector of water and spatial management in the region of Zwolle.

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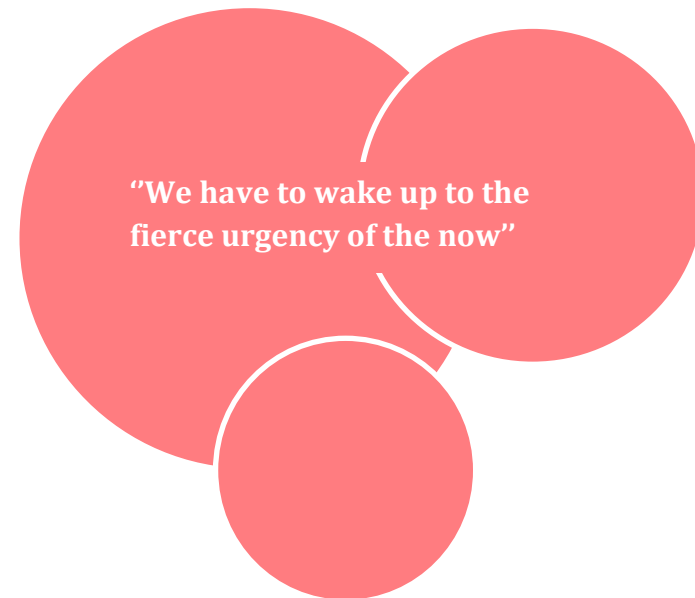
These are increase in peak discharge and flooding of flood defences, excessive water due to limited drainage by regional water systems, increase in problems water discharge by regional waters, decrease in freshwater availability and more heat stress and summer smog in urban areas.

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. How can Statistics Netherlands and the Municipality of Zwolle proceed to gather data that meet the needs of developing climate adaptation strategies?

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.

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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; mitigation and adaptation. The focus here lies with 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).

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

Therefore, the deliverable of this study would be an inventory of data availability and needs on climate adaptation activities, in the form of an advisory report.

Throughout the research the focus has been on local level, studying the topic from the perspective of the region of Zwolle. The compilation of statistical data itself was out of the scope, as the inventory should describe what data is already available and what is needed. Due to time constraints, it was decided to focus solely on the sector of Water and Spatial Management.

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 on the next page. The regional climate change adaptation strategy can also be considered as the starting point of the research since it includes the sector of water and spatial management.

Previous Literature on the topic has proved that 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). While mitigation is certainly doing its part in solving the climate change issues, adaptation still needs to be more incorporated into our way of working. 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.

# Introduction & Background

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. (Nationale Klimaatadaptiestrategie, 2016, p6).

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.

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."

Figure 1.1 The Four Climate Trends and Nine Sectors



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

Given the complicated nature of the topic and subsequent downscaling of the research scope, the organization might opt to conduct more or similar research in the future. Take for example the different sectors that are outlined in figure 1.1. This report focuses on the sector of water and spatial management, but the organization has already expressed interest in conducting research on the other sectors as well. Addressing the successes of this study can help guide future research.

## **Online Survey vs Workshops**

As discussed previously, the first phase of the research focused on prioritizing the effects of the four climate trends on the sector of water and spatial management. The research techniques that were used to do so are an online survey and focus group discussions (FGD). The online survey was initially supposed to be the only data source on which the five effects were based. However, the success of the focus group discussion that was originally meant to test the usability of the survey, prompted the initiation of two additional focus group discussions and the expansion of its function. Simultaneously the number of people that participated in the online survey turned out to be lower than expected. This resulted in the focus group discussions taking over most of the data gathering of the online survey; 22 out of 25 participants came from the FGD's.

Why exactly remains a question, but perhaps the amount of time and actions required to fill in the survey and the complicated nature of the topic has been a burden for the participants. The focus group discussions provided the participants with face to face contact with the researcher and the possibility to express opinions than they would have been able to do so online.

The active and enthusiastic involvement of the FGD participants also contributed in a positive way to the amount of data that the researcher was able to gather. The FGD's were structured in such a way that cooperation between and discussion among participants was stimulated. Moreover, since the subsequent research phase included individual interviews with some of the experts and professionals that participated in the online survey as well, the focus group discussion provided the researcher with the opportunity to establish first contact. Having already seen the participants, approaching them for further research was much easier than it was the case with those that only responded online.

## **Scope Limitation**

The initial objective of the research was to find out what data is already available in relation to climate change adaptation. The collaboration with the Municipality of Zwolle helped to limit the scope to just the area of Zwolle. The national climate change adaptation strategy was initially supposed to be the starting point of the research, but this was eventually narrowed down to the regional climate change adaptation strategy. It was then decided to focus on the sector of water and spatial management, opposed to all sectors as presented in figure 1.1. This sector included 44 effects of climate change, which were eventually prioritized into a top five. The focus of the inventorisation was on the availability of data instead of the data itself.

The process as it is described above was already completed before the research itself has started, with the exclusion of the prioritization of the five effects of the sector of water and spatial management.



The scope limitation has significantly helped in selecting the research objectives and research designs. Maintaining a certain degree of flexibility during the research has now proven to be very useful as a scope limitation proved to be necessary. Due to the scope limitation, the data that has been gathered is much more specific and valuable to the organization.

Moreover, it was initially proposed to include other organizations and institutions during the research as well. It was early on concluded that an inventorisation for Statistics Netherlands and the region of Zwolle could be easily done without the involvement of other organizations and institutions. The inclusion of for example institutions like the national climate change adaptation and Delta plan would broaden but also complicate the study.

## **National vs Local**

As was discussed earlier the focus of the research has relatively soon shifted from national to local/regional. This has contributed to narrowing down the scope of the research and resulted in more useful and specific data. More time and resources would have been needed to research the topic from a national perspective. The objective of the research was to find out what data is already available, and with the inclusion of the region of Zwolle, an actual specific was used to see what data was needed on a local/regional level.

Would the research only have been conducted from the perspective of Statistics Netherlands or only the Municipality of Zwolle, then the results would have been more one sided.

Those working on national level would look at the issue from a general view, but those working on regional level would look at it from a more specific perspective. This has also been evident in the survey and interview results, which has helped a great deal with drawing a cohesive and concise overview of the data availability and data needs.

## **Collaboration**

Much like the previous section of a national versus local perspective, the collaboration between Statistics Netherlands and the Municipality of Zwolle has resulted in an equal and diverse contribution of data during the data collection process. The involvement of national and local institutions and organization has proven to be very futile during the study.

The expertise of experts and professionals from both national and regional level has been used. The involvement of local institutions like the newly established climate campus in Zwolle and Urban Data Centre has provided the research with relevant and valuable network opportunities, while maintaining a certain balance between a national and regional focus.

The decision of Statistics Netherlands to hire two researchers has also proven to be useful. As both researchers focused on a different sector but did use the same research design, they were able to compare their research with one another.



# The Five Effects and Areas for Attention

Throughout the past four months research has been conducted on the topic of climate change adaptation to get a better insight into the data availability and the data needs in the sector of water and spatial management as it was formulated in the regional climate change adaptation strategy. In this section the results will be presented per prioritized effect, in addition to an advice on how to move forward with each of these effects.

## Increase in Peak Discharge and Flooding of Flood Defences

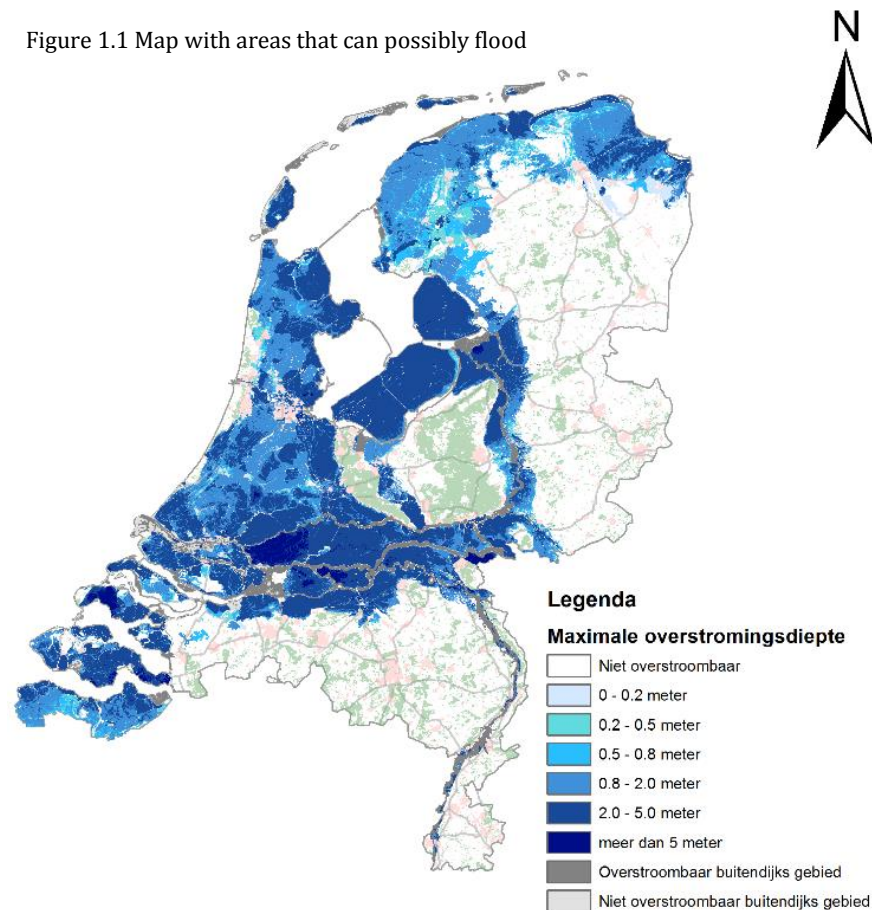
This effect contains two issues. An increase in peak discharge and the flooding of flood defences. According to the research participants this effect has rightfully been put forward as most important. The consensus is that overall speaking a significant amount of data is available, although more regarding the flooding of flood defences than for peak discharge. This is mostly due to the severity of the consequences of the flooding of flood defences.

The data that is available within the databases of Statistics Netherlands contains information on water discharges per year. They can identify variation and patterns, but data on water discharges is much more specifically gathered by the water boards. They use measurement points to see what the specific amount of water is that flows through a certain river on a certain moment in time.

As for the flooding of flood defences there is almost no data available within the data bases of Statistics Netherlands. This is because the responsibility lies with the local water boards. As discussed earlier they have established measurement points and invested vast amounts of money in dike reinforcements and space for the river. Moreover, the use of maps like the ones created by the National Information System on Water and Flooding can help shape a better picture (see figure 1.1).

Respondents also acknowledged that we have had flood defences and dikes since the beginning of the 12<sup>th</sup> century. We have more grip on such topics because we have been controlling and monitoring them for centuries. The National Information System on Water and Flooding for example has already created maps that are used for the preparation of water crisis's and flooding's.

Figure 1.1 Map with areas that can possibly flood



Source: Klimaat in Eigen Handen (2014)

## *Advice*

1. As peak discharges are a result of heavy rainfall, respondents see precipitation figures as important data. Better monitoring of these precipitation figures can give new insights. In the city district of Stadshagen in Zwolle one such concept is already being implemented, with multiple measuring devices placed around the city.

2. Applying the concept of Stress Tests in the region of Zwolle when it comes to peak discharges and flood defence might also give new insights. A stress tests is a test form in which the stability of a whole is tested by using a heavier load than usual, often to the point that the system fails. To what extend this has already been done remains a question according to the respondents.

3. The results of this stress test can function as starting point for a conversation between stakeholders. During this conversation the data availability and data needs of individual institutions and organisations can be attuned to each other. The main responsibility for this effect lies with the waterboards, but Statistics Netherlands could play a role in the collection of for example precipitation figures.

## **Excessive Water due to Limited Drainage by Regional Water System**

The main problem for this effect is the excessive amounts of water that are surfacing due to limited drainage of the water systems. There is data available for this effect, but it is not enough. This effect is also connected to the previous effect since they both have to do with excessive amounts of water.

The data that is available within the data bases of Statistics Netherlands includes damages that are reported by insurance companies due to excessive amounts of water. These are mostly used for publishing purposes. No specific information on the specific amounts of water in a certain region is known, just like no data is available regarding regional water systems.

The responsibility of the regional water systems lies with the municipality, in this case the municipality of Zwolle. They are responsible for the adaptation of these water systems to changing weather conditions. Important data is precipitation figures. This data can provide the municipality with an overview of where the bottlenecks are situated.

Also important for this effect is the use of the water systems. They are used by two different types of water; wastewater and rainwater. Wastewater is water that a user wants to get rid off as it is no longer useful, but rainwater is new and fresh water. Some newer city district has separate sewer systems, but the bigger share has not. Separating these two water types can help a great deal in solving the excessive water issue.

## *Advice*

1. As the problems with the regional water systems are a consequence from heavy rainfall, precipitation figures be important data in solving the issue. Knowing where the problems are situated can guide the improvement efforts of the water systems.

2. An overview of the dimensioning of the water system is a second important aspect in solving this issue. Normal waste water is being discharged all the time, but during periods of heavy rainfall this freshwater can cause peak discharges.

# The Five Effects and Areas for Attention

Our current climate sees more, and extreme rainfall and our water systems need to be adapted to these more extreme weather conditions by for example dividing the regional water systems.

3. A third important data unit is the value of property in a certain region. Due to limited drainage by water systems a certain area experiences excessive amounts of water. This can cause damages to properties. An overview of this data can help identify areas that need to be improved.

## **Increase in Problems Water Discharge by Regional Waters**

This effect occurs due to excessive amounts of water, which is a result of heavy rainfall. These excessive amounts of water need to be discharged by regional water systems in regional waters, and these regional waters discharge the water into the IJssel which transports it to the ocean. If in any case the regional waters cannot discharge the vast amounts of water, this has great consequences for the city and its surrounding area.

There is almost no data available within the data bases of Statistics Netherlands. This is much more a regional issue and it is therefore out of their reach and the responsibility of other institutions. In this case the regional waters are the responsibility of the local water boards. The only data that Statistics Netherlands has in relation to this topic is data on the amounts of water that flow into the country which is gathered by the Department of Waterways and Public Works.

The local water boards have more specific data on the amounts of water that flows through these regional waters. They can identify patterns and with this data decided where they want to store the water, so it can be discharged on a later moment.

## *Advice*

1. Respondents acknowledge that in tackling the issue of excessive amounts of water that need to be discharged by regional waters, knowledge on how much this entails is important. Gathering and incorporating this data into an overview that can be shared with other institutions and organisation can help in solving the issue.

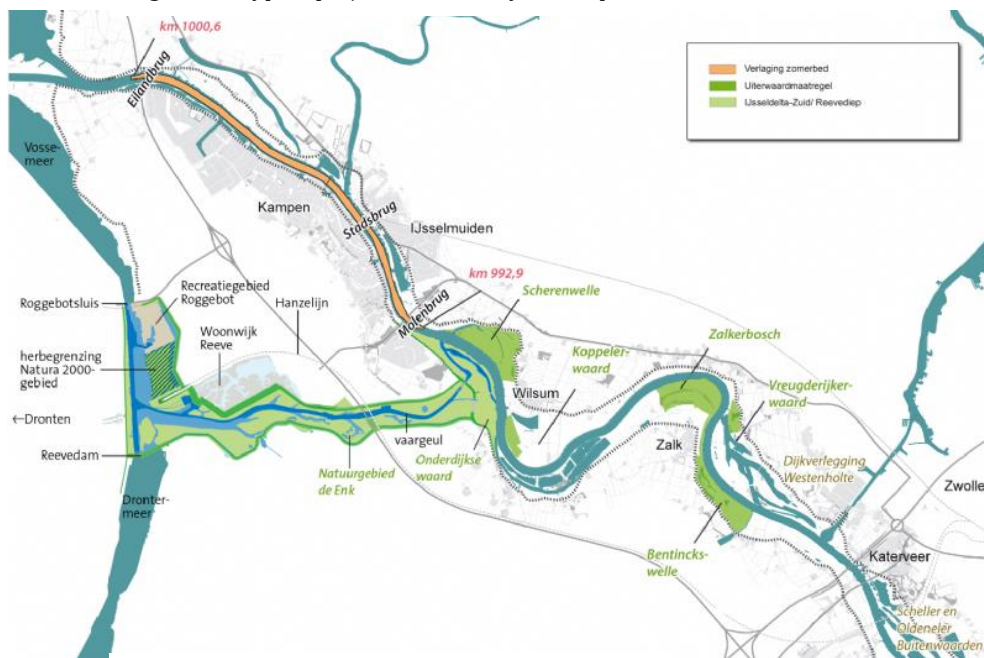
2. A second important data source would be information on how the water banks are currently being used, and how we can use these areas of land to accommodate these excessive amounts of water in the future. Respondents argue that currently large pieces of land in between the dikes and the rivers are barely used. They argue that it would perhaps be an option to give these pieces of land back to the river.

3. A third data source would be information on what the monetary value would be of these areas of land. Then we can answer the questions of whether the to be implemented actions would be worthwhile.

An example on how a concept to give the river more space can be seen in figure 1.2. This is a depiction of a project next to the city of Kampen which is close to Zwolle. The Department of Waterways and Waterworks has decided to install a bypass (the green and blue area), so that the river would have more space to store water in during period with for example heavy rainfall.

# The Five Effects and Areas for Attention

Figure 1.2 Bypass project near the city of Kampen



Source: Ruimte voor de Rivier IJsseldelta (n.d.)

## 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. Respondents argue that this effect has earned its spot in the top five most urgent effects. Especially due to the serious repercussions it can have.

Multiple data sources within the data bases of Statistics Netherlands are in some way relevant to this effect.

There is no data available on the specific amounts of fresh water that is available throughout the country or in a specific area, but data on certain aspects that stimulate this effect. For example, irrigation numbers. Farmers that irrigate their lands use freshwater for this. During period with extreme heat, the freshwater availability decreases, the use of irrigation only adds to this. Statistics Netherlands has data on how many farmers use irrigation on their lands and where these farmers are situated.

Another data source that they have is information on groundwater. So, 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. 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. The Municipality of Zwolle is a front runner in keeping this database going, so that it can help them keep an overview of what is currently going on in the region.

Another program that deals with the issue of freshwater availability is Freshwater supply East Netherlands. This program is collaboration between different institutions, organizations and other relevant stakeholders that all want to improve the fresh water availability in the East of the Netherlands.

## Advice

1. As was mentioned before, important data in tackling this issue is information on how freshwater is being spend throughout the country and in the region of Zwolle, as well as creating an overview of where the freshwater storages are located.

# The Five Effects and Areas for Attention

2. Perhaps the solution is not just one that can be found in the region itself. It is argued that 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 immediate. Data on how other regions deal with this can be useful as well.

3. Moreover it is important to look at the connection of this effect with the earlier presented effects that cover the problem of excessive amounts of water. The earlier mentioned effects all deal with problems of excessive water, the freshwater issue on the contrary is dealing with a shortage of water. Perhaps the solution to this problem is situation in the problem solving of another.

## **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.

Currently not a lot of data is already present in the databases of Statistics Netherlands or in the data bases of institutions and organizations in the region of Zwolle. However, they are aware of the issue and its consequences and are therefore starting to map out the current situation. Statistics Netherlands is 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.

The municipality of Zwolle is currently implementing stress tests to see where the urgent problems are situated. The main difficulty however lies with the term of heat stress itself. It is not something that can be easily measured nor defined. 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.

## *Advice*

1. In tackling the issue of heat stress the main data source that is needed is that of where these so-called heat island in the city are situated, and why specifically these areas face this problem.

2. In the future we also need to look at the way we build our cities and urban development. Incorporating the consequences of the effects of climate change in the way we built our city, can help us solve urgent problems, among them heat stress and summers smog.

3. Moreover it is important to consider that the issue of heat stress and summer smog in urban areas is up until now not a thoroughly research subject. It is very complicated as many components affect the problem. Think about the amount of green in cities, the amount of lakes, rivers and ponds and the number of paved road.



In the previous section we have summarized the results of the research while highlighting the data availability per effect for Statistics Netherlands and institutions and organizations in the region of Zwolle. In addition to this a short and concise advice per individual effect has been formulated with specific critical data needs. This section argues for a general advice on how to proceed after this advisory report has been published.

## **Collaborate and Share**

We can conclude 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 generally 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 has aimed and succeeded in finding out what data is already available, what data is missing, and what data is still needed in relation to the topic of climate change adaptation. Now it is up to all the stakeholders that are involved in adapting to this issue to sit together and discuss what kind of data they possess, what kind of data they can share, and on what points organizations and institutions can collaborate to close the data gaps.

## **Micro-Data Services**

Statistics Netherlands can sit in with these conversations and offer their customized research to close the data gaps. They can perform customization on existing data, but also carry out a completely new research. The products that they deliver can be a research report, customized tables, factsheets, dashboards and geographical maps. In the case that Statistics Netherlands does not yet possess the data that is being searched for, they can carry out new research or build further on an already existing study. Among the tasks they will perform are designing, programming and testing questionnaires, sampling and data processing.

Especially the use of micro data services that Statistics Netherlands can offer would be interesting for those operating in the region of Zwolle. Microdata are linkable data at the level of individuals, companies and addresses, which can be made available to researchers under strict conditions for statistical research. This type of research can help design an overview with the inclusion of different statistical variables; for example, data from weather stations.

## **Sas-Back**

One concept that is currently being implemented in the municipality of Zwolle is that of the sas-bak. 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. Users can see with one glance where the priorities are situated. This helps with keeping an overview and working more efficiently and cost effective in the future.

## Beyond the Scope

The aim of this research has been to identify possible data sources in the region of Zwolle and within Statistics Netherlands for the sector of water and spatial management. The early prioritization of the effects for this sector has been mentioned as one of the successes of the study, mainly because the information and data that has been gathered is much more specific than it would have been if the study would have focused on the whole sector. On the contrary this also means that some very interesting topics have been placed outside of the research's scope and could therefore not be included in its end product.

The enthusiasm and eagerness with which some of the respondents have vouched for these topics to be considered important as well has helped create an additional section in the advisory report; "Beyond the Scope". Some of these topics are arguable just as important and relevant as the one that were indeed discussed, and I therefore hope that those that will continue with this subject will take them into account as well.

### Water Quality

The importance of water quality has been frequently mentioned during the discussion of the individual effects, especially the freshwater aspect. Even if we solve the issue of freshwater availability, this does not say anything about the quality of said availability. Serious health related issues connected to bad water quality, and in the end everything that is being done is for the safety of the people.

### Subsidies

Multiple solutions are already available 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 all be implemented to tackle the issue. 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.

### What we See vs What we 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. Heat stress falls a bit out of the picture with this way of thinking, 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.

### 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. This should be one of the most important components if, or we should rather say when, we look at climate change adaptation strategies. 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?



## Next Steps

As this study only focused on researching five prioritized effects of the sector of water and spatial management and the topic of climate change adaptation being so complex, future research will be needed to study other aspects of the subject.

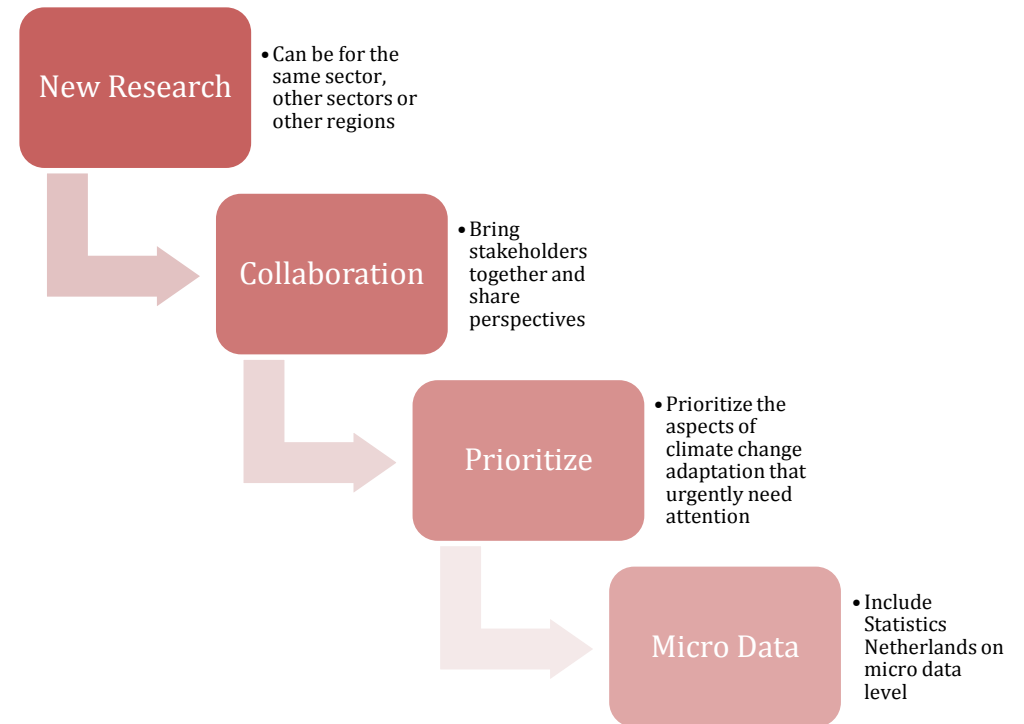
It would be likely and necessary for Statistics Netherlands to conduct future research on one of the other sectors as it is presented in the national and regional climate change adaptation strategies, if they want to have more insight into what the data needs are for each of these sectors.

This study has been conducted simultaneously with that of another student that has concentrated on the sector of Agriculture. The opportunity to occasionally combine research steps and compare the designs and results with one another have resulted in the conclusion that two, possibly one, but no more than two researchers can be approached for the other seven sectors. By doing so the research can be kept within clear boundaries.

It is important to consider that this study has been conducted only in the region of Zwolle. This has mostly to do with the availability of a regional climate change adaptation plan in that region, which functioned as starting point for the research. It is likely that in the future other regions or provinces will implement an adaptation plan as well. This opens up new areas for Statistics Netherlands for collaboration.

For future research it is important to address that this study has succeeded in identifying data needs because of the small scope. The five prioritized effects of one specific sector have provided the stakeholders with a lever to hold onto in closing the data gaps.

Figure 1.3 Next Steps



*United Nations Framework Convention on Climate Change.* (2014). United Nations.

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**thank you.**

And move forward

