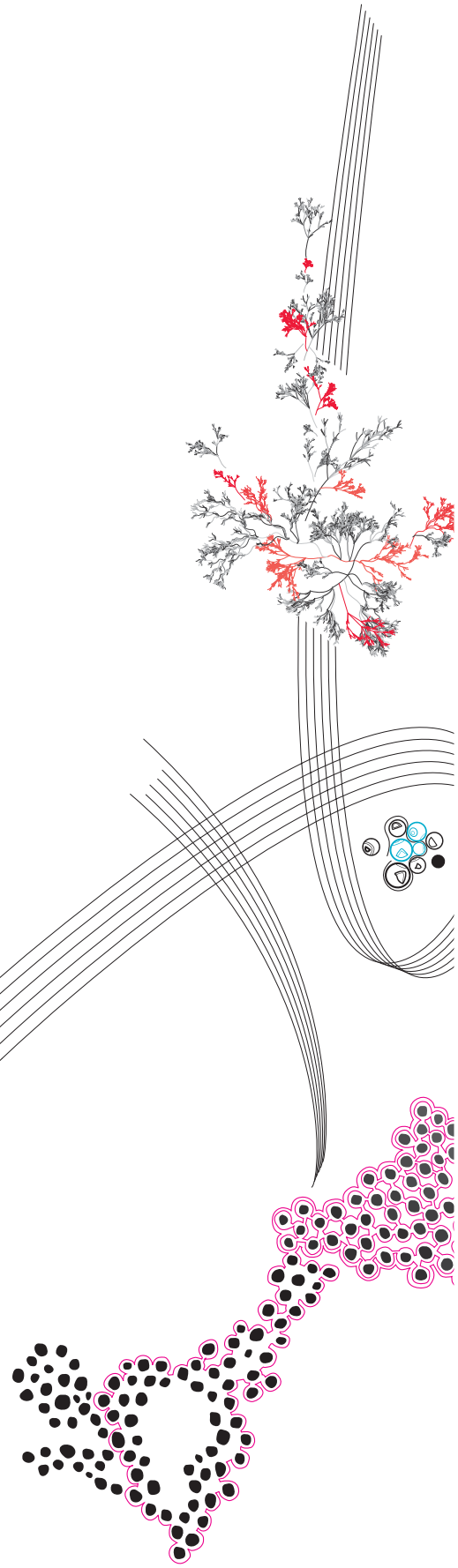

BSc. Civil Engineering
BSc. Thesis

Accelerating climate change adaptation through financial stimuli for local authorities

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Preface

Dear reader,

The Bachelor Thesis in front of you, titled "Accelerating climate change adaptation through financial stimuli for local authorities" was performed on behalf of the Ministry of Infrastructure and Water Management. In the pages that follow, the Climate Adaptation Stimulus Scheme will be introduced, which has been researched and evaluated for this Bachelor Thesis.

I would like to express my deep gratitude towards my supervisors at the Ministry of Infrastructure and Water Management and Rijkswaterstaat, with whom I'd have weekly meetings to discuss my progress and to have all my questions answered. I'd also like to express my gratitude towards my supervisors at the University of Twente, who guided me through the process of performing a scientific research. Your support and guidance was instrumental in the shaping and finishing of this Bachelor Research.

Tom Lamaker
University of Twente
September 3rd 2023

Executive Summary

Water management is an integral part of the history of the Netherlands. Climate change has introduced new challenges to water management. Traditional flood defences are no longer the only aspect of water management, since water is becoming a scarce resource. At the same time, weather extremes are shifting, and outliers of the past are no longer anomalies. Therefore, water needs to be retained, but at the same time, the spatial area needs to be prepared to sustain intense rainfall.

The Climate Adaptation Stimulus Scheme is a measure introduced by the Dutch government, to empower local authorities to adapt to climate change. This Bachelor's research has further investigated this stimulus scheme, part of the national Delta Plan Spatial Adaptation. The applications to the fund have been analysed and categorised, after which the applications from 2022 have been compared to applications from the previous year. A statistical analysis has also been performed, in search of patterns within the projects funded by the stimulus scheme. Interviews with expert users of the fund have also been held, which helped with feedback towards the process of application.

The results from the analysis of the applications made clear that local authorities are actively working to combat climate change, with close to 700 projects that applied for the fund in 2022 alone. These projects mostly put emphasis on retaining water, allowing the groundwater level to rise in combat of drought during warmer periods. Drought and waterlogging were seen as the major climate threats that most of the projects tackled. Flooding was not seen as a threat as much by local authorities. Through interviews, it became clear that the risk of flooding is felt, but the local authorities do not feel it is their responsibility to tackle this problem.

From the interviews with experts from the working regions, it became clear that the threat of climate change is felt on a local level, but the budget to combat this problem is hard to come by. The stimulus scheme offered a solution to this problem and helped local authorities get started on tackling this problem. However, the application process of the stimulus scheme was time-intensive and the accountability of the money that needed to be performed took a lot of time.

The stimulus scheme has offered an opportunity for local authorities to get started on adapting their local environment to climate change. However, only getting started on adapting to climate change is not enough. Local authorities need to continue to adjust their environment to climate change. To aid in this endless battle, it should be investigated if a permanent solution can be found, instead of the temporary solution offered by the Climate Adaptation Stimulus Scheme.

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Chapter 1

Introduction

Coastal engineering is interwoven in the history of The Netherlands, also referred to as *"The lower lands"*. Much of the Netherlands is below sea level, which means that for its entire history, the country had to take into account measures to keep the water out. In recent history, water management has shifted its focus. Due to climate change, an increasing emphasis is placed on reducing flood risk and drought.

The Delta Programme in the Netherlands protects the Netherlands from high water and flooding, ensures a sufficient supply of fresh water and contributes to rendering the Netherlands climate-proof and water-resilient. (Ministry of Infrastructure and Water Management 2021b) This bachelor thesis concerns the final category.

Due to climate change, the needed measures to keep the Netherlands safe have changed, and new problems need to be taken into account. Problems with excess water and flooding and extreme weather events related to heat and drought have become more likely due to climate change. (Ministry of Infrastructure and Water Management 2021d) To adapt to climate change, the Netherlands is structuring its urban and rural areas in a new, climate-resilient and water-robust way. This reconstruction is implemented through the Delta Plan for Spatial Adaptation (DPSA), which is an intergovernmental cooperation, where the Ministry of Infrastructure and Water Management is in the lead. The DPSA focuses on how municipal and provincial authorities, water authorities and the national government intends to accelerate the process of spatial adaptation. (Ministry of Infrastructure and Water Management 2021b) This plan has determined 45 working regions, consisting of municipalities, water authorities and provincial authorities. Together, through intensive discussion, these working regions must work towards complying with the requirements of the DPSA.

1.1 The Climate Adaptation Stimulus Scheme

An integral component of the DPSA is the Climate Adaptation Stimulus Scheme (CASS), a fund consisting of €200 million to encourage and facilitate climate adaptation. (Ministry of Infrastructure and Water Management 2021a) This fund can be used by the previously defined working regions, where each region is able to apply for a part of the fund, based on the inhabitants and the surface area of their working region. The fund can be used to speed up the development of adaptation measures, to expand already planned measures, or to initiate new measures. The maximal contribution of the fund towards the project is one-third of the total cost of the project. The other two-thirds must come from the authorities within the working region, such as the water authorities, the municipality and the provincial government. Working regions can apply for the fund, once a year, during the

years 2021-2023. The projects for which the funds have been granted need to be executed before January 1st 2028. (Bolleboom et al. 2022, p. 3)

This Bachelor's Thesis will focus on the evaluation of the Climate Adaptation Stimulus Scheme. The evaluation will cover various aspects of the fund, such as the application process, the types of requests, the types of measures that are taken and how different working regions approach the cooperation. The goal of this research is to determine if the Climate Adaptation Stimulus Scheme has successfully contributed to the spatial adaptation to climate change, by helping working regions get started on this pressing topic, both financially and on a governance level. Positive findings will support the Ministry of Infrastructure and Water Management's case for establishing the fund as a permanent solution instead of a temporary one.

1.2 Problem Statement

The Climate Adaptation Stimulus Scheme is a fund which is part of the Delta Plan for Spatial Adaptation, a plan from the Ministry of Infrastructure and Water Management, which aims to adapt to climate change by structuring the Netherlands in a climate-resilient and water-robust way. Different regions have varied approaches to applying for the funds, and it's unclear which approach works best or if some approaches are ineffective. Many applications focus on local measures, whilst the idea of the Climate Adaptation Stimulus Scheme originally was also to allow working regions to work together on regional measures. The goal of the stimulus scheme is to help working regions with the start of their adaptation to climate change.

In this bachelor thesis, an analysis will be conducted on the Climate Adaptation Stimulus Scheme (CASS), a government fund of €200 million. The primary objective of this fund is to encourage, facilitate and accelerate climate change adaptation in The Netherlands. For this scheme, the country has been divided into 45 working regions, which have all received a set amount of money, for which these regions can apply.

This Bachelor's Thesis focuses on the applications submitted to the fund during the year 2022. This thesis is performed on behalf of the Ministry of Infrastructure and Water Management.

The goal of this Bachelor's Thesis is to perform an analysis of the applications from 2022 of the Climate Adaptation Stimulus Scheme. During this analysis, many facets of the stimulus scheme will be analysed, such as the type of measures being implemented by the working regions and the scale at which these measures are implemented.

The goal of this research is to determine if the Climate Adaptation Stimulus Scheme has successfully contributed to the spatial adaptation to climate change by helping working regions get started on this pressing topic, both financially and on a governance level. If this is the case, this research will be used by the Ministry of Infrastructure and Water Management to make an argument that the fund should be a permanent solution to help make the Netherlands climate-change resilient, instead of a temporary fund.

Chapter 2

Methodology

For this bachelor thesis, data on the different projects funded by CASS were analysed, resulting in 45 Excel files that were analysed and close to 700 projects that were categorized. The data in these files describe the projects.

This data consists of information regarding the applications for funding from CASS, done by the working regions. These applications were categorised by reading these applications and the project description provided by the working regions.

Once the data was categorized, a statistical analysis was conducted to derive insights from the collected data. The objective was to discover valuable patterns and trends within the dataset. The process commenced with data preparation, followed by visual representation through bar charts to effectively compare and contrast the various categories. This visualization provided a clear overview of how the different categories compare.

The dataset has been analysed to determine how the CASS is being used, and it has also been compared to the evaluation of the CASS applications of 2021, to determine if trends can be found. This analysis consists of charts showing the division of properties, such as the division of measure categories or the division of the co-financing next to the money received through CASS.

A Multiple Correspondence Analysis (MCA) has been performed next. MCA is a statistical method that uses multiple variables to analyse categorical or qualitative data. (Biggs et al. 2021) This applies to the dataset used in this research. The goal of using the MCA procedure is to show the associations and patterns within the data by projecting the variables and observations onto a lower-dimensional space. (Abdi and Valentin 2014) MCA is specifically designed for categorical and qualitative variables, which suits this dataset very well. Using the MCA method, it is possible to visually observe the distances between the observations. This has helped to gain insight into the underlying relationships present in the data. By observing the distances between observations in the MCA plot, patterns of similarity or dissimilarity among the categories can be identified. (Cuddington, Edwards, and Ingalls 2022)

In the selection of statistical methods for this research, various options were considered, including cluster analysis, principal component analysis, and regression models. Cluster analysis, although it emphasizes data similarity, was found to be less suitable for nominal data, which is prevalent in this dataset. (Biggs et al. 2021) Additionally, regression models were not deemed suitable due to their incompatibility with nominal data. Principal component analysis, which is commonly used for continuous variables, did not align with the nature of the dataset. Not only are the variables not continuous in this dataset, but the principal component analysis method is also only suitable for comparing numerical variables.

Considering these factors, the Multiple Correspondence Analysis emerged as the optimal statistical method for this research. MCA specifically caters to categorical or qualitative variables, making it a suitable choice for analysing the dataset at hand.

A Multiple Correspondence Analysis (MCA) is performed to determine the statistical similarity between the 658 observations. MCA is a statistical method that uses multiple variables to analyse categorical or qualitative data. (Biggs et al. 2021) This applies to the dataset used in this research. The objective of using the MCA procedure is to unveil the associations and patterns within the data by projecting the variables and observations onto a two-dimensional space. (Abdi and Valentin 2014)

The MCA method is specifically designed for categorical and qualitative variables, which suits this dataset very well. Using the MCA method, it is possible to visually observe the distances between the observations. By studying the MCA plot, it is possible to gain insights into the underlying relationships present in the dataset. By observing the distances between observations in the MCA plot, patterns of similarity or dissimilarity among the categories can be identified. (Cuddington, Edwards, and Ingalls 2022)

Next to analysing data, expert interviews with users of the CASS application procedure have been held. These users were chosen based on the evaluation of the applications. These users are employees of a municipality, a province, or a water authority that is actively involved with CASS in their working region. These users are experts because they are professionals working on climate adaptation who have hands-on experience with CASS, which can help give insights into what aspects of the application process could be improved. These interviews have been conducted in a semi-structured manner. This method is selected due to specific questions that need to be answered, but at the same time, a natural conversation and input from the interviewees are highly valuable and often yield better results than a completely structured interview.

Questions were prepared and used as a guideline for the interview, but the flow of the conversation was prioritized over strictly following the order of the questions as prepared. This led to a more natural and dynamic exchange during the interview. The interview questions can be found in Appendix B.

After the interviews, all information has been combined and distilled into a summary that will give insight into what characteristics of working regions seem to be helping and hindering the working regions.

In total, five interviews have been held. The interviewees are highly knowledgeable experts who have used the application process needed to go through before a working region can apply for funds from CASS. Five interviewees represent over 10% of the total population, which are all working regions. Therefore, the five interviewees provide a substantial representation of perspectives and insights. More interviewees would be ideal to ensure saturation, (Dworkin 2012) but this is not realistic to perform in the span of this bachelor thesis, since the main research revolves around analysing the data provided by the applications from the working regions.

The interviewees were selected following recommendations from supervisors at the Ministry of Infrastructure and Water Management. These experts were chosen because their working region was of particular interest for reasons such as excellent cooperation within their respective working region, successful implementation of regional projects or instances where the working region had provided substantial feedback and critique on the application process. The interviewed working regions are Twents Waternet, Voornse Putten, Hollands Noorderkwartier and Fries Bestuursakkoord Waterketen.

Chapter 3

Research objective and questions

This chapter serves as the scientific foundation of the thesis. First, the problem statement will be discussed. Following this problem statement, the research objective will be discussed, based on which the research questions have been formulated.

3.1 Problem Statement

The Climate Adaptation Stimulus Scheme is a fund which is part of the Delta Plan for Spatial Adaptation, a plan from the Ministry of Infrastructure and Water Management, which aims to adapt to climate change by structuring the Netherlands in a climate-resilient and water-robust way. Different working regions applying for the funds take on different approaches towards their application of the fund, and it is uncertain if there is an approach that works best or approaches that might not be working at all. Many applications focus on local measures, whilst the idea of the Climate Adaptation Stimulus Scheme originally was also to allow local authorities to work together on regional measures. The goal of the stimulus scheme is to help working regions with the start of their adaptation to climate change.

3.2 Research objective

The research objective is to categorise and evaluate the incoming requests of the Climate Adaptation Stimulus Scheme, part of the Delta Plan Spatial Adaptation, to analyse which measures are taken by the working regions. This analysis will determine to which categories of the Delta Plan Spatial Adaptation the applications belong, to determine which types of measures are often implemented by the working regions, because they are deemed by the working regions as either important or easy to implement.

The end result of this research is a report that the Ministry of Infrastructure and Water Management can use to reflect on the process of the applications, and also to determine if the Climate Adaptation Stimulus Scheme has successfully contributed to the spatial adaptation to climate change by helping working regions get started on this topic, both financially and on a governance level. The ministry hopes to use the results of this report to make an argument towards the cabinet that CASS should not be a temporary fund, but a permanent measure from the government to aid local authorities in their adaptation to climate change.

The hypothesis is that CASS is helping local authorities get started or expand their efforts in spatial adaptation to climate change. While much of the current work has centred on the local, municipal scale (Ammerlaan 2022), there is a willingness among working

regions to explore broader regional measures. However, the challenge lies in cooperating on a large, inter-municipal scale. Some working regions already existed before money became available through CASS, whilst other working regions only formed because of CASS. The expectation is that well-established working regions will be working together on a regional level more often than working regions that have newly been founded. To examine this hypothesis, expert interviews will be conducted. These interviews will also be used to determine characteristics of working regions that work on a regional scale, which can be used in the guidance of the ministry to aid working regions.

It is anticipated that measures implemented by the working regions mostly focus on water retention through depaving and greening. A weakness of the fund that is expected to be seen is that the smaller scale at which most measures are implemented also result in a smaller impact compared to larger, regional projects. Based on analysis of the applications and expert interviews with users of the fund, it can be determined if there are aspects of the application process that are lacking. The research will also serve to build a compelling case that CASS is helping local authorities work on climate adaptation.

3.3 Research questions

The research questions follow from the research objective defined in section 3.2. The research questions guide the research towards achieving the research objective. The research questions for this research yield several sub-questions that must be addressed in order to provide comprehensive answers to the main research questions. The overview of all main research questions and the corresponding sub-questions can be seen below:

Research question 1:
Which spatial adaptation measures are being taken by working regions with financial support from the Climate Adaptation Stimulus Scheme to make their region climate-resilient and water-robust?

Sub-question 1:
What spatial adaptations are being taken by working regions?

Sub-question 2:
How do these spatial adaptations fit in the categories of the Delta Plan Spatial Adaptation?

Sub-question 3:
What are the similarities and differences between the applications submitted for the Climate Adaptation Stimulus Scheme in 2022 compared to those in 2021?

This research question and the accommodating sub-questions enable the research to determine which measures are being taken by the working regions. This will be accomplished by first answering the sub-questions in order, after which the main research question can easily be answered. Sub-question 1 is answered by preparing the data from the applications done by the working regions. During the data-preparing process, the applications will be categorized, which will help answer sub-question 2. Sub-question 4 will compare the applications from 2021 and 2022, to determine if there are notable similarities or differences between both years. Additionally, this sub-question seeks to determine whether there has been a shift in focus over the course of these years.

Research question 2:
What strategies can the ministry implement to effectively guide working regions in achieving the goals of the Climate Adaptation Stimulus Scheme?

Sub-question 1:
What are the perspectives of experts from working regions regarding the application process, and what areas of improvement can be identified within the application process?

Sub-question 2:
How can the ministry provide guidance to working regions during the application process?

Sub-question 3:
What are the key characteristics of working regions that have managed successful regional collaboration within the working region?

This research question, along with its associated sub-questions, aims to provide valuable insights into the perspective of expert users of CASS. The first sub-question aims to gain valuable insights into the viewpoints of experts directly involved in the Climate Adaptation Stimulus Scheme. By understanding their perspectives, the research aims to identify areas within the application process that can be improved. This information will provide valuable feedback for refining and optimizing the application process.

The second sub-question focuses on exploring strategies and approaches that the ministry can employ to effectively guide working regions throughout the application process. By identifying and understanding effective guidance practices, the research aims to provide recommendations to the ministry on how to better support working regions.

The third sub-question investigates the key characteristics of working regions that have achieved successful inter-regional collaboration. By identifying these characteristics, the research aims to provide insights into the factors that contribute to successful collaboration. This information is especially interesting to the ministry because inter-regional cooperation was the initial focus of CASS, but not many working regions have managed to make inter-regional cooperation work.

Ultimately, this connects to the overall research goal to help contribute to answering how the ministry can guide working regions to meet the goals of CASS.

Chapter 4

Results

The results of the research will be presented in this chapter. The research was multifaceted, and therefore there will be multiple sections in this chapter, each focusing on different aspects of the research. The chapter begins by discussing the results obtained from the analysis of the applications from 2022. The results from 2022 will also be compared with the results from the previous evaluation of CASS, performed on the results of 2021. The results from 2022 will then be tested using a multiple correspondence analysis, allowing for the visualization of the categories and their interrelationships or dissimilarities. Finally, the results of the expert interviews will also be discussed.

4.1 Results of the applications of 2022

In 2022, a total of 41 working regions submitted funding applications to CASS for a total of 658 projects. There are many variables to each project. For some variables, multiple categories are applicable, which means that some variables result in a sum that is larger than the total of 658 projects. The variables are as follows:

- CASS category
- Category of the measures
- Whether there was water and soil guidance
- Scale of the measure
- Climate threats
- Co-financing
- Linkage opportunities

These projects have all been categorized and in this chapter, the results of the applications will be discussed. Bar charts will be used to provide a clear understanding of the outcomes of all these variables and the relation between them. All results in this section of the chapter will consider the year 2022.

4.1.1 CASS categories

CASS has predetermined categories in which the projects are placed. These categories do not consider the actual measures implemented by the project, which will be discussed in subsection 4.1.2, but the goal of these measures. There are four categories defined by CASS, namely "Water retention", "Increasing the discharge capacity", "Spatial design"

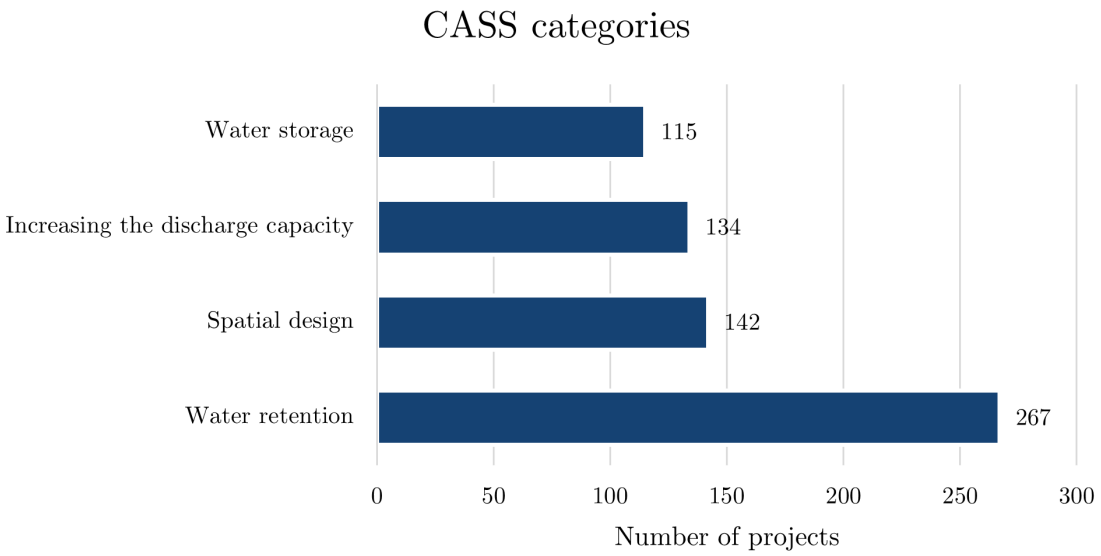

FIGURE 4.1: The division of the categories of CASS

and "Water storage". The division of the categories can be seen in Figure 4.1. Spatial design considers the design of the living environment, which can be redesigned to e.g. include more greenery.

As can be seen from the figure, the category "Water retention" is the largest category, which makes up 41% of the total. The other categories are all around 20%. It is important to note that each project can only have one CASS category.

4.1.2 Measure categories

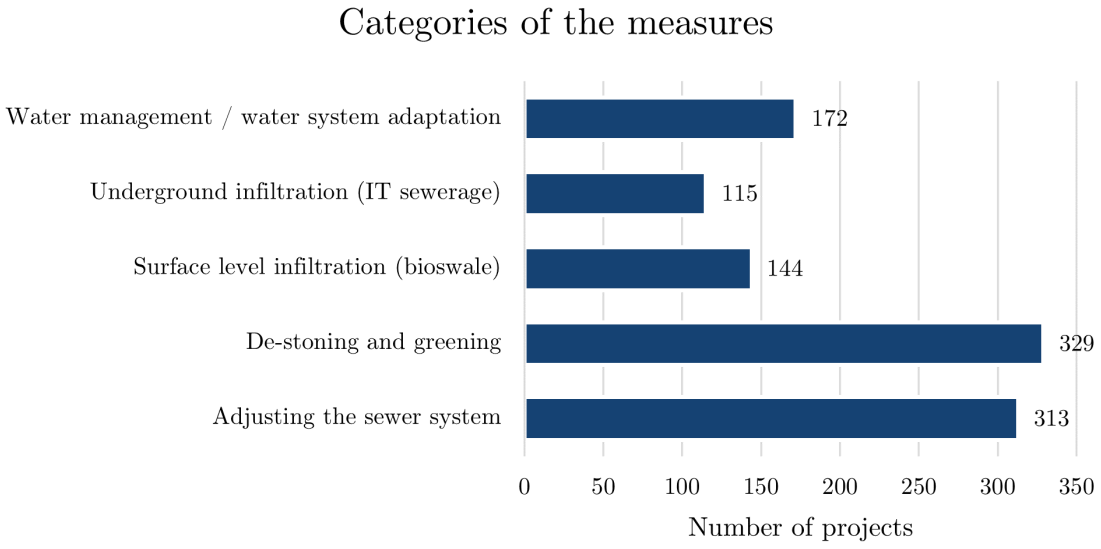

FIGURE 4.2: The division of the categories of the measures

Not only are the projects categorized by their objective, but the measures implemented by

the projects have also been categorized. These measures are "Water management/water system adaptation", "Underground infiltration", "Surface level infiltration", "Depaving and greening" and "adjusting the sewer system". A single project can incorporate multiple categories, therefore the total number of measures surpasses the total number of projects in the year 2022. Table 4.1 gives insight into how many measures are used per project. Projects can implement multiple measures, which is why the total number of measures implemented in the projects is 1073, which is far greater than the total of 658 projects. Table 4.2 gives insight into the division among the measures.

Table 4.1 indicates that both "Adjusting the sewer system" and "Depaving and greening" were implemented in approximately 50% of all projects in 2022. Depaving and greening measures are relatively easy to include in other ongoing renovations within a project, which explains their frequent incorporation. The "Depaving and greening" category is very versatile and aligns well with projects initially unrelated to climate adaptation. These projects, while not focused on climate adaptation, can seamlessly incorporate depaving or green initiatives, which makes it possible for these projects to apply for funding from CASS.

The sewer system occasionally requires replacement, and many working regions take the opportunity to move maintenance forward on the agenda, resulting in eligibility for funding from CASS. This category often involves separating rainwater from wastewater, allowing the rainwater to be discharged into the local environment while directing wastewater to water treatment plants. This is a relatively easy measure to implement, especially if the sewer system already had to be replaced during the runtime of CASS. The benefits of these measures are significant, as they enable the retention of clean rainwater in the local environment instead of classifying the clean rainwater as wastewater which is sent to water treatment plants.

Furthermore, both measures are straightforward to implement on a smaller scale. This is also indicated by Table 4.3, which is a table that compares the measures when considering the scale of the projects. Projects can be implemented on multiple scales, ranging from object scale all the way up to a regional scale. The percentages in this table show the percentage of the projects on each scale that include the measures shown in the rows.

"Adjusting the sewer system" was primarily implemented at the street scale, as 60% of the measures at the street scale included sewer system adjustments. At the neighbourhood scale, adjustments to the sewer system were still included in 43% of the measures, whereas "Depaving and greening" was even more prevalent at 57%. Due to the limited number of measures implemented at the city scale, it is challenging to draw significant conclusions regarding these measures.

Table 4.3 also highlights that water management measures were predominantly implemented at the object or regional scale. This will be further discussed in section 5.3.

Table 4.1: The division of the measures among the projects

Measure categories	Number of projects	Percentage of projects
Adjusting the sewer system	313	48%
Depaving and greening	329	50%
Surface level infiltration	144	22%
Underground infiltration	115	17%
Water management	172	26%
Total	1073	163%

Table 4.2: The division of the measures

Measure categories	Percentage of measures
Adjusting the sewer system	29%
Depaving and greening	31%
Surface level infiltration	13%
Underground infiltration	11%
Water management	16%
Total	100%

Table 4.3: A comparison of the measure categories when considering the scale of the project

Measure categories	Object	Street	Neighbourhood	City	Region
Adjusting the sewer system	19%	60%	43%	33%	0%
Depaving and greening	49%	47%	57%	67%	0%
Surface level infiltration	10%	22%	28%	0%	13%
Underground infiltration	7%	22%	16%	17%	0%
Water management	40%	19%	28%	67%	88%
Total	126%	170%	171%	183%	100%

4.1.3 Water and soil guidance

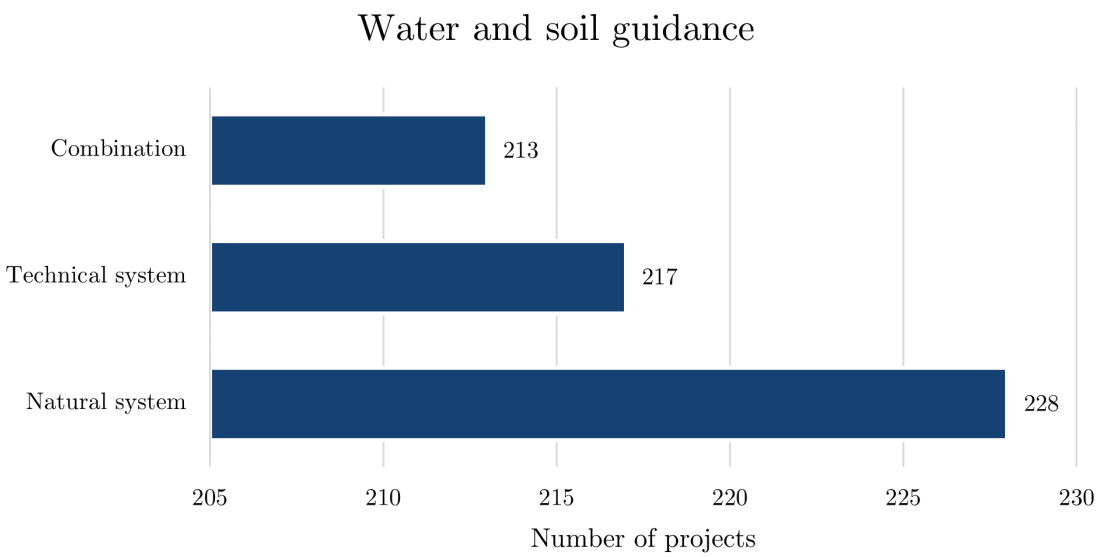

FIGURE 4.3: The division of water and soil guidance

Before human intervention began shaping the landscape according to their needs and desires, humans adapted to the natural conditions of the land, with the water and soil systems serving as their guide. This all changed when humans started building dikes and ditches, which made the water and soil systems adjust to the demands of humans. This approach is no longer sustainable due to climate change, the rising sea level, land subsidence and increasing flooding and drought. (Harbers 2022) There are limits to what the water and soil systems can withstand. Therefore, the Netherlands is focussing on allowing the water and soil systems to guide spatial planning decisions.

In the context of this guidance, there are three categories: "Natural system," "Technical system," and "Combination." The "Natural system" category encompasses projects that only include natural measures, employing nature in a climate-adaptive manner. The "Technical system" category includes projects that utilize technical measures, which are any measures that implement concrete, steel, or other man-made materials into the environment. The "Combination" category is for projects that include both natural and technical measures.

The distribution among these three categories is relatively balanced. 32% of the projects fit the "Combination" category, 33% fit the "Technical system" category and 35% of the projects suited the "Natural system" category best. Table 4.4 shows the measures of the projects considering the different guidance options. Many projects in the "Combination" category include both "Adjusting the sewer system" and "Depaving and greening", with 84% and 77% of the projects, respectively, including these measures. An example of a common project type that combines these two categories is the replacement of an old sewer system with a separate rainwater system. Since the street is already being opened for this purpose, it is very easy to decide to increase the greenery in the street by depaving.

TABLE 4.4: A comparison of the measure categories when considering the water and soil guidance system

Measure categories	Natural system	Technical system	Combination
Adjusting the sewer system	7%	54%	84%
Depaving and greening	66%	7%	77%
Surface level infiltration	28%	2%	36%
Underground infiltration	4%	20%	30%
Water management	25%	37%	15%
Total	130%	120%	242%

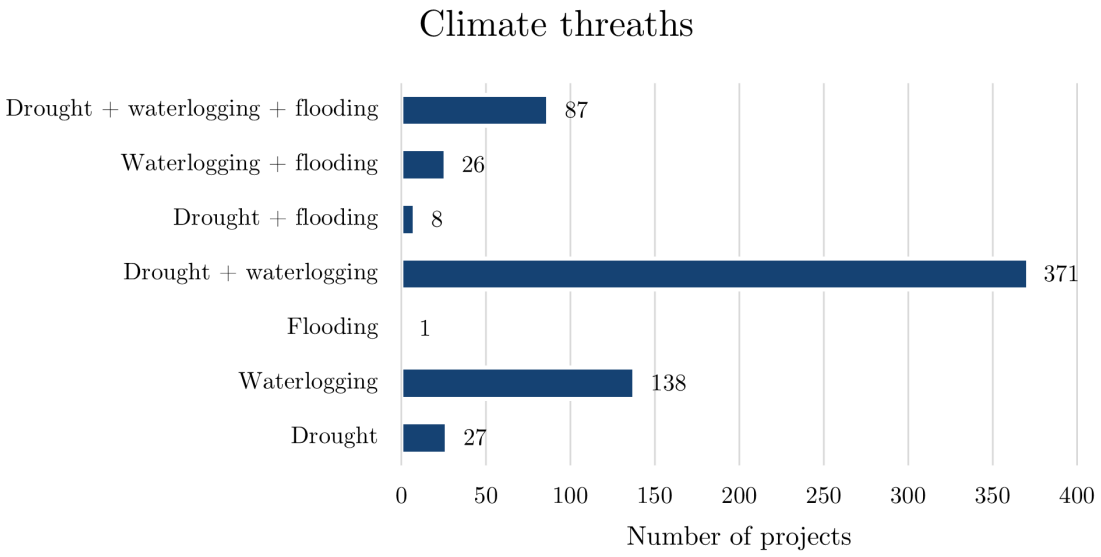

FIGURE 4.4: The division of the climate threats

4.1.4 Climate threats

According to the Delta Plan's definition, there are four primary climate threats: "Drought", "Waterlogging,", "Flooding" and "Heat stress". Heat stress is not fundable through CASS, although it is considered a linkage opportunity. All projects encompass at least one of these climate threats, although some projects may address multiple threats simultaneously. However, it is worth noting that only a limited number of projects specifically focus on the "Flooding" category. This can be attributed to various reasons, some of which were revealed during interviews with experts from the working regions, as discussed in section 4.4.

The interviewed experts mentioned that working regions often do not perceive or acknowledge their responsibility in protecting the Netherlands from flooding. On the other hand, the categories of "Drought" and "Waterlogging" are more visible at the local scale, leading to a greater sense of urgency in addressing these climate threats. Consequently, the combination of "Drought" and "Waterlogging" was implemented more frequently than all other combinations combined, accounting for 56% of the projects.

4.1.5 Co-financing of the projects

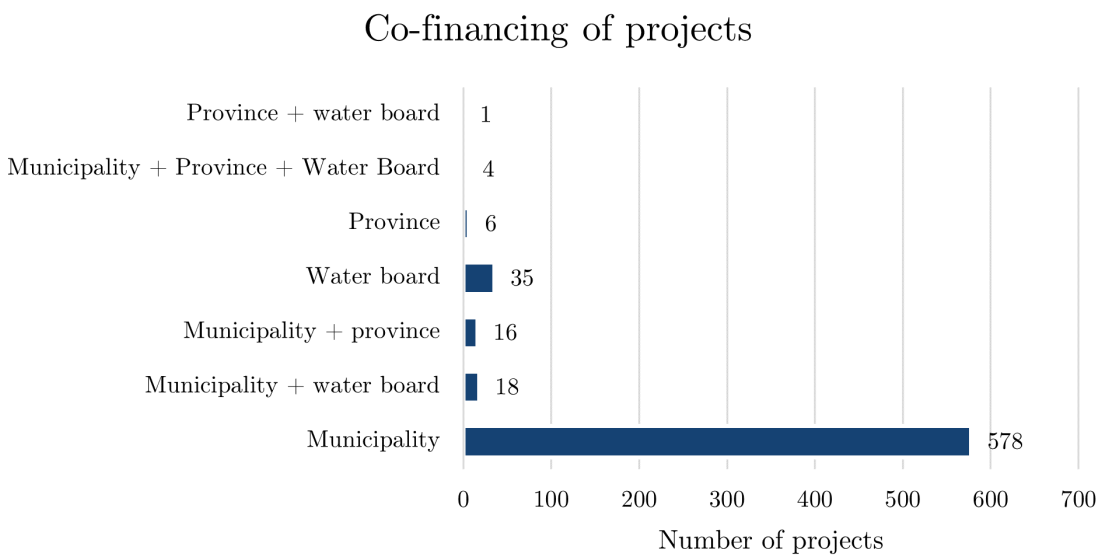

FIGURE 4.5: The division of the co-financing of the projects

CASS provides funding for 33% of projects in working regions, leaving the remaining 66% to be financed by the working region. The original goal of the ministry was that the province, water board and municipality would fund the remaining 66% of the projects together. The evaluation of CASS from 2021 revealed that only a limited number of projects received funding from the province or water board, with the majority, 79%, being financed solely by the municipality. (Ammerlaan 2022)

There was thought to be an explanation for this. Since CASS was implemented shortly after it was announced, working regions had limited time to prepare the applications for 2021. This led to a large portion of the projects remaining small-scale, often on street or neighbourhood scale. For projects on such a small scale, there is little reason for the province or water board to invest.

The expectation for 2022 was that, due to the increased preparation time, projects on a larger scale would apply for funds more often. Since the province and water board are authorities that operate on a larger scale than municipalities, regional projects fit their scope better than local measures on street or neighbourhood scale. Therefore, it makes more sense for the province and water board to help with the funding of large-scale projects, especially projects on a regional scale. However, when looking at the results of 2022, shown in Figure 4.5, it becomes clear that this expectation did not come true. The number of projects being funded solely by the municipality increased from 79% in 2021 to 88% in 2022.

The projects funded solely by the water board did increase from 2% to 5% of the projects. Table 4.5 shows that projects funded solely by water board are often projects on the "object" scale. Specifically, most of the projects solely funded by the water board consider pumping stations. The classification of pumping stations on the object scale is further discussed in section 5.3.

TABLE 4.5: The co-financing of the working region on the different scales

Co-financing	Object	Street	Neighbourhood	City	Region
Municipality	54	330	189	5	0
Municipality + water board	4	2	10	1	1
Municipality + Province + Water Board	1	1	0	0	2
Municipality + province	5	5	6	0	0
Water board	27	2	2	0	4
Province	6	0	0	0	0
Province + water board	0	0	0	0	1

4.1.6 Linkage opportunities

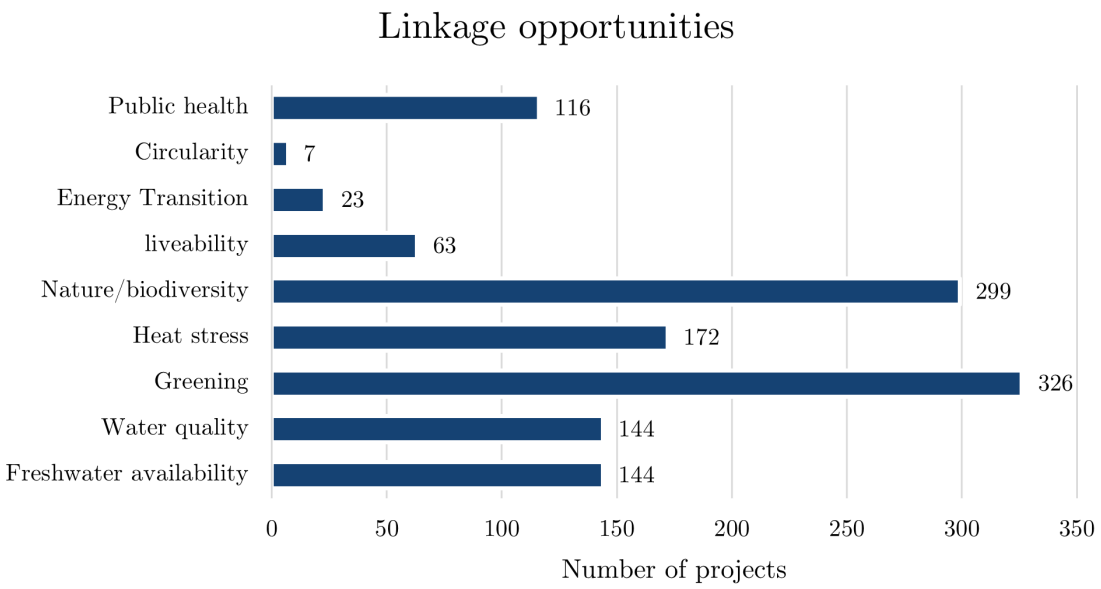

FIGURE 4.6: The linkage opportunities implemented in the projects

Linkage opportunities describe the possibility of linking spatial adaptations with other challenges in the physical environment. (Ministry of Infrastructure and Water Management 2021c) This offers opportunities, and it can be financially beneficial to link together multiple measures in one project.

Since "Depaving and greening" is a very common measure, it is no surprise that "Greening" is also a common linkage opportunity. "Nature/biodiversity" is a linkage opportunity that often goes hand in hand with "Greening". "Heat stress" is a linkage opportunity that was often combined with the measure "Depaving and greening". Increased urban greenery, especially when combined with water-sensitive spatial planning, can help reduce the temperature in urban climates by 2 °C. (Soltani and Sharifi 2017)

4.2 Comparing the results from 2021 and 2022

4.2.1 Comparison of the CASS categories

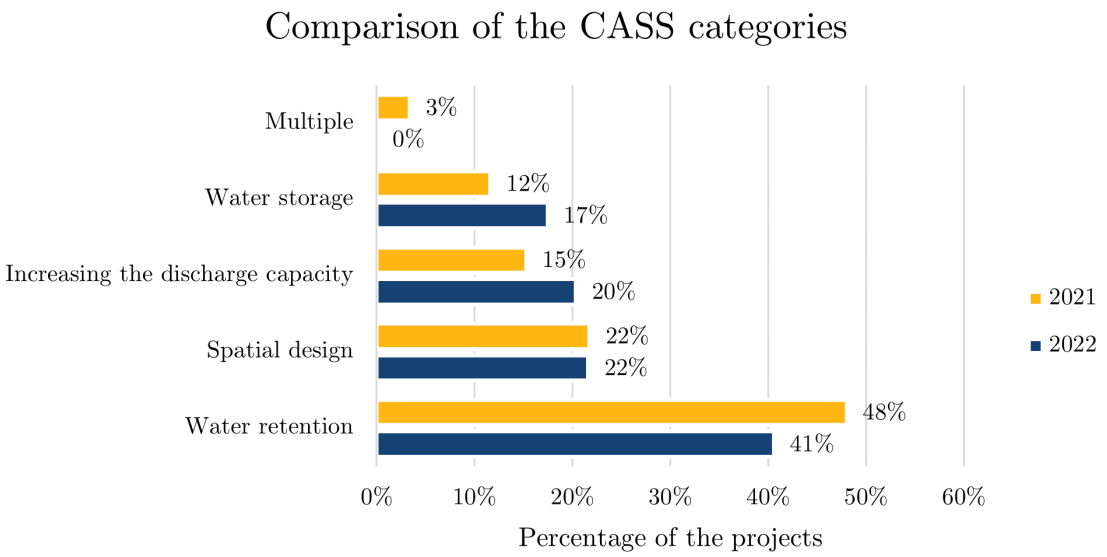

FIGURE 4.7: Comparison of the CASS categories

Every project needs to be assigned to one of the CASS categories. As depicted in Figure 4.7, the "Water retention" category is the largest category in 2021 and 2022, although it has decreased from 48% to 41%. A few projects had multiple categories in 2021. In 2022 there were also some applications where projects had multiple categories. However, since this is not allowed, the projects that had multiple categories were reviewed and the best-suited category was selected during this research. Typically, the chosen category aligned with the one encompassing the majority of the project's measures.

4.2.2 Comparison of the measure categories

When comparing the measure categories between 2021 and 2022, several observations can be made. In 2022 a lot more projects incorporated multiple measures compared to 2021. In 2021 there were 1.06 measures per project, whilst in 2022 there were 1.63 measures per project. This increase shows that many projects included multiple facets of climate adaptive measures, whilst in 2021 the projects barely incorporated multiple measures. This increase can likely be attributed to the fact that there was more time to prepare the applications, which means that projects could address a broader climate challenge.

This increase is very visible for the categories "Depaving and greening" and "Adjusting the sewer system", both categories were used 20% more than in 2021. These categories are also measures that can relatively easily be added as extra climate adaptive measures to already existing projects.

4.2.3 Water and soil guidance

When comparing the water and soil guidance between 2021 and 2022, a significant shift can be observed from projects that fall under the "Natural system" category to the "Combination" category, whilst the "Technical system" category remained almost identical. This

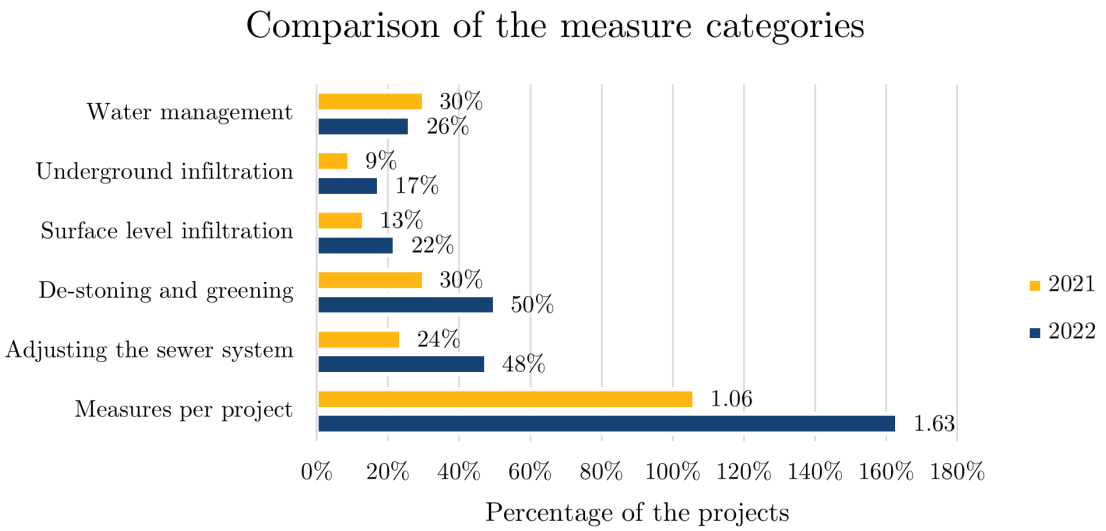

FIGURE 4.8: Comparison of the measure categories between 2021 and 2022

means that the number of projects that included technical measures and man-made materials increased from 53% in 2021 to 65% in 2022. This is quite a significant change and in the opposite direction of the vision of the government, namely to let building projects be guided by nature instead of changing nature to the building projects (Harbers 2022). This unexpected trend will further be discussed in section 5.6.

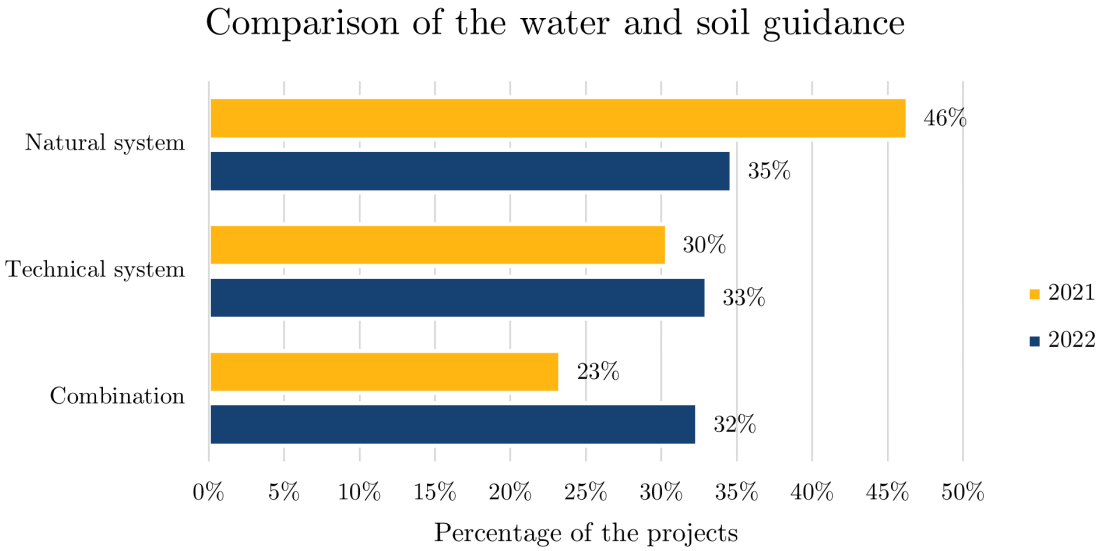

FIGURE 4.9: Comparison of the water and soil guidance between 2021 and 2022

4.2.4 Comparison of the climate threats

As Figure 4.10 shows, there has not been a large shift in focus between 2021 and 2022. The only significant change in 2022 is the increase of projects that only include climate adaptive measures that aim to reduce waterlogging. The combination of drought and waterlogging

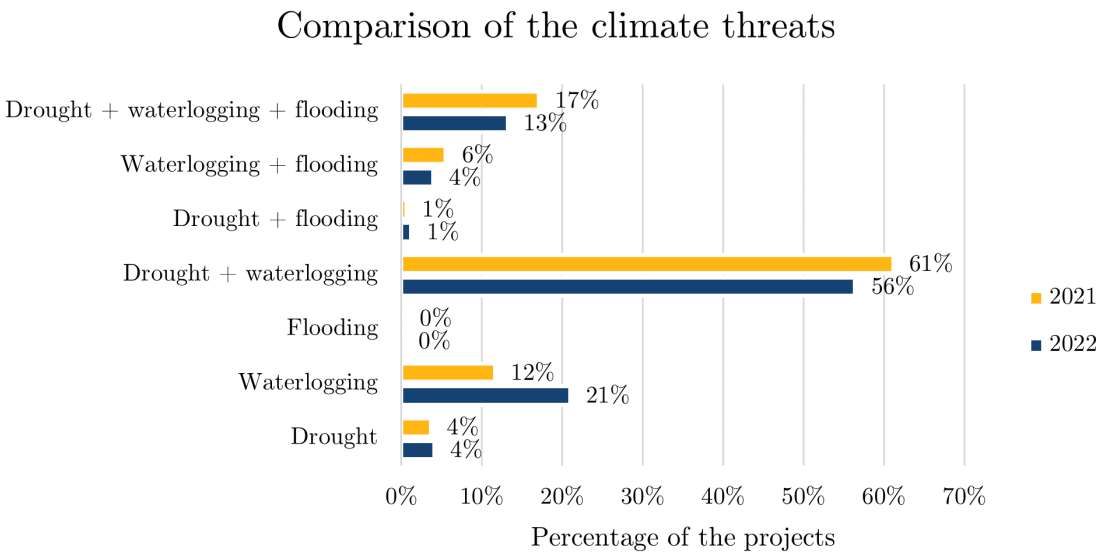

FIGURE 4.10: Comparison of the climate threats between 2021 and 2022

is still the largest category, although it has decreased slightly.

4.2.5 Comparison of the linkage opportunities

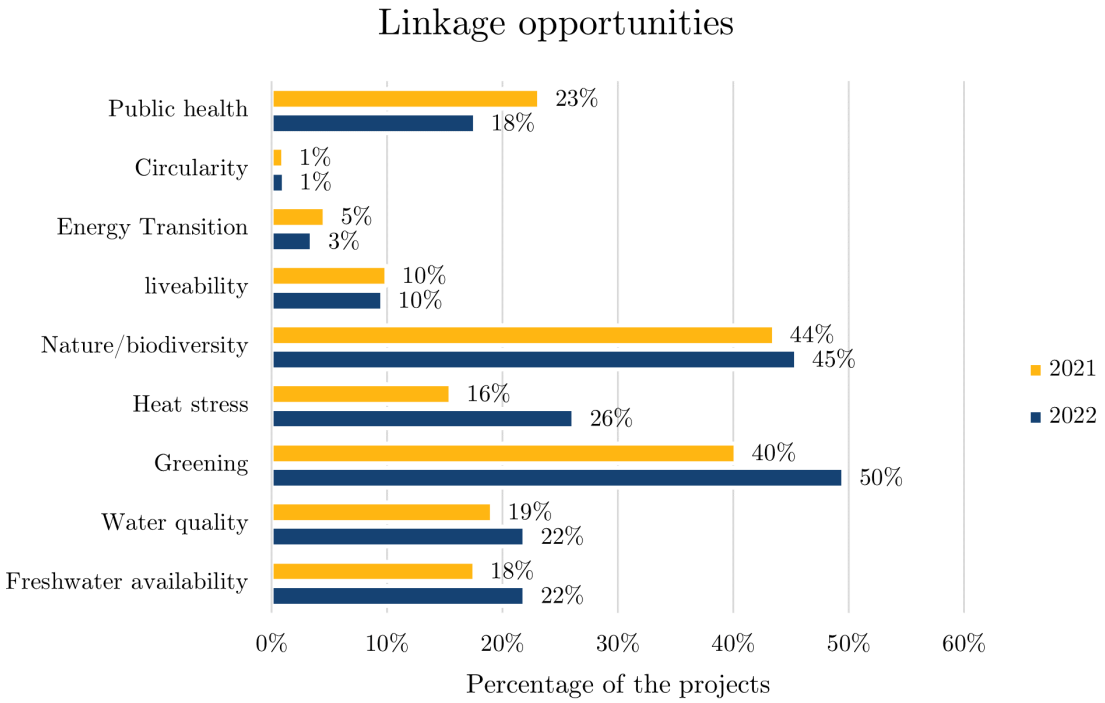

FIGURE 4.11: Comparison of the linkage opportunities between 2021 and 2022

Table 4.6: Example of a disjunctive table illustrated using the scale variable

Projects	Scale - object	Scale - street	Scale - neighbourhood	Scale - city	Scale - region
Project X	0	0	1	0	0
Project Y	0	1	0	0	0

Linkage opportunities are ways for climate adaptive projects to also tackle other problems in the spatial environment. From 2021 to 2022, there was an increase of, on average, 1.75 to 1.97 linkage opportunities per project. This increase can be attributed to several things. It could be that the working regions started incorporating linkage opportunities in their projects more often. Alternatively, it could be that working regions have started to mention these opportunities more often in their project applications. In section 5.1 the linkage opportunities usage of the working regions will be discussed further.

4.3 Performing a Multiple Correspondence Analysis

The MCA for this research was performed using XLSTAT, a data analysis add-on for Excel. Using XLSTAT, the data gathered from all the projects is transformed into a disjunctive table. This is a table where all the variables are split into the categories of this variable. A disjunctive table is a binary data matrix, where the correct variable from a category has a value of 1, and the other variables within that category have a value of 0. A disjunctive table makes it possible to turn nominal values into numerical values. (XLSTAT 2014) Table 4.6 illustrates a disjunctive table. For this example, the scale value of Project X = Neighbourhood and Project Y = Street.
The following step is to determine the factors for the MCA from the disjunctive table. The factors are derived from the variables from the dataset. These factors are linear combinations of the original variables and represent underlying dimensions that can explain patterns in the data. Each factor has an eigenvalue, which represents the amount of variability explained by the factor. (Ayele, Zewotir, and Mwambi 2014)

The inertia is the total variance of the factors from the disjunctive table. This is determined by the sum of the eigenvalues of all factors. (Ayele, Zewotir, and Mwambi 2014) Appendix A contains the table of all the eigenvalues of the factors. This table shows that the sum of all eigenvalues is 1.667. These factors are ordered based on the amount of variance they explain. This results in F1 having the largest variability, F2 having the second-highest variability, and so on.

The first factor explains as much variance as possible, and the second factor displays most of the remaining variance. The two largest contributors to the variability of the dataset will be used as the axis for the two-dimensional plot of the MCA, which helps visualise the distance between the different observations. In the case of this MCA, each project is a distinct observation.

F1 represents the main axis of variation, explaining the largest proportion of the total variance in the data. It helps identify the most significant patterns or relationships among the categories of the variables. F2 represents the second most important axis of variation and captures additional patterns or associations that are independent of F1.

Plotting the observations along the F1 and F2 axes makes it possible to visualize the relationships between the categories and their proximity or dissimilarity to each other. This visualization helps in interpreting and understanding the structure and patterns in the data.

Figure 4.12 shows the MCA plot of the dataset of this research. All the different points in the graph are the observations, the 658 projects from the dataset. These observations are categorized by the scale variable, and trendlines have been added to make it easier to distinguish differences between the different categories.

The MCA plot contains a lot of information, but it can be difficult to extract this information. This section will help sift through the information present in the MCA plot.

The further away observations are from the origin, the more distinctive their characteristics are. (Bock n.d.) The closer observations are to the origin, the more these observations have in common with the average characteristics across all variables that were considered in the analysis. The proximity of observations on the MCA plot shows the similarities between the observations. The trendlines help illustrate this proximity. The trendlines from the *City*, *Neighbourhood* and *Street* categories are very close and have a similar angle too. This suggests a similarity between these categories.

The *Object* and *Region* categories are not close to the other three categories. The trendlines from the *Object* and *Region* categories are also far away from the origin. This signifies a certain uniqueness in the observations that belong to these categories. This can easily be explained by delving into the types of observations that belong to each category. The "City", "Neighbourhood" and "Street" categories all concern observations that are similar in scale and measures they implement, as seen in Table 4.3. The "Object" and "Region" categories concern different types of projects, which also explains the distance from the origin to these categories.

4.4 Interviews

The following section presents the key insights from these interviews.

The interview was divided into two parts. During the initial phase, the focus was on exploring the details of the working regions. Various questions were asked during this phase to gather information related to the duration of the working region's existence, who had a leading role within the working region and the frequency of meetings.

Once the discussion on the working regions was completed, the interview transitioned into a deeper exploration of CASS from the perspective of the experts. This phase involved delving into specific aspects of the stimulus scheme. Participants were asked a series of questions concerning the allocation and distribution of funds within their respective working regions. Additionally, inquiries were made about the primary focus or objectives pursued by the working region in implementing CASS. The working regions were also given the opportunity to discuss any problems they might have experienced during the application process or with CASS in general.

4.4.1 Details of the working regions

The working regions interviewed for this research all existed before CASS was implemented. Most working regions started their cooperation based on the Coalition Agreement Water (CAW), which started in 2011. The goal of CAW was to increase the effectiveness of water management in The Netherlands. (Helpdesk Water 2013) Part of the new agreement was the increase of regional cooperation between municipalities, water boards and drinking water companies. This cooperation also included an increase in information sharing between government bodies. The interviewed working regions had set up an infrastructure that helped this information sharing, which only needed to be expanded to accommodate the new responsibilities due to CASS.

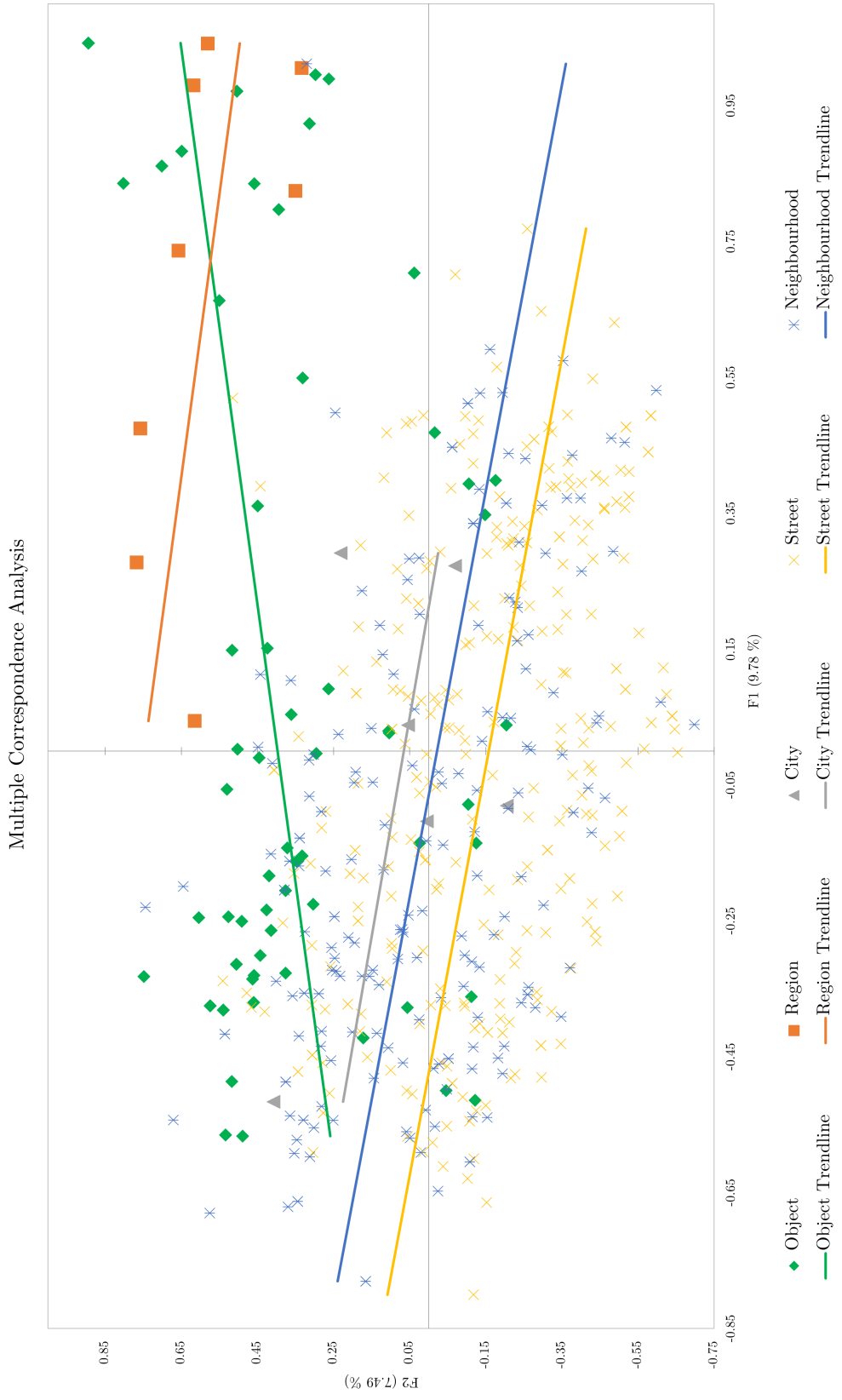

FIGURE 4.12: The Multiple Correspondence Analysis plot

Several working regions mentioned they found a structure within the working region through which local authorities were able to find each other on the topic of climate adaptation. This structure was often attributed to their joint efforts in applying for the budget made available by CASS. For other working regions, CASS was only an extension of their already existing joint efforts, which started in 2011 through CAW.

A common thread among all the interviewed working regions was the active involvement of the water board. In each case, the water board played a significant role within the working region. This involvement was notable through their presence in meetings, their willingness to share their knowledge with municipalities for their projects and, in some cases, co-financing projects of municipalities. The frequency of meetings was also quite similar in each working region, ranging from four to six meetings per year. For some working regions, these meetings were at set times in the year. However, there were also instances where working regions organized meetings solely in response to specific needs, indicating a more flexible approach.

In all the working regions, a prominent characteristic was the presence of a defined leading role, which was assumed by either the water board, a volunteering municipality, or a project group consisting of representatives from the water board, two major municipalities, and two smaller working regions. However, the extent of influence that the leading person or group had on the meetings and the allocation of funds varied among the working regions.

In certain working regions, the leading party had little to no impact on the decision-making process, and the division of funds was handled collaboratively with equal input from all stakeholders. However, in other working regions the leading party held a more significant influence, such as in the working regions Hollands Noorderkwartier and Twents Waternet.

In Hollands Noorderkwartier the water board was the leading party, which led to an active role in the initiation and coordination of projects from municipalities. Since Hollands Noorderkwartier is a large working region with a lot of municipalities, it divided the working region into five sub-regions. Municipalities had to and wanted to cooperate in these sub-regions, which led to joint efforts and close ties among the municipalities.

In the case of the working region Twents Waternet, a project group took on the leadership role within the working region. This project group decided on the allocation of the budget within the working region. This division was based on the population and surface area of the municipalities, which is the same strategy that was used by the Ministry of Infrastructure and Water Management to divide the budget amongst the working regions.

4.4.2 CASS details

Once the details of the working region were discussed, the interview continued with questions focussing on CASS and the feedback and experiences of the working region with CASS.

The working regions received a lot of freedom to determine how to allocate the budget within their working region. While many working regions followed a strategy similar to that of the ministry, some only considered the population when dividing funds, rather than combining both population and surface area.

The working region Fries Bestuursakkoord Waterketen stood out as an exception. This working region used a scoring method that incorporated various variables, all of which were discussed and agreed upon by all members of the working region. These variables included e.g. costs and the impact of the project.

This scoring system ensured that all parties involved were well-informed about the specific aspects their projects needed to adhere to in order to qualify for funding. Consequently,

this approach did not necessarily result in an equal distribution of funds throughout the working region, but the working region argues that the division did result in the best result since the projects that received the highest score also received funding.

Across all working regions, it was observed that the province did not utilize any portion of the budget made available through CASS. In some instances, the province went a step further and provided additional funding for municipalities. This budget from the province was independent of the CASS budget, but the funding was linked to projects that received funding from CASS. It varied among working regions whether the water boards received a part of the budget. In some regions, the water board did receive a share of the budget, whilst in some working regions it was decided that the water board would not receive any budget.

Projects that have an impact on a regional scale are of special interest to the ministry, so working regions were urged to work on projects on a regional or inter-municipal scale. Three of the four interviewed working regions did reserve a part of their budget for regional or inter-municipal projects. This reserved budget was often used for projects that considered the water system on a regional scale, often with the involvement of the water board.

Examples of projects that have been funded from this part of the budget are pumping stations that have a regional impact or projects focussed on improving the freshwater supply in the region.

Working regions were asked the question *"Were any projects abandoned because there was not enough time or priority?"*. The answers to these questions were very elaborate. Instead of lack of priority, most working regions mentioned having to prioritise because there were significantly more projects than budget available.

Time constraints were often mentioned, specifically the preparation time needed for larger, regional projects. Projects that want funding from CASS need to finish preparation before 2024 and need to be completed before 2028. This timeline is quite limited for large, regional projects. These time constraints imposed by CASS therefore prevented working regions from initiating new projects that required extensive planning and preparation. Regional projects involve a larger scale, more stakeholders and other limitations that result in the necessity for extensive planning and preparation. As a result, most of the projects for which funding was sought were those with existing preparation work completed or projects that required less preparation time.

Because of this, working regions mentioned that CASS often was used for projects where the implementation was accelerated. Projects that were on the agenda for later years, but were able to be executed earlier because of CASS.

Another frequent use case of CASS involved incorporating climate adaptive measures into projects that were originally unrelated to climate change. Through CASS, adding climate adaptive measures into existing projects was an easy method to expand their project. This expansion didn't necessitate a significant budget increase, since the climate adaptive measures of the project are funded by CASS.

All working regions mentioned that most of their projects focussed on waterlogging. This deliberate focus on waterlogging is a common and intentional decision made by most regions. However, it is worth noting that Fries Bestuursakkoord Waterketen mentioned that their scoring model does not specifically prioritize waterlogging.

In many cases, measures aimed at tackling drought are also integrated with the measures targeting waterlogging. But, even in these projects, the primary emphasis remains on addressing waterlogging concerns.

Interestingly, the urgency to address flooding is not strongly felt by these working regions, as they perceive flooding to be a problem that extends beyond their regional

operational scale. On the other hand, waterlogging problems are much more visible and tangible within their respective working regions, making them a priority for action and intervention.

> *'What are the odds that regional flood defences will flood?'*
> - Fries Bestuursakkoord Waterketen

Working regions were asked if they prioritised projects with high priority or projects that were easy to implement and execute. Most working regions did not emphasise one over the other, but often combined both types of projects. Because of the lack of preparation time for large projects, there was often enough budget to also include projects that were low-hanging fruit. The working region Hollands Noorderkwartier chose their projects based on the stress tests they performed, which resulted in projects that were proven to be urgent.

Although all working regions stated that the application took a lot of time, the time invested increased with the size of the working region. A larger working region means dealing with a greater number of stakeholders, leading to more extensive discussions and decisions to be made. Particularly, the first year of CASS included a lot of preparation time because the entire process was new. This also signifies another advantage of pre-existing working regions, since these working regions did not have to start from scratch, but instead already had a way of working within the working region.

Multiple problems were encountered during the process of CASS, such as the unclarity of the precise rules when CASS was just starting out. One prominent issue encountered was the response time of CASS, which was perceived as rather lengthy, often having to wait close to three months for a response.

Experts, when asked about the application process, always mentioned the trial application as a very positive aspect of the application process. This trial application is meant to verify if the projects that the working region wants to apply for actually fit the criteria from CASS. Through the trial application, working regions gain clarity on whether both the projects and the budget division of the projects would be approved by CASS in an actual application.

The response time of the trial application was quick and there was very effective communication between the working regions and the helpdesk. The response time for the actual applications was sometimes viewed as lacking, although working regions did understand that approving the actual application costs more time than the trial application.

Working regions also mentioned that CASS seemed to prioritise waterlogging over drought as a climate threat. The absence of heat stress was also considered a problem of CASS. Single Information, Single Audit (SiSa) was seen as a big task. SiSa is required as accountability for the money municipalities receive from the government, for example, money received through CASS. Making an application SiSa approved is a lot of work that is not directly related to the mission of CASS.

When asked if there was anything else the working regions wanted to say, all working regions wanted to emphasize that CASS was a very good measure that made it possible for local governments to start working on climate adaptation. The need for a permanent solution instead of a temporary solution is felt strongly by the working regions.

Chapter 5

Discussion

The discussion section of this paper puts emphasis on analysing and interpreting the results obtained from the research conducted. This section aims to explore the implications and significance of the findings. The design and implementation of CASS are examined, identifying its strengths and limitations, and exploring its broader implications for promoting sustainable development and reducing vulnerability.

5.1 Linkage opportunities usage by working regions

Climate adaptation efforts often present opportunities for linkage to other issues that can be addressed within a project. These linkage opportunities refer to the potential to integrate spatial adaptation measures with other challenges in the physical environment (Ministry of Infrastructure and Water Management 2021a). This offers opportunities, and it can be financially beneficial to link together multiple climate-proof measures in one project. The linkage opportunities defined in the Delta Plan are as follows: (Ammerlaan 2022)

- Freshwater availability
- Water quality
- Greening
- Heat stress
- Nature/Biodiversity
- Liveability
- Energy transition
- Circularity
- Public health

There are two types of linkage opportunities. Some linkage opportunities, such as "Energy transition", are an opportunity for climate adaptation to latch onto other projects, whilst other linkage opportunities, such as "Water quality", are gaining traction by linking to climate adaptation.

It is important to note that not all working regions interpret these linkage opportunities in the same way. Some working regions include linkage opportunities such as "Liveability" and "Public health" in almost all of their projects. Their rationale is that incorporating water management and green infrastructure into public spaces can enhance aspects of

Table 5.1: The division of the categories between 2021 and 2022

Year	Adjusting the sewer system (% of total)	Water management (% of total)
2021	22%	28%
2022	29%	16%

liveability and contribute to public health benefits. On the other hand, there are working regions that do not include liveability or public health considerations in any of their projects, even though some projects may have a clear relevance to those categories.

Due to this, the results from the linkage opportunities give an impression of how working regions have incorporated these linkage opportunities into their projects, but it is hard to draw definitive conclusions from the results since there is a substantial difference between working regions and their interpretation of the application form for their projects.

5.2 Similarity between categories

Two categories of the measures show similarities, namely "Adjusting the sewer system" and "Water management/water system adaptation". Determining the priority between these categories is a topic of discussion due to the overlap in sewer system adjustments. The categorization of projects is based on the scale of the project. Specifically, adjusting the sewer system is favoured for smaller projects where, as the name of the category suggests, adjustments are made to the sewer system.

Water system adaptation becomes the preferred category when there is a cumulative effect of multiple (small-scale) sewer modifications that collectively transform the entire water system within a project. To illustrate this distinction, consider the following example:

The planned renovation of a street's sewage system is expanded to include climate adaptive measures through financial support from CASS. Instead of allowing rainwater to flow into the wastewater sewer, the sewers are separated, creating two different sewer systems, one for wastewater and one for rainwater. Consequently, the wastewater can be transported to the water treatment plant, whilst the rainwater can run off into the local environment. (Ministry of Environment of Denmark 2014) This measure qualifies as small-scale, as it only affects one street.

However, if the separation of the sewer system occurs throughout an entire neighbourhood rather than just one street, the scale of the measures increases significantly, consequently impacting the water system of the entire neighbourhood. Suddenly, the rainwater from the entire neighbourhood will be discharged into the local environment, representing a substantial change to the neighbourhood's water management and likely involving other measures to store this water locally.

The division between the two categories also relies on the interpretation of the researcher who categorized all the applications. When comparing the results of 2021 and 2022, there is a notable difference between the two categories, as can be seen in Table 5.1. The author of the 2021 research did not provide an explanation of their interpretation regarding the division between the categories. Therefore, it remains uncertain whether the disparity between the years can be attributed to differences in interpretation.

5.3 The classification of pumping stations

Pumping stations are classified as projects on the *object* scale since these projects only involve climate adaptive modifications to a single object. However, in the case of pumping stations, the impact of these measures often extends beyond the object scale to a larger scale.

However, determining the actual extent of impact caused by a pumping station is difficult and involves assumptions regarding factors such as the hydrological conditions and the interconnectedness of water systems. It is a time-consuming process that involves many assumptions to determine the scale of the impact of the pumping station. This scale can vary among pumping stations, some might only operate on a neighbourhood scale, whilst other pumping stations might have a significant impact on water management at a regional scale. To avoid making incorrect assumptions, despite acknowledging the larger impact of pumping stations, all pumping stations have been categorized on the object scale.

5.4 Heat stress

Heat stress is one of the climate threats defined in the Delta Plan Spatial Adaptation. However, heat stress is not a climate threat that is fundable through CASS. This is due to the fact that CASS only grants funding to projects that relate to water in some way, which heat stress does not. This has led to frustration for the working regions, since heat stress is a climate threat that is felt significantly in the urban environment. Working regions would like to work on this pressing topic, but can not receive funding for projects that emphasise heat stress.

5.5 Interviews

All the interviewees for this research were selected based on advice from the ministry. These interviewees were selected based on positive attributes from their working region, or instances where the working region had provided substantial feedback and critique on the application process. This led to a bias within the interviews since all working regions were selected based on their excellent performance. However, no working regions were selected that struggled with cooperating on a regional scale. Interviews with these working regions might have led to more feedback on the support from the ministry for these working regions.

5.6 Water and soil guidance

When comparing the years 2021 and 2022, an unexpected trend was observed when considering the water and soil guidance. As mentioned in subsection 4.1.3, the goal of the ministry is to let nature be guiding in building projects again. However, as mentioned in subsection 4.2.3 and shown in Figure 4.9, the data shows a trend that goes directly against what the government is promoting.

It is entirely possible that local governments are implementing more technical solutions and using more man-made materials, but there might be another explanation. During the categorisation of the projects, I was quite strict. Whenever the project involved any type of man-made structures or materials, the project would be categorized as "Technical system" if no measures using nature would be involved. If natural measures were involved, the project would be classified as "Combination", even if the technical aspects of the project

were small compared to the natural aspects. This strict policy could be the explanation that a negative trend can be observed in the water and soil guidance variable.

5.7 Answering the Research Questions

This research started off with two research questions, each with three sub-questions. These questions will all be discussed and answered in this section.

5.7.1 Spatial adaptation measures being taken by working regions

Related research question: *Which spatial adaptation measures are being taken by working regions with financial support from the Climate Adaptation Stimulus Scheme to make their region climate-resilient and water-robust?*

This research question consists of three sub-questions. These sub-questions will be answered first, which will help answer the research question.

What spatial adaptations are being taken by working regions?

This sub-question has been answered by categorizing the 658 projects which were sent in by the working regions to CASS. By classifying these projects, an overview was created of all the spatial adaptations being taken by the working regions. These categorized projects were used in chapter 4 to gain further insights from the categorization of the projects.

How do these spatial adaptations fit in the categories of the Delta Plan Spatial Adaptation?

This sub-question has been answered by performing the analysis of the projects which were sent in to CASS by the working regions. The detailed analysis can be found in section 4.1.

The spatial adaptations being taken by the working regions are discussed in depth in section 4.1. Figure 4.1 and Figure 4.2 in this section show the division of the spatial adaptations. From these figures, it becomes clear that the working regions put emphasis on spatial adaptations that focus on water retention. 41% of the projects fell in the water retention category, whilst the other three categories were all around 20%. The type of measures performed by the working regions mostly involved depaving and greening and adjustments to the sewer system.

What are the similarities and differences between the applications submitted for the Climate Adaptation Stimulus Scheme in 2022 compared to those in 2021?

This sub-question has been answered in section 4.2. From this section, it can be concluded that no major shift in focus was seen. Many statistics were similar between the two years. Water retention remained the major emphasis of the working regions, most projects focus on drought and waterlogging as the major climate threats and the linkage opportunities did not differ significantly either, except for the "Heat stress" linkage opportunities, which did see an increase of over 50% compared to 2021.

One significant difference between 2021 and 2022 is the increase in measures per project. Projects can include multiple measures, such as a combination of depaving and greening combined with adjusting the sewer system. In 2021, there were 1.06 measures per project,

whilst in 2022 there were 1.63 measures per project. This increase shows that many projects included multiple facets of climate adaptive measures, whilst in 2021 the projects barely incorporated multiple measures. This increase can likely be attributed to the fact that there was more time to prepare the applications, which means that projects addressed a broader climate challenge.

Conclusion of Research Question 1

Now that all the sub-questions have been answered, research question 1 can be answered. From the categorization and analysis of all the applications, it became clear that water-logging and drought is perceived as the biggest climate threat, emphasising measures that focus on water retention. From comparing the results from 2022 with the results from the previous year, no significant trends or changes were noticed, although there was a significant increase in measures that were implemented per project.

5.7.2 How can the ministry guide the working regions?

Related research question: *What strategies can the ministry implement to effectively guide working regions in achieving the goals of the Climate Adaptation Stimulus Scheme?*

The second research question revolved around the supporting aspect of CASS, from the perspective of the Ministry of Infrastructure and Water Management. When the ministry offers support tailored to the needs of the working regions, it allows the working regions to deliver better results. The second research question considers this support. This research question has been divided up into three sub-questions. These sub-questions will be answered first, which will help answer the research question.

What are the perspectives of experts from working regions regarding the application process, and what areas of improvement can be identified within the application process?

To answer this sub-question, interviews were held with experts from working regions. These interviews have been summarized in section 4.4.

Overall, the interviewed experts were satisfied with the current application process. Especially the trial applications are very well appreciated. When asked for areas of improvement, working regions mentioned that the application process took a lot of preparation time. This preparation time can partly be accredited to the internal process of coming to an agreement within the working region and to the preparation time to deliver the documents in the format of the ministry. However, working regions also often mentioned the Single Information, Single Audit (SiSa) accountability method that the government uses to justify subsidies granted to municipalities and provinces. This is a very time-intensive method that leaves little trust in the municipalities and provinces, according to the interviewees.

How can the ministry provide guidance to working regions during the application process?

The ministry currently already provides guidance, through the trial applications. This guidance is viewed very positively. Although the ministry already provides detailed guidance through these trial applications, further ways of offering support could be investigated. It should be noted that the working regions were asked their vision on the guidance of the

ministry and no working regions mentioned a lack thereof or tips for improving the guidance.

What are the key characteristics of working regions that have managed successful regional collaboration within the working region?

Not many working regions have managed to cooperate on a regional level within the working region. This has led to projects remaining on a relatively small scale, as seen in section 4.1. However, there were also some working regions that did manage to make regional collaborations work. Some of these working regions were interviewed, to try to determine the characteristics of these working regions.

The working regions that managed to deliver projects with a regional impact had different ways of dividing the budget, but often there was a part of the budget reserved for projects on a regional scale. This made it easier for local governments within the working region to work together on a regional project, knowing there is money available.

Another big aspect of the working regions that managed to realise a regional impact is the fact that these working regions already had some sort of regional cooperation before CASS started. This made the working regions only have to take up CASS as an extra task within the already existing working region. Multiple of the working regions interviewed for this research started off as regional cooperation after the Coalition Agreement Water in 2011.

Due to this long-lasting cooperation before CASS, the working regions already had a way of working, complete with a meeting schedule and a local government that had taken the lead in the working group. This made for an easier starting phase when CASS was introduced, which has helped the working region focus on CASS itself, rather than spending time deciding on the way of working within the working region. Because of the long-lasting cooperation, it was easy for the members of the working region to find and learn from each other and discuss topics like projects on a regional scale.

Conclusion of Research Question 2

From these interviews, it can be concluded that, overall, the working regions are very content with the support that is being offered by the ministry. The trial applications are important to the working regions and through these trial applications, the working regions feel prepared when delivering their final application. The response time of the final application is sometimes perceived as long, taking up to three months. The biggest complaint, all interviewees had, came from the SiSa accountability method, which was an extra measure on top of the application process.

Chapter 6

Conclusion and recommendations

This research aimed to identify which spatial adaptation measures are being taken by working regions to make their region climate-resilient and water-robust. Based on an analysis of all the applications of the year 2022, it became clear that the working regions emphasised water retention measures to combat drought and waterlogging, whilst putting less emphasis on measures that prevent flooding.

The research also investigated strategies the Ministry of Infrastructure and Water Management could implement to guide working regions in achieving the goals of CASS. Through expert interviews and literature research about the current offerings of the ministry, it became clear that the current feedback system the ministry has implemented is very well appreciated. Trial applications can be delivered and will be provided with extensive feedback before the definitive application is handed in.

Recommendations for further research include the analysis of the CASS applications of 2023. This would help conclude the hypotheses made in this report, such as the expectation that projects applying for funds in 2023 will include more cooperation within the working region since there was more preparation time. The ministry could investigate what their position is in further improving the cooperation within the working regions.

Although funding for heat stress is not possible through the DPSA, it is a climate threat that is felt by almost all working regions. Exploring alternative opportunities to finance heat stress adaptation projects for local authorities is recommended, albeit through CASS or another fund.

The most important recommendation that can be concluded from this research is that a permanent solution or replacement for the Climate Adaptation Stimulus Scheme should be considered. Working regions do not have the budget and capabilities to tackle climate change on their own, help from the government is needed. CASS has been a great start to help get climate change adaptation on the agenda for local authorities, but this alone is not enough. Climate change adaptation can not be solved in three years, but instead can be tackled through continuous adaptations and measures. To be able to complete this challenge in the Netherlands, a permanent solution needs to be found.

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Appendix A

Eigenvalues and variability of the data

TABLE A.1: The eigenvalues and variability of the factors

Factor	Eigenvalue	Variability (%)	Cumulative %
F1	0.163	9.776	9.776
F2	0.125	7.488	17.264
F3	0.089	5.328	22.591
F4	0.083	4.966	27.557
F5	0.069	4.170	31.726
F6	0.066	3.969	35.695
F7	0.064	3.870	39.565
F8	0.063	3.772	43.337
F9	0.060	3.591	46.928
F10	0.055	3.320	50.247
F11	0.052	3.133	53.381
F12	0.051	3.051	56.431
F13	0.050	3.022	59.453
F14	0.049	2.919	62.372
F15	0.047	2.848	65.221
F16	0.046	2.750	67.971
F17	0.045	2.702	70.673
F18	0.042	2.500	73.173
F19	0.041	2.431	75.605
F20	0.039	2.326	77.931
F21	0.037	2.230	80.161
F22	0.036	2.145	82.306
F23	0.034	2.042	84.348
F24	0.032	1.946	86.294
F25	0.029	1.749	88.043
F26	0.028	1.677	89.720
F27	0.026	1.576	91.295
F28	0.025	1.521	92.816
F29	0.024	1.467	94.283
F30	0.024	1.444	95.727
F31	0.021	1.267	96.994
F32	0.017	1.040	98.035
F33	0.014	0.821	98.855
F34	0.011	0.668	99.524
F35	0.008	0.476	100.000
Total	1.667	100	

Appendix B

Interview questions

This appendix includes the questions used as a guideline for the semi-structured interviews held with the experts of the working regions. These experts are the users of CASS that have experience with the process of application. Four interviews were conducted in total.

- Did the working region exist before CASS?
- How was it determined who took on a leading role within the working region?
- What was the influence of the party that took on the leading role in the meetings and the distribution of the money?
- Is the water board actively involved in the working region?
- How frequently does the working region meet?
- Has a structure emerged within the working region as a result of CASS, making it easier for members of the region to find each other in the field of climate adaptation?
- How was it determined how the money was distributed within the working region?
- Did the water board/province also receive a part of the budget?
- Has money been put aside for regional or intermunicipal projects?
- Were any projects abandoned because there was not enough time or priority?
- What type of measures did the working region focus on?
- Did CASS eliminate a major bottleneck?
- Were high-priority projects chosen or projects that were easy to implement?
- Did the water boards and province contribute (financially) to the working region?
- Were attempts made to obtain funding from the water boards and the province?
- How much time did the applications take?
- What problems were experienced with CASS or the application process?