The City of Utrecht as a Flood-Proof City

An Assessment of flood management and governance of Utrecht

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Abstracts

Climate change and urbanization increased the risk of flooding in the cities and urban areas, highlighting the need for resilient flood risk management in Urban areas. Involving public and private stakeholders and the community in the formulation of policies and decision-making procedures is essential to the governance of water resources. For efficient flood control and equitable decision-making, a coordinated and inclusive strategy encompassing the public and private sectors, stakeholders, and public participation frameworks is required. Despite having a strong flood defense system, the Netherlands needs to be e resilient due to hazards from urbanization, climate change, and economic expansion. To improve the resilience of the Dutch city of Utrecht which experienced extreme water events in recent years, the Municipality of Utrecht has adopted a governance approach for climate adaptation. To effectively manage flooding in Utrecht, the Municipality, Waterboard, Safety Regions, and other stakeholders work together. It is crucial to employ adaptive methods, accept uncertainty, and develop damage-prevention plans in managing flood risk. This thesis aimed to evaluate the flood risk management of Utrecht. The study assesses flood-proofing strategies and the adaptability of flood management and governance to safeguard urban areas from the effects of precipitation and climate change. The research examines the steps taken by Utrecht's flood management governance and their efficacy in boosting resilience using a literature review, policy analysis, and stakeholder interviews. Three components of policy and planning, infrastructure and technology, and community engagement and participation were selected to evaluate the flood risk management and governance of Utrecht based on different literature. In the thesis's conclusion, suggestions are made for enhancing Utrecht's flood management and governance. The importance of ongoing stakeholder cooperation, openness, and public involvement is highlighted. The study emphasizes the need for a thorough and inclusive approach to improve flood resilience in urban areas and helps to comprehend community engagement and collaboration in water management governance.

Keywords: community engagement, collaboration, water management governance, flood-proofing techniques, resilience, Utrecht, Netherlands

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1. Introduction

The population of cities has been growing all around the world due to economic expansion, the advancement of technology, and the expansion of business cities. Climate change, urbanization, and economic growth are increasing flood risks in cities worldwide, making the need for building "climate-proof" cities more pressing (Wardekker et al., 2010). Coastal cities, especially those in low-lying deltas, may face significant challenges as a result of the anticipated effects of climate change (IPCC,2007). Flooding is the most frequent natural disaster in Europe, and it also causes the most fatalities and economic damage (Guha-Sapir et al., 2013). Climate change uncertainty has caused a movement toward flood resilience because it helps manage unforeseen climatic disturbances that have an impact on extreme flows (McClymont et al., 2020). Many adaptation plans were established and put into practice in cities in both the Global North and the Global South, with the majority taking resilience, flexibility, monitoring, intersectoral coordination, scenario planning, and co-benefits into consideration (Gober, 2018). In many European countries, different governmental institutions are responsible for ensuring that floods do not affect economic growth, national security, or welfare standards (Penning-Rowsell et al., 2006).

In addition, there is a disproportionately greater surface area of water infiltration in metropolitan settings (Zhou, 2014), urban drainage systems are an essential part of urban infrastructure that reduces the risk of flooding by transporting stormwater and wastewater out of cities (Ana & Bauwens, 2010; Karamouz & Nazif, 2013). During intense storm events, the dysfunction of these infrastructures can account for, for example in the UK, over 40% of urban flood damage (Ellis & Viavattene, 2014). However, there are still obstacles to efficiently utilizing urban drainage systems (Chocat et al., 2007; Leandro et al., 2016). Integrated urban drainage modeling can aid in the development of a single interactive simulation for storm event conditions (Ellis & Viavattene, 2014). In many European urban areas drainage systems and urban infrastructures are inadequate for coping with extreme flooding. Therefore, an effective management system is crucial to protect urban areas and prevent loss of life in flood hazards by improving urban systems.

Management of floods and their effects is becoming increasingly crucial on a global scale as urban areas expand and increasingly, consensus seems to have formed in policymaking and scholarly circles that it is essential to develop a coordinated and all-inclusive strategy that involves both the public and private sectors as well as all stakeholders to manage flood risk

effectively. As to the former, the European Flood Directive 2007/60/EC[1] for example, demands the construction of public engagement structures. The Sendai Framework for Catastrophe Risk Reduction 2015–2030[2] identifies four action objectives and seven specific targets for preventing and reducing catastrophe risks: 1) Understanding disaster risk is in management, 2) improving disaster risk governance, 3) investing in disaster reduction for resilience, and 4) enhancing disaster preparedness for an effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction. In the scholarly literature, Wehn et al. (2015) for example, argue that living with floods will not be possible until communities are "involved" and "empowered." In other words, diverse stakeholders must be involved in the development and execution of adaptation strategies, and creative solutions must be found to combine their efforts, dedication, and knowledge in order that everyone can contribute to the process (Wamsler, 2017). Moreover, the lack of local stakeholder participation in flood defense decision-making is likely to cause conflict, frustration, and, possibly, a worsening of inequities (Begg et al., 2018). Governments, companies, communities, and people all need to be active participants who share responsibility and provide financial assistance within a defined framework of cooperation (Sayers et al., 2013). Public-private collaboration can be a successful strategy; however, for this strategy to be successful, legislation and regulations must be carefully considered.

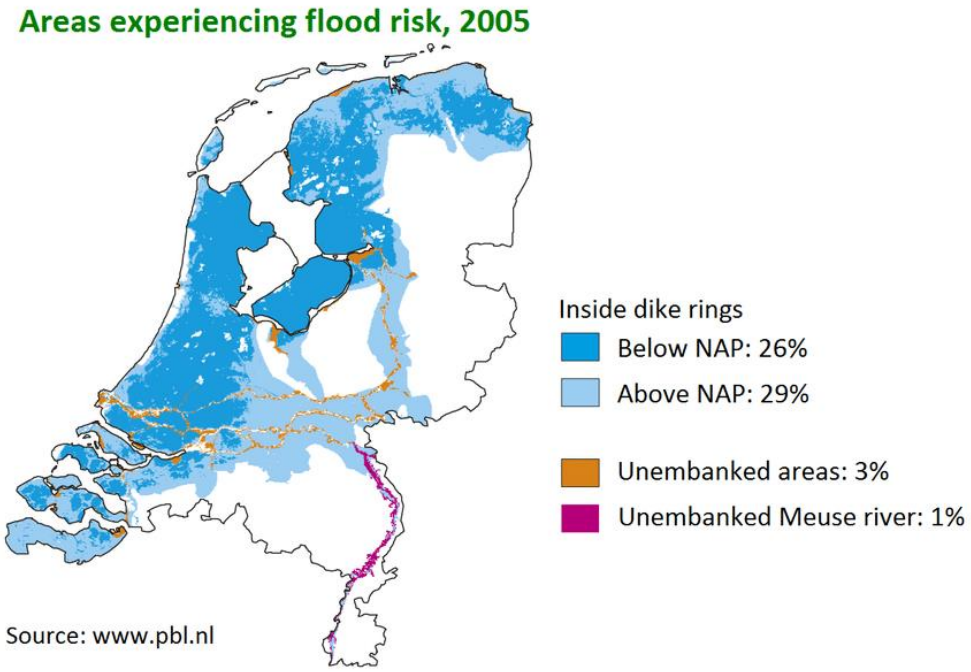


Figure 1. Areas experiencing flood risk in 2005 in the Netherlands, Source: www.pbl.nl

[1] The EU Floods Directive, implemented in 2007 by the European Parliament and the Council of the European Union, aims to establish a framework for assessing and managing flood risks in the European Union. It emphasizes the importance of coordination between Member States and the involvement of all stakeholders, including the public and private sectors.

[2] This framework, which offers a worldwide road map for lowering disaster risks, was adopted by United Nations Member States in 2015.

The empirical focus of this thesis is the Netherlands, a country in Western Europe that has a sizable percentage of its territory below sea level. According to the Ministry of Infrastructure and Water Management, several significant rivers pass through the Netherlands on their way to the sea. Without a flood defense system, around 60% of the Netherlands' surface area – an area home to nine million people and generating 70% of the country's gross domestic output – could potentially affected by flooding (National Water Plan 2016-2021). The economically significant low-lying part of the Netherlands, which roughly corresponds to the western half of the country, is protected by levees (dikes) (Silva et al., 2004) (see Figure 1). While Silva et al. (2004), also discussed that the risk of being harmed by flood flows and the associated mud, debris, and pollutants cannot be completely eliminated by structural protection.

Flood risk management in the Netherlands has a long history. The Dutch have created a 3500 km primary flood defense system in the form of dikes, dams, and dunes since the 11th or 12th century (Kind, 2014; Nieuwhof et al., 2019). Despite having a very sophisticated Dutch protection system in place, the 1953 flood tragedy in the Rhine/Meuse/Scheldt delta resulted in significant damage and approximately 2000 fatalities (Wesselink et al., 2015). Since then, pluvial flooding has grown to be a significant problem and has negative effects on urban society in the Netherlands, (Van Herk et al., 2011). Therefore, land-use planning made its way back into the flood risk management policy agenda. Two near-flood incidents in 1993 and 1995 gave political priority to landscape values, ecology, and environmental restoration, which led to the "Room for the River" (*Ruimte voor de Rivier*) program in 2000 (Van Buuren et al., 2016).

The Room for the River program was the start of a paradigm shift that resulted in more living with floods rather than fighting against them; therefore, the Netherlands has started to implement different policies to make the country more resilient. The Delta Program (updating each year since 1953), The Environmental Act (Since 2009), and Room for the River (since 2000) are a few examples of Dutch government policies that have changed to incorporate more resilience into the policy-making process. Therefore, managing flood risk is crucial in the Netherlands (Vis et al., 2003). The annual precipitation in the Netherlands rose in the last two decades and according to KNMI (2015), the intensity of weather conditions has significantly increased. As a result of climate change, extreme weather events like torrential rain are likely to become more frequent and intense (IPCC, 2014); therefore, The Netherlands as a coastal delta is especially at risk of more extreme water events and floods.

1.1. Problem definition and knowledge gap

The evaluations for water management governance in different contexts have been subject to expanding literature. Hartmann & Driessen (2017), propose a new flood risk management plan in Europe that combines traditional flood protection measures with adaptive strategies. Vis et al. (2003) compare two alternative flood resilience strategies that aim to lessen the effects of these floods while still allowing some flooding to the current flood resistance strategy used in the Netherlands, which is designed to prevent flooding along the lower Rhine River by raising the dikes. These researchers pointed out the prominence of the resilient approaches along with emphasizing participation's beneficial role in such an approach and its transition governance. While still, none of them suggest any context-specific evaluations or recommendations.

Flood resilience measures and governance evaluations are much dependent on the context characteristics. Both social and geographical aspects of a city or country are important aspects that can turn an effective recommendation for a case study into a very insufficient one for another. Therefore, Dai et al. (2018), evaluate the Dutch approach to urban flood management in Amsterdam, Rotterdam, and Utrecht. Brockhoff et al. (2019), provided a framework to assess the capacity of Utrecht governance to manage the pluvial flooding with the participation of citizens and different stakeholders. The Municipality of Utrecht has experienced extreme flooding events in recent decades, highlighting the need for effective climate adaptation governance. Several policies have been implemented to make the city resilient for these policies to be effective the participation of different private and public stakeholders is required. This thesis will assess existing policies and practices that have been taken to involve citizens and private stakeholders in flood risk management and governance in Utrecht.

1.2. Research questions

The purpose of this study is to determine the flood-proofing methods that water management governance must implement to be resilient so that urban areas can continue to operate as intended and safeguard from the harmful effects of climate change and precipitation. The City of Utrecht was studied in this thesis to assess the current state of multi-level governance and policy-making process governance put in place to make the city a flood-proof city. Recommendations were formulated to provide a context for including more participation in the process of decision-making.

The research question in this study is as follows:

“Which measures have been undertaken in order to make Utrecht’s flood management and governance resilient, with what results?”

Three sub-questions have been developed to provide the most thorough response to the main query:

1. *How is resilient flood risk management conceptualized in the academic literature?*

This question focuses on the measures that have been introduced by academic literature and policy documents. To answer this question current academic pieces of literature on resilient flood risk management and governance were reviewed and measures were extracted from the literature review.

2. *Which measures have Utrecht flood management and governance taken toward being flood-proof?*

To implement resilience measures in the city of Utrecht, the goal of this question is to investigate policies and approaches for the flood management and governance of the city as well as their impact on the multi-scalar context of flood resilience. The question was addressed based on an examination of responses from respondents who represent various stakeholders in the governance as well as reviewing the policy documents associated with this case.

3. *How are different actors and stakeholders in governance cooperating to make the city resilient?*

In this step, a deeper knowledge of the degree to which various actors and stakeholders cooperate in the administration of the city's resilience was attained, and methods to encourage more cooperation were determined. To answer this sub-question, interviews were conducted with relevant representatives of organizations.

1.3. The scientific and societal relevance

This research is aimed to assist in the development of effective flood management policies and strategies, which can reduce the impact of floods on communities and the environment. Urbanization changes the land's surface characteristics and affects atmospheric variables, causing extreme precipitation events resulting in economic and infrastructure damage and social disruptions (Shepherd et al., 2002; Koks et al., 2015). According to a 2019 analysis of precipitation patterns by the Dutch Meteorological Institute (KNMI), the Netherlands' average annual rainfall has grown by 26% between 1910 and 2013 and precipitation extremes have increased by 5 to 30% over the past 50 to 100 years (aan de Brugh, 2021; van Weeren et al., 2018).

The rise in the risk of flooding due to excessive precipitation, drought, and sea level rise is a significant water-related concern in Dutch cities (KNMI, 2014). The present study can inform

policymakers and decision-makers of current flood management strategies, identify areas for improvement, and contribute to protecting the safety and well-being of communities. Extreme precipitations in the Netherlands have also had considerable financial consequences for years. Climate change is predicted to increase the frequency and intensity of extreme weather events, which would likely increase the amount of money lost to catastrophes (IPCC, 2007), and a significant portion of this sum is utilized to repair rainwater-related damages to homes, cars, and other items (van der Aa, 2020).

To lessen the effects of floods on communities and the environment, effective flood management policies and practices are essential. The increase in frequency and intensity of floods makes it urgent to research context-specific resilience measures and the evaluation of practical methods of putting them into practice. Extreme precipitation events are predicted to increase in frequency and intensity, according to a study by Dottori et al. (2016), emphasizing the need for efficient flood management techniques. Floods can have a devastating impact on human lives, property, and the environment, and it is crucial to understand the strategies that cities and regions use to prevent and manage floods.

Whereas concepts, tactics, and adaption plans have been presented in scientific studies on the topic, there is still a relative lack of information regarding their actual application (Mimura et al., 2014). Even if aspects of application are discussed, what is mostly emphasized is the restrictions for integrating adaptation planning (Kabisch et al., 2016; Mimura et al., 2015). On the other hand, while the role of flood management and governance in adaptation has been pointed out in several pieces of literature such as Hartmann & Driessen (2017) and Morrison et al. (2018), a concrete evaluation of the practical approaches to the way of being a flood-proof city is still missing. Brockhoff et al. (2019) argue that public participation is crucial for managing pluvial flood risk, and subsidies and knowledge alone are insufficient to encourage citizens to implement resilience measures. The study in question recommends formally involving residents in flood risk management decisions and enacting stricter regulations to increase awareness and involvement, leading to an increase in flood resilience measures.

The governance in Utrecht has started the implementation in the way of making the city fully resilient in the future. By examining the flood-proofing measures implemented by Utrecht's water management governance and proposing recommendations for future policy, this research can provide valuable insights into the effectiveness of flood management strategies and identify areas for improvement. The research can contribute to the scientific understanding of the complex relationship between water resources management and resilience. Resilience is a critical concept in disaster management, and understanding the factors that contribute to resilience can help inform policy-makers to increase the ability of communities to adapt to and recover from disasters (Pelling, 2003).

2. Theoretical Framework

2.1. Flood resilience

Over the last 20 years, the discussion surrounding climate change has triggered a paradigm shift in the flood risk management of European countries, leading to a move away from resisting floods and towards adapting to them (resilience) (Hartmann & Driessen, 2017). While resilience seeks to minimize the effects of flooding, resistance strategies strive to lower the likelihood of a flood danger (Restemeyer et al., 2015). Holling (1973) provided one of the earliest definitions of resilience as "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables. s" (p. 14). Gober (2018) defines resilience in connection with climate adaptation as a city's ability to absorb shocks and bounce back rapidly. The development of flood-proof cities seeks to lessen vulnerability and boost urban resilience. The United Nations Office for Disaster Risk Reduction (UNISDR) defines resilience as the capacity of a system, community, or society to withstand, absorb, accommodate, and recover from a hazard in a timely and effective manner, including through the preservation and restoration of its fundamental basic structures and functions (UNISDR, 2009, discussed by Priest et al., 2016).

Recognizing that floods cannot always be averted and that additional measures should be put in place to respond to flooding when it occurs, the ability to absorb and recover accepts that floods cannot always be prevented (Dai et al., 2018). The current focus of city policies is less on guarding against flooding and more on adapting and being resilient in the face of it. Although Moss & Monstadt (2008) argue that the primary options for managing flood risk are still believed to be engineering and technical flood defense, building flood resilience seems to be a more promising strategy in comparison to flood defense. Strategies for building resilience "rely on risk management rather than hazard mitigation" (Vis et al., 2003, p.33). It seems to be certain that cities that face uncertainty and surprise on a regular basis may benefit from developing resilience to handle an unpredictable environment (Gober, 2018).

The methods within the resilience approach, therefore, need to consider the ability not only to respond to threats (with in-built flexibility) but also to take advantage of opportunities that arise from future change (Gersonius, 2012). The resilience approach, furthermore, suggests that future change may open opportunities for incremental adjustments or, possibly, transformational change (Gersonius, 2012). Incremental adjustments refer to small-scale changes or adaptations that can be made to enhance resilience in response to changing conditions (Pelling et al., 2015). Those adaptations that are adopted at a considerably greater

scale or intensity, those that are truly novel to a given region or resource system, and those that transform places and shift locations are all considered to be transformational (Kates et al., 2012). This type of change may involve rethinking the underlying assumptions and values that shape decision-making processes and adopting new approaches that better align intending to build resilience. According to the resilience approach, creating resilience necessitates a flexible strategy that can adapt to shifting circumstances and spot chances for incremental adjustments and transformational change.

2.2.1. Resilience measures

Scholarly literature on resilience discusses several measures to improve flood resilience in urban areas, including social capital, institutional capacity, adaptive capacity, and diversity. Social capital refers to the networks, norms, and trust that enable cooperation and collective action (Folke et al., 2010), Restemeyer et al. (2015), define it as building relationships of trust with all stakeholders involved. Institutional capacity refers to the resources and structures that facilitate decision-making and implementation of policies (Adger, 2000). Healy et al. (2017) use the term "mobilization capability" and explain it as including financial resources and support for a certain plan from policy and decision-makers to define shared aims and objectives and mobilize the required resources and support to realize these goals (discussed by Restemeyer et al., 2015). Adaptive capacity, defined as the ability to learn from experience and adjust to changing circumstances, is crucial in enhancing flood resilience (Norris et al., 2008). This is further supported by Raadgever and Hegger (2018), who also define adaptive capacity as the ability to learn, develop, and enhance flood resilience. Adger et al. (2005), proposed that it is possible to improve adaptive capacity through actions including education and training, livelihood diversification, and the expansion of social safety nets. While diversity refers to the variety of resources and options available to a system or community (Norris et al., 2008).

Diversifying flood risk management techniques necessitates correspondingly diversifying rules and regulations, which may entail adopting preexisting laws from other fields that are applicable to flood risk governance and therefore broadening the purview of law (Raadgever & Hegger, 2018). These dimensions of resilience can be applied to the specific context of flood management. For example, social capital can facilitate community participation in flood management and response efforts, while institutional capacity can enable effective coordination and implementation of policies. Adaptive capacity can help communities learn from past floods and adjust their strategies to be more effective, while diversity in flood management measures can increase the range of options available to mitigate the impact of floods.

Furthermore, flood resilience is encompassing various factors as discussed before, different pieces of literature pointed out early warning systems, infrastructure resilience, risk assessment, and community participation in addition to what was mentioned before (Adger et al., 2005; Aitsi-Selmi et al., 2016; Garschagen & Romero-Lankao, 2015; Meyer et al., 2015). Infrastructure for water supply and sewage systems are developed in the first part of the 20th century as a result of expanding public health and sanitation concerns (Kissling-Näf & Kuks, 2004). Three of the most crucial physical requirements of contemporary urban life are the availability of clean water, piped sanitary and wastewater drainage, and freedom from flooding (Hamilton, 2009). The most obvious concerns to the urban environment are flood risks, including malfunctions in the drainage system (Hamilton, 2009). For cities to function, numerous infrastructure system networks are required. During natural disasters, these infrastructure system networks both functions independently and dependably with other infrastructure system networks (Kanti Sen et al., 2021). Therefore, it is important that the infrastructure, including the roads, the drinking water system, and the energy supply, function properly during flood events. Infrastructure resilience refers to the ability of infrastructure systems to withstand and recover from flood events (Meyer et al., 2015). The resilience of infrastructure systems can be enhanced through measures such as the use of durable materials, redundancy, and the integration of green infrastructure (e.g., rain gardens, bioswales) (Meyer et al., 2015).

To create sustainable solutions, which can make cities more resilient to future conditions that might get worse, it is crucial to consider a variety of benefits while planning urban infrastructure (Lundy & Wade, 2011). Blue-green (BGI) infrastructures play an important role in flood resilience. BGI is a cutting-edge strategy that integrates green infrastructure and water management to preserve natural water cycles and improve environmental and urban rejuvenation (Drosou et al., 2019a). This can have a variety of positive effects on people and social systems, including lowering the risk of flooding, enhancing the quality of life, lowering heat and dust levels, and enhancing biodiversity (Hartmann et al., 2019). This scenario is significant when discussing the possibilities of the associated technical solutions because blue-green infrastructure is heavily marketed for climate change adaptation (Sörensen & Emilsson, 2019). To do this, the hydrological and biological assets of the urban environment are combined and protected, and flood-resilient and adaptive solutions are provided (Lawson et al., 2014).

Effective and dependable flood warning systems are becoming essential for better decision-making and risk management, notably in major floods (Wang et al., 2019). Early warning systems provide timely information about impending floods, allowing individuals and communities to take appropriate measures to protect themselves and their properties (Garschagen & Romero-Lankao, 2015). Real-time rainfall data conversion, model-driven hydrologic forecasting, model calibration, precipitation forecasting, and flood analysis can all be done using a web-based flood forecasting system (Li et al., 2006). The main goal of a flood risk assessment is to determine where there is an unacceptable level of risk and where

mitigation measures are required (Vojtek & Vojteková, 2016). In the context of flood management, resilience measures refer to the strategies and actions taken to prevent or mitigate the impact of floods (Norris et al., 2008). It entails the identification, assessment, and mitigation of flood risks through the use of numerous tactics and strategies.

2.2. Flood-risk management and governance

In establishing the concept of flood risk management, understanding its role appears to be the first step. Water provision, wastewater management, and flood control are just a few of the various tasks that make up urban water management (Jameson & Baud, 2016). Flood risk management is a crucial component of water management and? governance in flood-prone areas. The assumption underlying flood risk management (FRM) is that interactions across water and land affect the likelihood of flooding (Tempels & Hartmann, 2014). For years the dikes have played an important role in the management of flood risk. The existing approach results in an ongoing requirement for building and improving water defense structures, which limits a river system's natural dynamics and degrades landscape qualities like cultural heritage and aesthetics (Vis et al., 2003). While trying to get rid of water instead of letting it properly flow into groundwater led to a variety of environmental issues such as water quality, drought, and heat, large investments are still being made in the area because the resistance strategy fosters a false sense of security (Vis et al., 2003). Richert et al. (2019), also pointed out that dike protection decreases the likelihood that people will take or consider individual adaptation measures, but that this effect could be lessened by zoning tools.

Flood risk management strategies must address all related issues, including prevention, protection, readiness, flood forecasts, and early warning systems [to] comprise improved water retention, controlled flooding of certain areas, and sustainable land use techniques" (Directive 2007/60/EC: VII.3, discussed by Hartmann & Driessen, 2017b) Instead of only acting in accordance with a design level regardless of the vulnerabilities, managing flood risk requires taking into account various risk levels, analyzing them, and developing actions while taking potential damages into account (Jüpner, 2013). Flood risk management has proven successful at reducing the threat of some flooding hazards, preventing loss of life during flooding events, and easing the economic burden on communities and regions following floods (Disse et al., 2020). Davoudi et al. (2012), speak of three types of resilience for guiding flood risk management engineering, ecological, and evolutionary, with the last category showing the most promise. In addition, Chandler (2014), discussed that governmental reason should not attempt to control or manage the outside environment but rather should concentrate on more successful methods of evolutionary adaptation by correctly interpreting market signals. Evolutionary resilience entails a new way of thinking about managing flood risk, including the acceptance of uncertainty, adaptive methods, and a variety of damage-prevention techniques (Restemeyer et al., 2018).

2.2.2. Resilient flood-risk management

In many parts of the world, flood risk management has taken over as the primary strategy for mitigating the potential effects of flooding disasters (Disse et al., 2020). To understand and improve resilience to floods, flood risk management based on resistance needs to be integrated with resilience measures (Morrison et al., 2018). Resilient flood risk management is flood risk management that aims to allow for floods while simultaneously minimizing their effects (Vis et al., 2003). In other words, it encompasses a wider range of measures, with the goal of "making space for water/rivers" and acknowledging the limitations of flood defenses including land-use management and planning, flood insurance, flood risk communication, and environmental policies like preserving wetlands (Krieger, 2013). According to De Moel et al. (2011), "the process of detecting, analyzing, and evaluating flood hazards and vulnerabilities, and the execution of actions to reduce the possibility or consequence of flooding" is what is meant by "flood risk management." Flood hazard maps are important for flood control strategies because they accurately depict the geographic range and spread of flood threats (Di Baldassarre et al., 2010).

The earlier mentioned shift that has taken place in flood risk management from flood defense to flood mitigation and consequently a shift from engineering defense by constructing dikes to spatial planning has caused a greater emphasis to be placed on the connection and coordination of numerous policy documents relating to institutional structures, legal and regulatory papers, and strategic planning for flood risk management. The planning system also may represent the most adaptive way to control flood risk since it has the capacity to impact elements like location, type, design, and function of construction, in addition to providing for risk management and preventing or even reducing risk (White & Richards, 2007). Furthermore, Europe is transitioning towards soft interventions like planning controls and coping with floods, but damage mitigation still maintains significance, leading to the advancing of technologies for flood risk management at the sensory size (Connelly et al., 2015).

2.2.3. Participation in resilient flood-risk management and governance

There has been a recent change in the governance of flood management, where private actors are now more involved in policy-making processes as a result of the complexity of flood risks and the need for more creative and adaptable solutions (Meijerink & Dicke, 2008). Studies show how public participation in climate change can influence both direct and indirect support for climate policy and individual climate mitigation activities (Borongan & NaRanong, 2022). Community participation is a critical component of flood resilience as it promotes social cohesion and collective action, which are crucial for effective flood management (Aitsi-

Selmi et al., 2016). The need to involve private stakeholders is necessitated by the diversification of flood risk management measures, which calls for a broadening of the disciplines involved in flood risk management (such as water management, spatial planning, ecology, and disaster management) (Restemeyer et al., 2019). The policy area of flood risk management has a long-standing 'technocratic culture' and is well-known for its 'predict and control' framework (Lintsen, 2002; Pahl-Wostl, 2007; Van den Brink, 2009). The field is currently moving toward more integrated and adaptable systems of governance, accepting unpredictability as an 'unavoidable part of existence', according to Brugnach et al. (2008).

Flood resilience cannot be attained if the legitimacy of governance systems is called into question; the input, process, and outcome must all be legal and societally acceptable (Driessen et al., 2018). Van Rijswick et al. (2014), also mentioned water management and governance as complicated processes in which several individuals, each with varied and frequently opposing values, opinions, and interests, analyze problems and negotiate solutions. They contend that the width and depth of stakeholder participation in water policy processes determine its strength. The degree of community inclusion is referred to as the width of participation, and the level of stakeholder influence over the governance process is referred to as the depth of involvement (Van Rijswick et al., 2014). However, due to the predominance of" the usual suspects ", the inclusion of stakeholders in water management projects frequently lacks wide representativeness, and the realization of stakeholder influence is sometimes hampered by power battles with governmental organizations (Sabatier et al., 2005; Van Buuren et al., 2012).

To implement flood risk management, a sort of "co-production" will be needed that involves both governmental and non-governmental actors (Mees, Tempels, et al., 2016). The academic literature on flood risk management governance emphasizes the importance of an integrated and adaptive approach, that involves the collaboration of various stakeholders, including government agencies, communities, and the private sector, in the development and implementation of flood risk management strategies (Klijn et al., 2015). In addition, flood governance is ensuring connectivity between relevant policy sectors and between administrative levels, raising risk awareness among societal groups, and activating public discourse on future perspectives and related transformative pathways (Driessen et al., 2016). According to Restemeyer et al., (2015) the key to making the transition to more robust approaches more feasible in the future is raising awareness among both public and private stakeholders. Therefore, all kinds of initiatives aiming at increasing local citizens' understanding and empowerment, such as brochures and public campaigns, but even early teaching in the classroom, may aid in transformability. This strategy acknowledges the complex and dynamic nature of flood threats (Restemeyer et al., 2015).

2.3. Conceptual Framework

Resilient flood risk management is a dynamic, intricate process that calls for an all-encompassing strategy. It is crucial to assess and evaluate different aspects of flood risk management to mitigate flood risks effectively. A framework with three main pillars will be used for this thesis to assess the current state of flood management and governance: 1) policy and planning, 2) infrastructure and technology, and 3) community engagement, and participation. The assessment's elements were selected in accordance with the aspects indicated in the theoretical framework (Table 1). The first two components – policy and planning and infrastructure and technology – aim to answer the second sub-question of "*Which measures have been taken by Utrecht flood management and governance toward being flood-proof?"* and the last component – community engagement and participation – aim to answer the third sub-question of "How *are different actors and stakeholders in the governance cooperating in the process of making the city resilient? ".*

The focus of policy and planning is on institutional arrangements, legal and regulatory papers, and documents relating to strategic planning. It also is thought about how these various government documents are coordinated and connected as well as the source and number of resources available in different public or private sectors for this goal. The infrastructure and technology component concentrate on the physical infrastructure and technological systems that support the city's efforts to control its flood risks, such as the planning and development of early warning, drainage systems, and blue-green infrastructures. Additionally, it is considered how well these systems are maintained and improved to support the transition to more resilient flood management. The community engagement and participation component focus on the role of communities and stakeholders in governance, including the degree to which they are engaged in decision-making processes. In addition, the availability of information and resources enables residents and the private sector to take proactive measures to reduce their vulnerability to flooding is evaluated.

These elements were determined using the concepts in different pieces of literature among literature reviews and by summarizing the theoretical framework. Alexander (2013), (p.40-41) introduced an evaluation framework for flood risk governance with three main components of societal resilience, resource efficiency, and legitimacy. Brockhoff et al. (2019), introduced three dimensions of knowing, wanting, and enabling supporting with nine pillars of awareness, useful knowledge, continuous learning, stakeholders' engagement process, management ambitions, agents of change, multi-level network potential, financial viability, and implementing capacity (p. 4). Van Rijswick et al. (2014), mentioned content, organization, and implementation as three main components of their assessment framework (p.727) (see also; Folke et al., 2010)

Three components were selected among many important measures that were discussed in the theoretical framework The document "Vision Water and Sewage Utrecht (*Visie Water en Riolering Utrecht*)" that was published by the Municipality of Utrecht was also used for listing out dominant components in the context of Utrecht city. By using this framework, this thesis seeks to provide an assessment of to what extent flood management and governance of Utrecht is resilient and pinpoint areas that may be improved.

Table 1. A Framework for flood management and governance (Source: Author's compilation based on various sources (see references in table))

Component	Resilience	Description	Sources
Policy and Planning	Adaptive Capacity	• Learning from experience • Adjust to changing circumstances.	Norris et al., 2008
	Sustainable land-use techniques	• Considering the resilience measures • Damage-prevention • Evacuation after flood	
	Evolutionary Resilience	• Accepting uncertainty, • techniques • Risk assessment	(Restemeyer et al., 2018)
	Institutional Capacity	• The resources and structures for decision-making and implementation. • Cooperation of different players in support of the goals.	(Adger, 2000), (Healy et al., 2017)
	Diversity	• Rules and regulations, to adopting preexisting laws from other fields.	(Raadgever & Hegger, 2018)

Infrastructure and Technology	Infrastructural Resilience	• The use of durable materials, • Appropriate drainage system which can continue functioning in flooding events.	(Meyer et al., 2015).
	Mapping	• Information about impending floods • Allows individuals and communities to take appropriate measures to protect themselves and their properties.	(Garschagen & Romero-Lankao, 2015)
	Blue- green infrastructure	• Combining and protecting hydrological and biological assets of the urban environment. • redundancy, and the integration of green infrastructure (e.g., rain gardens) •	(Lawson et al., 2014), (Meyer et al., 2015).
Community Engagement and Participation	Decision making and implementation process	• Broadening of the disciplines involved in the decision-making and implementation process • Government agencies, Communities, and Private organizations' involvement	(Restemeyer et al., 2019), (Klijn et al., 2015)
	Legitimacy of governance	• The input, process, and outcome must all be legal and societally acceptable. • Width of participation	(Driessen et al., 2018),

		• Depth of involvement	(Van Rijswick et al., 2014)
	Connectivity	• Between relevant policy sectors (public-private partenship) • Administrative levels • Related transformative pathways. •	(Van Rijswick et al., 2014)
	Raising awareness	• Risk awareness among societal groups • Activating public discourse •	(Driessen et al., 2016)

3. Methodology

The research used qualitative research techniques to address the main research question *"Which measures have been undertaken in order to make Utrecht's flood management and governance resilient, with what results?"* These qualitative research techniques form the foundation for the analysis of different policy stakeholders' views and knowledge, as well as for an assessment of how they communicate within their organization, between other organizations, and with citizens. As explained earlier, this analysis aims to address the knowledge gap in the literature on recommendations for future resilient flood risk management policy, based on a thorough study of the situation in Utrecht.

The context of flood management and governance might vary by district and city based on geographical characteristics, legal procedures, and the degree of flood risk in a certain area. Qualitative research is an approach that aims to build understanding by examining how participants interpret their experiences and the world around them (Bryman, 2016). In this study, qualitative methods - policy document analysis and interviews- were deployed to better understand the policy-making and governance processes used in Utrecht's flood management system. It is widely interpretive in nature, as it recognizes the importance of understanding social phenomena from the perspectives of the people involved (Bryman, 2016). Qualitative research can be very helpful in the governance of flood management because it enables researchers to examine the subtle differences in how various stakeholders view and interact with flood risk management. Through qualitative research methods such as interviews, researchers can gain an in-depth understanding of these contextual factors and how they shape the perceptions and behaviors of those involved in flood management and governance (Clark et al., 2021). By examining various viewpoints, this strategy can help identify potential gaps in flood management strategies and policies and, eventually, help to create more equitable and effective flood management and governance.

In this chapter, the first section will provide a detailed explanation of the chosen research methods, which will be followed by a discussion of data analysis. The third section will present the case study selection criteria and the current state of the art in Utrecht. The final two sections of the chapter will discuss research quality and ethics of the research, respectively.

3.1. Methods for Data Collection and Data Analysis

Three qualitative methods made up the case study design in this thesis to answer three sub-question and the main research question. Before the data collection process, a literature

analysis was conducted to operationalize the ideas of resilience, flood management and governance, and various involvement strategies. Knowing what is previously discussed about the subject in literature is essential because it highlights the key ideas that existing studies have employed and illustrates how helpful or ineffective those ideas have been in assisting with the primary inquiries on the subject (Clark et al., 2021). This part of the research aimed to answer the "How is resilient flood management conceptualized in the academic literature?" while also being used to shape the conceptual framework for further analysis in the thesis. The semi-structured interviews and policy documents analysis followed by using the conceptual framework designed to answer the: Which measures have been taken by Utrecht flood management and governance toward being flood-proof? By analyzing the two first components of policy and planning and infrastructure and technology. Further information gathered from interviews and policy documents helped in order to draw the relationship between different stakeholders and the quality of collaboration in flood management by answering the last sub-question: How are different actors and stakeholders in the governance cooperating in the process of making the city resilient?

3.1.1. Literature Review

An analysis of the existing academic research in this field and the literature review was carried out as the research's first step. The literature review completes a theoretical framework that was used to compare current climate adaptation at Utrecht to potential measures and identify the factors that are relevant for effective resilience measures and determine how to implement additional measures. Papers and reports on climate adaptation, resilience measures, the role of regional water authorities in the Netherlands, and the role of participation in flood management and governance and policy implementation were gathered. Scopus and Google Scholar were the two main tools for finding different literature. Keywords that were used to find sources were "Resilience, Flood resilience, Climate change adaptation, Flood risk management and governance, Governance, Flood risk management in the Netherlands, Flood risk management in Utrecht, Water management, Water management in the Netherlands, Climate policy, and the Paradigm shift in water policy in Europe".

The outcomes were collections of various works from journals on water management and governance as well as various books by experts in the field, all published in the last decade and illustrating how the subject has changed over the course of years of research on flood defenses and adaptation strategies in Europe and especially in the Netherlands. Through this research strategy, a body of foundational literature was obtained, which helped to develop the initial concepts of the knowledge gap and identify the current state of the subject. Further materials were sought and used to create a more focused and systematic literature review

based on the reference lists and bibliographies of the articles and books that had been collected.

The first part of the research was designed to answer the first sub-question of the research: How is resilient flood management conceptualized in the academic literature? To create the fundamental framework for other data collection techniques of this research (policy documents review, and semi-structured interviews) in-depth understanding of existing research on the topic was necessary. The assessment framework was further shaped by defining significant measurements and the components of flood resilience and flood risk management and governance. Three components—policy and planning, infrastructure and technology, and community engagement and participation—were taken for assessing Utrecht's flood management and governance. To draw up the conceptual framework another assessment framework such as those introduced by Van Rijswick et al. (2014), Alexander et al (2016), and Brockhoff et al. (2019), were taken into consideration along with theories and concepts (see p. 19). In addition, two initial interviews with an area advisor of the Municipality of Utrecht and an Advisor on air quality, and climate change from the Rijwaterstaat (respondnets A and B) helped for gaining more in-depth insight into the topic.

3.1.2. Policy Document Analysis

Documents offer background information, a framework for further inquiry, supplemental data, a way to monitor change and progress, and confirmation of conclusions from other data sources. Documents may also be the most efficient way to obtain information when it is impossible to see events or when sources have forgotten the specifics (Bowen, 2009a). The majority of the policy documents and plans studied for this thesis can be found on various government websites (including, rijkwaterstaad.nl, hdsr.nl, provincie-utrecht.nl, and omgevingsvisie.utrecht.nl. In addition, numerous journal articles and reports have been published to educate stakeholders and offer reflections on various governmental initiatives, directives, and policies. These materials were obtained during the phase of data gathering using search engines, and inquiries from many organizations. The Netherlands Delta Plan (2023) (Deltaprogramma, 2023), and Vision Water and Swerage Utrecht (Visie Water en Riolering Utrecht (2022)), were a few of these documents in this section. The full list of documents and explanation of each of them can be found in Chapter 4 (see p.38). In addition, a number of policy documents were sent by respondents (e.g., Integrated Vision on the housing market (Integrale visie op de woningmarkt)). In all the interviews, respondents mentioned websites or documents and they were asked to send those documents and links through email after the interview. Five documents were received in this respect (e.g., Integrated Vision on the housing market (Integrale visie op de woningmarkt)) as well as two websites (e.g., water on the street after extreme rain and how high does the water get to you?) which was used as data.

In the stage of evaluating and categorizing the policy papers from various governmental levels, a variety of policy documents were used. The initial stage in the analytical process was reading through the relevant chapters. Following the reading process, the Environmental Act and Water Act were taken out of the coding process because they are in the form of regulations rather than policies and plans, and because it appeared that the legal provisions of the Act do not provide relevant and helpful information on the governance strategy and policy for flood management. Instead, the 'Integrated Vision on the Housing Market' (Integrale visie op de woningmarkt) which was sent from an area advisor water and climate from the Municipality of Utrecht, and the 'Guide to urban water management under the environmental act (2021)' (Handreiking Stedelijk waterbeheer onder de Omgevingswet, 2021) which was cited in Delta Programme, was added to the list of the initial document.

The conceptual framework's various components were operationalized into a list of keywords that were used for selecting sentences from documents before the start of the coding process. The policy documents were searched using these keywords, and phrases that were relevant to the research were chosen and highlighted. All the documents from the Water Board Utrecht Southwest, the Province of Utrecht, and the Municipality of Utrecht were in Dutch, but the documents from the Dutch national government were available in English on the governmental websites. The Dutch-language documents were translated using DeepL, a translator AI. In the pre-coding process and keyword finding in these papers, relevant Dutch terms were also searched in addition to searching for English keywords in the translated version. This was done to avoid missing any information due to differences in word selection in the translation. The initial list of keywords and publications was expanded by inductive searching. The same process was followed for new papers and keywords, and based on a back-and-forth approach, previous papers were also checked for new keywords.

Several criteria were used to select the appropriate sentences from documents. These criteria vary based on the functions of the various papers. First, the Netherlands was the focus of national policy documents. As a result, many of these papers' sections examine problems and strategies in regions different from the case study or have characteristics unrelated to the research topic. In this instance, the entire title's content—where the keywords were located—was examined to ascertain whether this information would be helpful for the present investigation. Second, some of the sentences in each document that contained the keyword discussed information concerning the previous or following sentence; in this case, all the sentences before and after were chosen to convey the information as entirely as feasible. The keywords themselves made up the third criterion. Some of the keywords have multiple meanings depending on the context only relevant use of the words were selected.

The inductive coding procedure began after picking the sentences. The sentences that had been directly transcribed from the main policy documents without any alterations to the sentence structure or word choice were coded with the assistance of Microsoft Word and were grouped based on the conceptual framework. Appendix 1 contains the themes and

codes that were collected from this procedure. These codes created the primary categories for the analysis the results of which are discussed in Chapter 4.

3.1.3. Semi-structured Interviews

Semi-structured interviews were used as the third approach to the data-collecting process. Interviewing is used to gather rich, and in-depth information about the experiences, and knowledge from the perspectives of respondents who partake in the shaping of flood management and governance as stakeholders. To choose interviewees, the snowball method has been chosen. A non-probability sampling approach called snowball interviewing uses current participants to find new ones (Stratton, 2021). The use of snowball sampling is also occasionally advised for studying networks of people (Coleman, 1958). In this thesis, since cooperation and collaboration among different stakeholders is one of the important aspects of assessment, this method was useful. On the other hand, to prevent potential biases in the selection process, for starting the snowball sample from multiple sources, some distinct respondents from various organizations were discovered on Linkedin and websites.

When conducting qualitative interviews, the researcher's preconceived notions are frequently more flexible, leaving considerably more room for the participant to influence the interview's focus and course (Clark et al., 2021). The semi-structured interviews could be used to gather more detailed information and follow up on specific points, it can provide a substantial supplement to the examination of the policy papers. Interviews have been conducted with experts and stakeholders from organizations that are involved in flood management and governance of Utrecht. The interviews took place between 30-45 minutes online or face-to-face. Interviews were conducted by following a general topic list whereby specific questions were added depending on the respondent's backgrounds (see Appendix 2). As a part of the semi-structured interview, follow-up questions were also added during the interviews based on the answers that were given by the respondents.

Ten interviews were conducted for this thesis. Four experts from the Municipality of Utrecht (Gemeente Utrecht), one from the Water Board Utrecht Southwest (Hoogheemraadschap de Stichtse Rijnlanden (HDSR)), two participants from Rijkwaterstaat, and one from the Safety Region Utrecht (Veiligheidsregio Utrecht). The professional background information of participants and the communication process are mentioned in Table 2. These interviews, initially, were used to gain insight into the framework and main focuses based on the state of the art that was pointed out by respondents this insight was used to shape the conceptual framework along with the literature review. The interviews were transcribed verbatim for data analysis and coding, whereby further mentioning of some of the sentences was edited in favor of grammar correction and cohesion.

Table 2. Semi-structured interview respondents' background and interview information

Code	Organization and position	Source of contact	Contact	Mode of interviewing, location, date and duration
A	The Municipality of Utrecht - Area advisor Water and Climate	Found in Linkedin of Gemeente Utrecht	The initial explanation was given in the Linkedin chat. Further information is given by email.	Face-to-face at Stadsplateau Utrecht 23 Feb 39 minutes
B	The Rijkwaterstaat - Advisor air quality, climate change	Found in Linkedin of Rijkwaterstaat	The initial explanation was given in the Linkedin chat. Further information is given by email.	Face-to-face in the Utrecht University Library on 23 Feb - 60 minutes
C	The Water Board Utrecht Southwest (HDSR) - Content Manager	Recommended by respondant A	communicated with E-mail	Online with Microsoft Teams on 9 Mar - 29 minutes
D	The Safety Region Utrecht - Specialist Risk and Security	Recommended by respondant A	communicated with E-mail	Online with Microsoft teams on 16 Mar - 42 minutes
E	The Municipality of Utrecht - Strategic policy advisor on urban water and climate adaptation	Recommended by respondant A	communicated with E-mail	Online with Microsoft teams on 31 Mar - 42 minutes
F	The Municipality of Utrecht - Area advisor Water and Climate	Found in Linkedin of Gemeente Utrecht	The initial explanation was given in the Linkedin chat. Further information is given by email.	Online with Microsoft teams on 13 Apr - 42 minutes
G	The Municipality of Utrecht - Advisor water and climate adaptation	Found in Linkedin of Gemeente Utrecht	The initial explanation was given in the Linkedin chat. Further information is given by email.	Online with Microsoft teams on 4 Apr - 23 minutes
H	The Water Board Utrecht Southwest (HDSR) - Coordinator Climate Adaptation	Recommended by a colleague of him at HDSR in Linkedin massage	communicated with E-mail	Online with Microsoft teams on 25 May - 28 minutes
I	The Rijkwarestaat - Software Coordinator for Flood risk management	Found in Linkedin of Rijkwaterstaat	The initial explanation was given in the Linkedin	Face-to-face in the Rijkwaterstaat Utrecht on 25 May - 20 minutes (was

			chat. Further information is given by email.	planned to be 30 minutes conducted with 10 minutes delay)

Following the data collection, the interviews were coded slightly differently from the approach used for policy documents. For interviews, (also the policy documents) a mixed method of deductive and inductive coding was used. While in policy documents keywords were used to search through the whole document, interview transcripts were coded by reading the full content instead of coding only the sentences with specific keywords. The findings have been distilled following an iterative process of traveling back and forth in the data, constantly connecting and breaking down concepts and elements (Becker et al., 2012) while considering theoretical and conceptual frameworks in the coding process. Deductive content analysis is relevant to qualitative research methodologies that seek to present a comprehensive picture of the topic being examined (Kyngäs, 2020).

Coding is always a conceptual activity; by assigning a code to a portion of your data, you designate that portion as an instance of a particular notion (Schreier, 2012). The in-depth analysis starts with labeling the sentences by deductive codes along with listing and using inductive codes during the in-depth analysis. Even though the labeling method was different from policy documents based on differences between these two types of data, the ultimate themes and codes were the same and are presented in Appendix 1. By mixing two different qualitative methods [triangulating data] the research seeks to present "a confluence of evidence that breeds credibility", thus reducing the potential biases that may exist when one method is used (Eisner, 2017,p.110 discussed by Bowen, 2009). In addition, semi-structured interviews were used to gather more detailed information and follow up on specific points. All sentences from interviews and papers with the same themes were copied into separate Word documents to integrate the data collected and produce the results presented in the following chapter. In this phase of analysis, all the coded sentences were reviewed once again, and repeated or non-relevant information has been removed.

3.2. Case study: the City of Utrecht

Utrecht was selected as the case study for this thesis to conduct in-depth and context-specific research. Expert action is fundamentally based on knowledge and experience that are context-dependent (Flyvbjerg, 2006). These skills and knowledge are also at the core of the case study as a research and teaching approach, or, to put it more broadly, as a learning method (Flyvbjerg, 2006). Researchers can preserve the comprehensive and important aspects of real-world occurrences using the case study method, such as organizational and

managerial procedures (Yin, 2009). In this section, the case study context will be sketched, and its relevance explained.

The city of Utrecht was chosen due to a number of factors, including its geographic location at the confluence of the Rhine, Amsterdam Canal, and the Vecht and its proximity to a network of canals and waterways. Second, Utrecht has endured severe flooding events, such as the catastrophe in 1953, and extremely wet years in 2014, 2016, and 2021. These events have resulted in the development of flood management strategies in the city. Third, several stakeholders and various levels of government work together to build the governance for Utrecht's flood management. The case of Utrecht flood management involves planning initiatives including participation from multi-level governance in urban climate adaptation, and more especially, flood resilience. In this setting, multi-level governance emphasizes interactions between the various governmental levels. According to Vedeld et al. (2015), the analysis of coproduction in multi-level governance places a special emphasis on interactions between public officials and citizen groups (or the private sector) concerning collaboration (engagement/disengagement) models, modes, and levels of participation in service delivery, and potential coproduction in flood risk management.

The city of Utrecht is situated in Randstad's eastern region. In recent years the city has seen several extreme precipitation events, including those in 2014, 2016, and 2021. The Municipality of Utrecht receives between 80 and 90 billion liters of precipitation annually (Municipality of Utrecht,2022). Utrecht's capacity to hold such downpours is constrained as just 21.8% of the city's central area is covered with vegetation or is blue (water) (EEA. Urban Adaptation to Climate Change in Europe, 2012). Utrecht's sewer system is aging, with only 384 kilometers of stormwater sewers, and 630 kilometers of combined sewers (Brockhoff et al., 2019). According to the "Vision on water and sewage system in Utrecht 2022", Utrecht has a strong connection to two major waterways, and canals that define the characteristics of Utrecht (Municipality Utrecht,2022). In addition, increasing precipitation extremes, a high proportion of impermeable urban surfaces, and an aging drainage system necessitate more sophisticated urban flood adaptation in Utrecht (Brockhoff et al., 2019).

As a result, increased surface runoff is produced, increasing the risk of flooding in urban areas. To overcome these planning challenges, the Municipality of Utrecht adheres to the principle of public participation in water management governance. The city has also adopted an integrated flood management strategy that combines hard (and soft) measures (such as land-use planning and green infrastructure). The responsibilities and tasks that the Municipality of Utrecht has regarding the management of water are listed in the "Municipal Water Tasks Plan Utrecht 2016" document (Municipality Utrecht,2022). Several water management-related concerns are addressed in the plan, including providing access to clean drinking water, managing wastewater, reducing the risk of flooding, and protecting water-related cultural and natural resources.

3.3. Research Quality

The highest priority in any research is to ensure the study's quality. Validity and reliability are two important factors that affect study quality. As Brink (1993) pointed out, all research must have validity and reliability as important components. Paying close attention to these two factors can assist in distinguishing between high-quality research and subpar research and increase the likelihood that findings will be regarded as reliable and credible by other scientists. Validity considers how accurate scientific results are, while reliability deals with the consistency, stability, and repetition of the informant's stories as well as the capacity of the investigators to gather and record information effectively (Brink, 1993; LeCompte & Goetz, 1982). The value of studies in science depends in part on each researcher's capacity to establish the reliability of their findings (LeCompte & Goetz, 1982). This section of the research discusses some of the risks to research quality and how to deal with them to maintain the quality.

3.3.1. Validity

Valid research must show what is genuinely true, and an appropriate tool or measure must accurately reflect what it is intended to assess (H. I. L. Brink, 1993). Two types of validity are used by Campbell and Stanley (1966), internal and external (Calder et al., 1983). The degree to which scientific observations and measurements accurately reflect some reality is known as internal validity and the degree to which these representations may be properly compared across disciplines is known as external validity (H. I. L. Brink, 1993). Based on Gaber (2020), for qualitative research, the majority of internal validity concerns center on potential researcher bias and any falsification or obscuring of the findings, in four ways, three of which have been mentioned here in relation to this investigation:

- **The researcher's characteristics** may make them more likely to work closely with some informants while paying little attention to or completely ignoring others. The researcher only captures a portion of the tale consequently. It claims to provide the "big picture," but it tends to one viewpoint.
- **The researcher's personal, philosophical, and theoretical beliefs** may influence the way the research procedure is carried out to the point where it affects the study's conclusions. In this situation, the researcher has already decided on the scope of the study, as well as which community members will serve as key data sources and which ones will serve as secondary sources.
- **The terminology the researcher employed** may have skewed the results of their research and perplexed community people who were contacted for the study. Construct validity is a type of validity check that examines the degree to which "terms,

generalizations, and interpretations are shared across time, settings, and populations."

- **“Going native”** is another and very common, threat to qualitative research’s internal validity. This bias occurs when the researcher takes on the stance and viewpoint of the group she is researching, sometimes at the price of her allegiance to the government, NGO, or funding source that is paying her to do the study. This duty could be difficult.

As the researcher in this thesis, my own planning experience as a non-Dutch student was created in Iran which is commonly regarded to be part of ‘the Global South’. Therefore, by trying to stick truthfully to data, self-reflection, and self-assessment I tried to minimize the biases as much as possible, although Bryman (2016) demonstrated, social science makes it impossible to fully do this.

In addition, Gaber (2020) highlights the risk related to external validity, including the extent to which a researcher can generalize findings from one study project to similar circumstances in other contexts. This is not to suggest that findings from qualitative research cannot logically enlighten other comparable circumstances. Planning researchers may use "theoretical inference" to generalize broad results from one qualitative research study to another. The policy documents provide background for existing inclusion, participation, and legislation when combined with the interviews, and the combination of the policy analysis and the conducted interviews may provide some degree of external validity.

3.3.2. Reliability

Reliability involves the consistency, stability, and repetition of the informant's accounts in addition to the capacity of the investigators to gather and record information effectively (H. I. L. Brink, 1993). This means that another investigation with the same method and inputs will have the same outcome if it is repeated. Noble & Smith (2015), consider two issues for reliability in qualitative research:

- **Consistency** relates to the "trustworthiness" of the procedures used and is reliant on the researcher keeping a "decision trail," or making judgments that are understandable and transparent. In the end, a different researcher should be able to reach equal or equivalent conclusions.
- **Neutrality (or confirmability)** is achieved after addressing truth value, consistency, and application. focuses on recognizing the complexity of sustained participant involvement and that the methodologies used, and results are intrinsically linked to the researchers' philosophical viewpoints, experiences, and views. These need to be taken into consideration and set apart from participant accounts.

In this research, I tried to be as transparent as possible in transcribing and coding process by triangulation and discussing the self-interpretation of interviews.

3.4. Ethics

Research ethics are an essential component of all phases of the research process, from choosing a research subject to gathering and analyzing data to disseminating study findings (Pietilä et al., 2020). The interviews were carried out in a way that upholds ethical standards, which includes considering how respondents are handled. The contact details, the selection criteria, the intended use of the data, and the goals of the interview were told clearly to the participants. Therefore, in order to provide the respondents with a written statement, the respondent's rights are sent to them via email. Additionally, participants' names and identities were kept a secret, and their anonymity was protected. The interview tape has only been used for this study and will only be listened to for the purpose of this research to ensure the respondent's privacy. Lastly, it is made clear to respondents before starting to record interviews that they have the option to withdraw if necessary.

4. Results

The analysis in this thesis was built based on the literature review that resulted in the theoretical and conceptual framework. As presented in Table 1 (see p.20), three components: 1) policy and planning, 2) infrastructure and technology, and 3) community engagement and participation shaped the main operational evaluation framework for coding. In this chapter, the results of semi-structured interviews and policy document analysis are presented based on the components of analysis. In order to make the results comprehensible, it is necessary to contextualize them in a multi-scalar setting. Therefore, an institutional context part that aims to present the political framework of governance will open the chapter. The list of policy documents that were chosen for this policy document analysis and the organizations in charge of creating these policy documents are provided in the second section, along with a brief description of each document. Results from interviews and policy document analysis for the three components of the conceptual framework will be completed in this chapter.

4.1. Institutional context

Different levels of government are involved in the governance structure for flood and water management in the Netherlands. The Ministry of Interior and Kingdom Relations and the Ministry of Infrastructure and Water Management both play significant roles at the national level. National highways and waterways are built and maintained by Rijkswaterstaat, the Ministry of Infrastructure and Water Management. Regional-level authorities including provinces, safety regions, and waterboards, and, at the local level, municipalities are involved in managing floods and water resources. For flood management to be effective and efficient, these parties must cooperate and coordinate with non-profit organizations (NGOs), and private sector stakeholders are all players within the field of Dutch water management and governance (Delta Program, 2023). According to the Delta program (2023), all decisions in Working Regions in which the province, municipalities, waterboard, and Safety Region work together should be made in consultation with the various water authorities and the parties in the area. The Water Board Utrecht Southwest *(Hoogheemraadschap de Stichtse Rijnlanden (HDSR)),* the Municipality of Utrecht *(Gemeente Utrecht)*, and the Safety Region Utrecht *(Veiligheidsregio Utrecht)* are involved in the regional government body in the city of Utrecht.

Rijkswaterstaat, as a public authority, is responsible for constructing and maintaining national highways and waterways. They also establish rules and regulations for other entities, such as dike management, and implementation of these rules is part of the Ministry of Infrastructure

and Water Management's responsibility. The province focuses on tasks such as energy systems. Waterboards are regional governing bodies responsible for water treatment, managing surface water, and flooding from rivers in the region. This includes the responsibility for the prevention of river flooding in collaboration with the national government and Rijkswaterstaat. Among the most noticeable organizations in Dutch common water resource management are the waterboards (Toonen et al., 2006), which are one of the oldest organizations in the Dutch constitution (*Waterschappen – Holland – Land of Water*, n.d.). It is regrettable that the water board is less well-known because it performs crucial functions to keep the nation habitable (Havekes et al., 2004). The waterboard is responsible for maintaining and improving the dike system. The essential elements of local water management are mostly handled by the 37 water boards. These days, this encompasses much more than just building dykes and running pumping stations (Havekes et al., 2004). Figure 2 below shows different waterboards in the Netherlands. In the Waterboard Southwest (HDSR) the "Lekdijk" is a critical and big dike in the region, they collaborate with the Municipality of Utrecht in their role of managing wastewater treatment plants.

Figure 2. Different Waterboards in the Netherlands

The Safety Region's main responsibility is to ensure the community's safety and well-being by focusing on crisis management and emergency management. Dispatchers, firefighters, risk management, crisis management, medical aid groups, and support services work together to create the Safety Region. The Safety Region prepares for and handles crises, putting an

emphasis on collaboration and reconstruction for stability. Their objective is to assign jobs to the people best suited to complete them. They help people to escape during incidents such as flooding, and fire. They also analyze the impact of climate change on safety and provide advice to the municipalities. (Safety Region Utrecht, n.d.). The Safety Region seeks to anticipate all forms of crises early on, work to avert them, lessen their consequences, and boost our society's resilience (Safety Region Utrecht, n.d.). There is a total of 25 Safety Regions in the Netherlands. Each Safety Region is associated with a certain geographical location. The creation of these areas, which are based on administrative divisions, ensures effective communication between several stakeholders, including municipalities, emergency services, and other pertinent entities. However, the respondent from the Saftey region mentioned that plans and actions alone are not the complete solutions, and prevention measures before the incidents are important along with emergency management.

In the Netherlands, local planning practices cannot be fully comprehended by analyzing provincial or national planning frameworks and rules alone since municipal governments have some discretion in their application, and they can modify or reinterpret these frameworks during the local implementation process (Neuvel & Van Den Brink, 2009). Municipalities are accountable for dealing with the consequences of extreme rainfalls and flooding in cities according to their jurisdictions; responsibility for river flooding is shared with the relevant state agency and water boards, while urban planners have not yet taken a very active role in identifying the effects of climate change in their regions and creating adaptation plans (Mulder et al., 2009).

The Municipality of Utrecht is responsible for dewatering and drainage from public spaces and the implementation of climate adaptation measures in spatial planning. In addition to addressing flooding caused by extreme rain and groundwater problems. The city also handles rainwater and wastewater management, which is then conveyed to the water board. Private owners have a responsibility for dewatering their own areas. An advisor from the Municipality of Utrecht explained that private developers should follow specific rules in the building to get permission from the Municipality, and there are incentives for citizens, such as financial rewards for implementing flood resilience measures like planting greenery in their gardens (A). He also highlighted the authority of the Municipality of Utrecht and the Waterboard HDSR in granting permission for flood management measures.

The institutional context in the Netherlands acknowledges the value of resource distribution, collaboration, and coordination among a range of stakeholders, including governments, private landowners, water boards, and for-profit businesses. Through collaborative initiatives, knowledge sharing, and efficient governance and policy coordination, the goal is to create a region that is water-safe and climate-resilient. In the document of Vison Water and Swerage Utrecht, the Municipality of Utrecht named its partners in the preparation of the document as Hoogheemraadschap De Stichtse Rijnlanden (HDSR), Waterboard Amstel, Gooi en Vecht, Rijkswaterstaat and the province of Utrecht are the competent authorities regarding the

national and regional ground and surface water system in the Municipality of Utrecht. This partnership which resulted in the development of the document, Vision Water and Sewerage Utrecht, can provide an example of a decision-making process with the cooperation of different stakeholders and regions.

In addition, working regions *(werkregio)* have been mentioned in both the Delta Program (2023) and toward one climate resistance. The provinces, municipalities, water boards, and Safety Regions collaborate in these working regions to develop plans for adjusting to the changing environment and implement programs involving risk-sharing and stress tests. By encouraging connection in dealing with climate adaptation at the regional level, this strategy encourages coordination and collaboration among various entities. Every party of regional authorities shares its policies and plans in its Working region.

> *"Collaboration takes various forms in the 45 working regions. In large cities, a lot of work is being done on climate adaptation, with the work of getting all the different units of the organization on board requiring a lot of effort. Large municipalities have more capacity, but the processes are also more complex to organize. … The provincial authority is also often involved. Organizations such as the Municipal Health Services, Safety Regions, the Forestry Commission, Rijkswaterstaat, and drinking water companies are sometimes invited to work together on a specific theme." (Delta Program,2023, p.63)*

The Netherlands' flood risk management policy comprises facilitating talks and involving a variety of stakeholders in the decision-making process. According to all eight respondents, these stakeholders include inhabitants, the water board, and the province. While concept plans may be published for feedback, it remains uncertain how much influence the public has on actual policy changes. While Utrecht lags further behind in comparison to Rotterdam and Amsterdam, an advisor from the Municipality of Utrecht (F), noted that great efforts have been made for a long time in Rotterdam and Amsterdam to get everyone (different public and private stakeholders) around the table to chat and share their thoughts. Utrecht is divided into regions, and each of these regions has one or two advisors focusing on water and climate change challenges. These advisors from different parts of the region collaborate with each other in knowledge transition and exchange within their regions. The goal is to have a decentralized advising system in the city to address water and climate change adaptation at the regional level, ensuring effective interaction and coordination (Advisor Water and climate adaptation, the Municipality of Utrecht (G))[3].

Since the Netherlands began prioritizing climate adaptation policies, numerous national and local government publications have been created. At the national level, the "National Water

[3] To improve communication, some words and/or verbs were altered in the sentences that were selected from the interviews. Sentences were attempted to be maintained. Only to ensure that these alterations would uphold the fundamental notion raised by respondents, Grammarly was utilized in conjunction with QuilBot.

Plan 2016-2021" has been recommended to municipalities by the government which is a long-term plan for managing water (National water plan, 2016). The strategy intends to provide access to clean water, effective wastewater treatment, and a decreased danger of flooding. The strategy is based on an integrated approach to water management that combines hard measures (such as water storage basins, pumps, and dikes) with soft measures (such as land-use planning and green infrastructure). The plan also stresses the necessity of international cooperation in tackling the world's water concerns, as well as the significance of public engagement and knowledge in water management activities. The National Water Plan is continuously reviewed and modified to reflect the most recent advancements in science and water management techniques (North Sea Policy in the National Water Plan, n.d.).

4.2. Policy documents

Numerous policy documents are accessible at all levels of governance in various areas including flood management and climate adaptation, as was also explained in chapter three. Seven documents were chosen for coding and analysis in accordance with the criteria outlined in the Methodology part. The policy documents section initially presented brief general information about each of these publications, followed by a description of the main findings. These documents are presented in Table 3, with an overview of what they contain, and which organizations are responsible for publication.

Table 3. Key policy documents pertaining to flood risk management at different governmental levels in the Netherlands.

Policy Level	**Document** ***(Title in Dutch)***	**Publication Organization**	**Year of publication**	**Targets**
National Level	Delta Programme (*DeltaProgramma*)	Ministry of Infrastructure and Water management (The Delta Programme Commissioner)	2023	1.Sound flood risk management 2. Ensuring freshwater availability 3. Promoting spatial adaptation 4. Enhancing flood protection and river management 5. Optimizing water storage and distribution

				6. Integrating climate adaptation into spatial planning 7. Promoting green infrastructure and nature-based solutions 8. Enhancing resilience of critical infrastructure 9.Encouraging community engagement in adaptation efforts
	National Water Plan *(Nationaal Waterplan)*	Ministry of Infrastructure and Water Management	2016	1. Strengthening flood protection infrastructure, 2. Developing flood risk management strategies, 3. Enhancing spatial planning, 4. Promoting nature-based solutions, to achieve the goal of remaining the Netherland a safe and habitable country.
	Guide to Urban Water Management Under the Environmental Act *(Handreiking Stedelijk waterbeheer onder de Omgevingswet, 2021)*	Ministry of Infrastructure and Water Management	2021	1. provide guidance for giving a decentralized interpretation to urban water management. 2. Continuously evolving and adapting to new insights and practical experiences.
	Cabinet Approach to Climate Policy *(Kabinetsaanpak Klimaatbeleid)*	Letter from the Minister for Housing and Spatial Planning, the Minister of Infrastructure and Water Management and the Minister for Nature and Nitrogen	2023	1.Introducing the "Landelijke maatlat voor een groene, klimaatadaptieve gebouwde omgeving" (National standard for a green, climate-adaptive built environment) to the Parliament. 2. Providing the underlying building blocks report along with the national standard.

				3. Fulfilling the commitments outlined in the coalition agreement to prioritize water and soil in spatial planning. 4. Addressing the recommendations from the Policy Table on Water Overload and High Water to legally anchor the maatlat and explore its implementation in existing built environments.
Regional	Handbook Water in Spatial Plans *(Handboek Water in ruimtelijke plannen, 2023)*	The Waterboard (HDSR) (Hoogheemraadschap De Stichtse Rijnlanden) Utrecht	2023	1.Provide guidelines for incorporating water policies into spatial developments.
Provincial Level	Towards one Climate Resistant Utrecht Program Climate Adaptation *(Op Weg Naar Een Klimaatbestendig Utrecht, 2020)*	Province of Utrecht	2020	1.Make the province of Utrecht climate-resilient and water-safe by 2050. 2. Outlines the province's goals, ambitions, and strategies. 3. Acknowledges the impact of climate change, including extreme weather events. 4. Emphasizes working together with government bodies, land managers, and residents to create a climate-resilient region. 5. Ensure a safe, attractive, and economically strong province for current and future generations.
City Level	Vision Water and Sewage Utrecht	Municipality of Utrecht	2020	1. improvement of the sewage system so that 2. Capture and use rainfall again.

	(Visie Water en Riolering Utrecht, 2020)			3. Engagement of everyone for this goal

At the national level, the Ministry of Infrastructure and Water Management is responsible for policy documents and evaluations regarding environmental, climate change, water management, and spatial planning in the Dutch government. One of the key policy documents regarding fresh water supply, spatial adaptation, climate change, and flood mitigation is known as Delta Programme. This document's first version was published after the flood happened in 1953 and 1990s which resulted in many losses (Government of the Netherlands, 2021). This annual document is reviewed every year, evaluated, and changed based on evolving circumstances and newly available knowledge. The latest Delta Program was published in September 2022 and outlines the steps taken between 2021-2022 as well as the actions envisioned for the following years (Government of the Netherlands, 2022).

Furthermore, the Ministry of Interior and Kingdom Relations Published "The Environmental and Planning Act of the Netherlands" *(Omgevingswet)*. This document aims to update, harmonize, and streamline existing regulations on land use planning, environmental protection, nature conservation, building construction, cultural heritage protection, water management, urban and rural redevelopment, development of major public and private works, mining, and earth removal, and integrate these regulations into one legal framework (Government of the Netherlands, 2017). "The Guide to Urban Water Management under the Environmental Act (2021)" shows what remains and what changes in "The Environmental and Planning Act of the Netherlands" to decision-makers, attorneys, water management, and sewers. The availability of the current guide to all governments and other stakeholders in urban water management as a useful tool and reference work is one of its key goals (Ministry of Infrastructure and Water Management, 2021). This collaboratively created guide gives practical tools and explains to practice the purpose and content of the new system (Ministry of Infrastructure and Water Management, 2021).

Another national-level policy document which is published by the Ministry of Infrastructure and Water Management working together with stakeholders, water boards, and other governmental organizations, and is considered during the data analysis process of this thesis is National Water Plan 2016-2021. This document provides the 2016–2021 planning period's general framework, guiding principles, policy orientation, and a look ahead to 2050 (Government of the Netherlands, 2015). Moreover, the plan highlights priority areas for investment and action and offers instructions on how to combine and integrate water management policies across all governmental levels.

The Ministry of Housing and Spatial Planning, the Ministry of Infrastructure and Water Management, and the Ministry of Nature and Nitrogen all contributed to a letter titled Cabinet Approach to Climate Policy. This letter was sent by one of the respondents who works as an advisor for the Municipality of Utrecht (A). The National Yardstick Program is the foundation of this letter. The significance of this is already evident in the manner of receiving it since it demonstrates which aspect of the main program is mostly utilized or put into practice by the Municipality of Utrecht. The Ministry of Infrastructure and Water Management, working together with the Ministries of the Interior and Kingdom Relations, is developing the national yardstick and the spatial assessment framework. The Union of Water Boards (*Unie van Waterschappen* (UvW)), the Interprovincial Consultative Body (Interprovinciaal Overleg (IPO), the Association of Netherlands Municipalities (Vereniging van Nederlandse Gemeenten (VNG)), and the Delta Commissioner have all worked closely on the development of the yardstick. The national yardstick is the foundation for designing climate-adaptive structures and specifies qualitative objectives, quantitative performance standards, and guidelines for a variety of issues, such as flooding, drought, heat, biodiversity, and subsidence.

In February 2023 the Waterboard Southwest (HDSR) published the document "Handbook Water in spatial plans (2023)". The Provinces of Utrecht and Zuid-Holland, Rijkswaterstaat, project developers, consulting firms, and municipalities, in general, are the target audiences for this handbook. It translates current water policy into geographical developments and offers guidelines. This manual served as the regional water government's policy manual.

Another paper is titled "Towards a climate-proof Utrecht (2020)" which was released in May 2020 by the province of Utrecht. The province of Utrecht describes its strategy for the upcoming years in order to become a climate and water-safe province by 2050 in this document. All provincial policy is directed by climate adaptation. Other objectives towards a healthy and vibrant region can be accomplished by the steps being taken to make the province more climate-proof.

The Municipality of Utrecht has drawn up several plans to make the city flood resilient. "Plan Vision Water and Sewerage Utrecht (2020)" is a long-term strategic plan for the management of water and sewerage in the city of Utrecht. The Water and Sewerage Program describes the measures and resources required for the next five years. Access to clean water, efficient wastewater treatment, and a reduced risk of flooding are all goals of the approach. It is based on the principles of integrated water management, climate adaptation, and environmental sustainability. Important components of the strategy include encouraging public participation in water management projects, establishing new water storage basins, updating the sewer system, and creating green infrastructure. The plan is regularly updated to incorporate the most recent developments in technology and water management strategies (Gemeente Utrecht, 2022).

4.3. Policy and planning

Policy and planning is the first pillar of the conceptual framework. This component has five sub-components that were utilized as a foundation for extracting keywords for policy document analysis and as deductive codes: adaptive ability, sustainable land use practices, evolutionary resilience, institutional capacity, and diversity. Results regarding this pillar will be discussed in this section.

The importance of cooperation and partnerships among various levels of governance, including national, regional, and local authorities, is repeatedly emphasized in the policy papers. They place emphasis on the necessity of collaboration between national government, local authorities including, Waterboards, Municipalities, Safety Regions, and other stakeholders to effectively handle the issues surrounding flood risk management and climate adaptation. As the Delta program (2023) mentioned the cooperation for dikes improvement:

> *"In almost all dike upgrade operations, municipal or provincial authorities also contribute to larger or smaller opportunities for leisure, nature development or road safety." (Delta Programm, 2023; P.41)*

This document also emphasizes the most important stakeholders of the Water Act[4]:

> *"Important stakeholders are the Union of Water Authorities (UvW), the water authorities with primary flood defenses, Rijkswaterstaat, the Flood Protection Programme, the Association of Provincial Authorities (IPO), the Association of Netherlands Municipalities (VNG) and the Human Environment and Transport Inspectorate (ILT)." (Delta program, 2023; P.36)*

The stakeholders also emphasize the necessity of coordinating efforts at both the municipal and national levels of government to adapt to climate change. The HDSR's representative mentioned that to ensure effective flood management, many discussions, partnerships, and coordination take place within this Network (H[5]).

Policy plans for each region in the Netherlands should be developed in collaboration with the entire region, considering the potential impact of flooding from large rivers. Given that the HDSR and the Municipality of Utrecht both want to combat climate change, disputes between them are uncommon according to the Area advisor of the Municipality of Utrecht. But in some circumstances, like the location of a new pumping station, or new residential area

[4] In the Netherlands, the Water Act is a comprehensive legal framework that oversees the administration and conservation of water resources nationwide. It was put into place to ensure the sustainable use, management, and conservation of water resources as well as to prevent and lessen dangers associated with water, like flooding and water pollution.

[5] The capital letter in the brackets corresponds to the respondent as mentioned in table 2 on page 27.

development problems do occur as pointed out by the Waterboard Southwest representative (H). Superiors, boards, and even the court may be consulted if necessary if disputes deteriorate. Although he mentioned that even if this happened most of the time the agreements will be achieved by discussion and meetings between the organization's advisors and not the court. To solve issues relating to water and climate, the Safety Region actively collaborates with other network organizations, such as the province. Specialist Risk and Security from the Safety Region brought up the issue of how the Municipality's employees occasionally do not comprehend their duties or the significance of the security area (D). She added:

> *"We are a separate company, in my opinion, and when I met with municipality's personnel that are involved in water management, they had no idea who we were. They said that I am not responsible for spatial planning. You cannot say that it is not your responsibility because it is, in fact, your organization's responsibility. It might not be your department, but it is still your organization."*

Even though municipalities have a legal right to autonomy, the representative of the Safety Region contended that the national level should provide more guidance to municipalities than just advice in order to ensure the implementation of effective and necessary measures. To attain resilience goals, it is acknowledged that resource allocation, finance, and partnership evaluation are important. Municipalities are allowed to charge for sewage to collect money for the management of urban water resources. The materials also stress the requirement for adequate human and financial resources to implement climate adaptation strategies successfully. Proper resource allocation and risk assessment are essential to develop effective flood risk management methods. Due to the flexibility of financial distribution, management may adjust to changing priorities and demands.

In the past, Utrecht relied on a substantial dam built in the year 900 to stop river flooding. This strategy puts an emphasis on the dike and structural management for prevention, reducing the consequences of flooding, and disaster response. However, since major flood incidents in 1993 and 1995, there has been a trend toward a multi-layer safety approach with the rise of climate change. Stakeholders stress the significance of spatial planning when taking climate change-related flooding concerns into account. To find weaknesses and create action plans, stress testing is advised as a starting point. For flood risks to be effectively reduced, capacities for prevention, adaptation, and recovery which is Dutch three levels of safety must be built. Stakeholders also understand the significance of considering residential and commercial areas, small companies, and crucial services like schools when addressing the effects of floods. As the respondent from the Safety Region (D) brought up the concern that residential areas are emphasized while the effects on businesses, small businesses, and important services like schools are ignored.

Respondent “H” from the HDSR, mentioned the need for spatial planning to consider the risks of flooding due to climate change. The Waterboard urges spatial planners to take flooding risks into account when deciding on housing locations and design, emphasizing the limitations of the existing water management system. The area advisor water and climate in the Municipality of Utrecht, also mentioned that, in new developments, the Municipality of Utrecht considers whether a location is suitable for development due to being below the sea level and gives the guidelines such as raised doorsteps to developers to ensure certain levels of flood protection (A).

Based on the interviews with the Municipality of Utrecht and the Waterboard advisors, the Waterboard and the Municipality advise spatial planners to consider flooding concerns when determining the sites and designs of homes. Stakeholders also stress the value of water infiltration and green infrastructure in managing heavy rain and avoiding floods. For rain flooding, the Municipality’s advisor mentioned the goal of using or retaining 90% of rainwater and retaining 15 mm of rainfall on-site. To make public spaces resilient enough to handle an 80 mm rainshower in an hour, slightly higher than the national standard of 70 mm, the Municipality of Utrecht aims to transform 420 hectares of grey areas into green spaces (A).

A content manager of the Water and Climate mentioned the necessity of providing space for water, separating rainfall, and promoting more green infrastructure while minimizing the use of gray infrastructure (C). According to the strategic policy advisor on urban water and climate adaptation in the Municipality of Utrecht, this entails increasing the amount of water infiltration into the drainage system and establishing temporary water storage sites. The Municipality aims to increase water penetration and turn unused lands into green spaces and temporary water storage sites (E).

A strategic policy advisor on urban water and climate adaptation in the Municipality of Utrecht emphasized that rather than flooding, which they believe they can now manage, the greatest problem in water management is adapting to heat and droughts. The current emphasis is on putting policies in place to store and infiltrate water as well as to ensure quick discharge to the sea when required. Another advisor from the Municipality underlined that this would help to lower temperatures and offer to cool in certain regions (G). She also added:

> *“And I think that's really a way to contribute not only to the water aspect but … it can be a city a nice place to live where you can feel good and healthy.” (G)*

Additionally, the Coordinator Climate Adaptation from the HDSR mentioned:

> *“So, we also take other purposes. Other subjects in accounts in which we can improve, so of course recreation, nature, mobility. So, we take everything into account, and we make one big, big plan with all those things.” (H)*

The documents emphasize the value of evaluation and adaptive management in implementing policies. They draw attention to the necessity of evaluating both the efficacy of resilience measures and the progress gained in incorporating climate adaptation techniques into spatial projects. It is believed that adaptability and flexibility are essential for modifying methods in response to shifting objectives and needs. The documents stress the importance of thorough risk assessment and management techniques. For carrying out efficient risk assessments, they emphasize the significance of data collection, analytical tools, expertise, and financial resources. The objective is to create effective flood risk management plans that take into account the accuracy and efficacy of risk assessments.

During interviews, the importance of stress tests was emphasized. An advisor from the Municipality of Utrecht (F) pointed out that these stress tests are an important factor for the Security Region to consider adaptive measures:

> *"But they also make look to, stress tests that we make for heat, for flooding, and then they see how high the water level for example is. And can you still go to the hospital? In the hospital, I think they've already thought about it. OK, let's not put all the equipment in the basement because if it's flooding and everything stops, so they will put it higher."*

The new stress test will change the goals and policies of flood management and governance. They evaluate whether the current policies are effective for mitigating the level of damages and what extra policies should be in place. Another area advisor from the Municipality of Utrecht (A) mentioned that the Municipality of Utrecht will review goals after the stress test in 2024.

Overall, concerning the pillar of Policy and planning, the theories on flood management emphasize evaluation, and collaboration in building governance (see, Hartmann & Driessen, 2017; Mees, Tempels, et al., 2016; Penning-Rowsell & Becker, 2019; Van Buuren et al., 2012). The Netherlands' flood risk management and climate adaptation underlines the significance of collaboration among stakeholders and levels of government. The distribution of resources, risk assessment, and spatial planning are essential components. A multi-layer safety approach is becoming more prevalent, taking into account prevention, adaptation, and recovery. An integration of different climate adaptation goals such as heat and droughts is considered important. Modifying tactics and evaluating risks need the use of evaluation, adaptive management, and stress tests.

4.4. Infrastructure and technology

In all its national-level initiatives, the Dutch government acknowledges the significance of infrastructure resilience in protecting crucial systems and infrastructure from the effects of

climate change. Local governments and suppliers should cooperate to make sure that these systems and infrastructure can better withstand flooding, an abundance of water, a drought, or extreme heat, according to the Delta Program (2023). The Guide to Urban Water Management Under the Environmental and Planning Act (2021), acknowledges that municipalities, in cooperation with water boards, will conduct a fresh assessment to fulfill the municipal job for wastewater in the outlying region once the infrastructure reaches the end of its technical lifecycle. This suggests that the government is aware of the significance that infrastructure upkeep and modernization to ensure its reliability and efficiency over time.

The relevance of climate-adaptive construction agreements is emphasized by the Handbook Water in Spatial Plans (2023), a document from the Waterboard Southwest (HDSR). The intention is to stop severe precipitation from harming structures, infrastructure, and facilities. Additional steps must be taken in spatial development to guarantee there is enough room for water collection and processing to achieve this. The municipal main sewer system is 1,292 kilometers long, and due to city growth, about 20 km of new sewerage is added each year. The total replacement cost of the system is approximately two billion euros (Vision Water and Sewage Utrecht, 2020).

Due to the Municipality's responsibility for wastewater management, proactive actions are required to address potential weaknesses and preserve the infrastructure's operating performance, according to the Guide to Urban Water Management Under the Environmental and Planning Act (2021). One of the emphasized goals of government policies is mentioned to guarantee the resilience of critical facilities and infrastructure (such as energy supply, drinking water supply, and infrastructure) in the face of harsh weather conditions. The National Water Plan (2016) recognizes that by 2050, critical and sensitive national operations, such as the energy grid, the wastewater system, the provision of drinking water, hospitals, and emergency communication, must be more flood-proof. There are efforts undertaken to lower the risks following identifying these functions' climate-related vulnerabilities. According to the Towards One Climate Resistant Utrecht Program Climate Adaptation (2020), to evaluate the resilience of the province's crucial and vulnerable functions, stress tests and risk dialogues have been conducted.

During interviews, several topics relating to infrastructure resilience in flood management governance came up. The Vecht, Rhine, and Amsterdam Canals are three significant surface waterways that are close to the city of Utrecht. Rijkwaterstaat and HDSR are responsible for the management and safety of these rivers and bodies of surface water, as Respondents from these two organizations have noted. The HDSR has two main duties, The management of minor rivers is the first. This suggests that their primary concern is ensuring the correct operation and upkeep of these water features. The significance of the Amsterdam Canal in providing water supply, especially during the summer. The software coordinator for flood management from Rijkwaterstaat mentioned that 50 cubic meters of fresh water are supplied through the canal. In addition, an advisor from the Municipality of Utrecht, mentioned

directly releasing precipitation into ponds, rivers, and other areas of surface water as a measure to adapt to rainfall flooding (A).

The second responsibility of HDSR entails wastewater treatment, including wastewater facility ownership and management. The respondent from the HDSR (H), underlined the value of wastewater treatment in upholding environmental norms. Since the development of sewerage and drainage systems and transferring the wastewater to treatment areas are the Municipality's responsibility, this process is followed by the collaboration of the Waterboard and Municipality in the region. This part of the municipalities' legal responsibility is also emphasized by the Handbook from the HDSR. Wastewater is released into the public sewer system and treated at the nearby sewage treatment facility by the Waterboard.

The drainage and sewerage system are important aspects of flood management governance. The document, Water and Sewage Utrecht (2020) mentioned the installation of new dewatering equipment is only taken into consideration when specific requirements are met, like enhancing the state of the individual drainage resources. Through management, replacement, and maintenance, the Municipality of Utrecht seeks to provide a reliable water and sewage system. Additionally, as part of sewer replacement projects, the policy attempts to compel property owners to connect rainwater discharge to new stormwater sewer systems. It also acknowledges the significance of protecting the city from climate change and making sure that crucial infrastructure would continue to function in the event of catastrophes or breakdowns.

Within the next 30 years, according to an advisor from the Municipality of Utrecht (A), the current combined sewerage system must be updated. The system will be divided into two sections: one for household wastewater and one for rainfall. This division will aid in more effective water management and lower the chance of flooding. Based on another area advisor of the Municipality of Utrecht, by doing so the clean water on the site can be used for things like toilet flushing and groundwater replenishment. He gave details regarding the current implementation of this separation of sewer systems as he mentioned that the implementation is 4 to 5 kilometers each year (F).

Similarly, for public spaces, as the Municilapitiy's representative pointed out public areas must be resistant to an 80 mm rainstorm event. This argues that to avoid flooding, the infrastructure of public spaces should be equipped to handle such severe rainfall. A Rijkwaterstaat''s representative (I) brought out the drainage issues in recently constructed communities in marshy areas. Controlling water levels in these areas is difficult because of the topography, therefore unique procedures and systems must be put in place to manage and control water levels. In the past, it was customary to install larger sewer lines to drain water from the impacted areas effectively. The Content manager of HDSR, stressed, however, that the current approach seeks to emphasize the use of surface-level measurements and the integration of different methodologies into gardens. instead of relying entirely on sewer lines.

The Coordinator from the HDSR discussed that these green spaces aim to catch rainwater and keep homes and roads from flooding.

Providing infiltration by using green infrastructures and plants in gardens, roofs, and public places were mentioned as a sufficient technique for reducing the damages of extreme rainfall and flooding with preventing run-off at various levels of flood control governance. According to the Delta Program (2023), rainwater is increasingly being stored or drained above ground using techniques such as wadis, green strips, and designed roads. Public properties and areas are being made climate-resilient by introducing height differences, creating more green areas, and incorporating open water. Initiatives like the Green City Challenge[6] encourage the replacement of paving stones with green alternatives to promote water awareness among the public. Strong green and blue networks are essential for enhancing water storage and infiltration capacity in built-up and low-lying areas/stream valleys, according to the Guide to Urban Water Management Under the Environmental and Planning Act (2021). The Cabinet Approach to Climate Policy approach (2023), mainly discusses important criteria and implementation policy of the National Yardstick Program, the program which is designed to make greenery more incorporated in urban areas.

The HDSR places a strong emphasis on the area's biodiversity and green-blue structures. Even when social performance and costs are the same, natural processes and ecological solutions are given precedence over "grey" ones. With a focus on retaining and reusing rainwater within the plan area, the policy suggests water-neutral (re)development and (re)design. Trenches and waterways are ideal infiltration facilities for water storage. To reduce the need for overflows, extra rainwater is drained into public areas rather than into the sewer system. The water board advocates climate-adaptive policies that give natural rather than artificial solutions precedence. To make urban areas greener this Vision Water and Sewage Utrecht (2020), suggests creating national standards based on ideas that acknowledge how beneficial greenery is for a variety of policy objectives. For climate adaptation and to enhance the built environment's resilience, green building practices must be incorporated into the development of new structures.

A Municipality of Utrecht's advisor (A) added that the Municipality intends to turn 420 hectares of parking lots and other unused land into green spaces. To accomplish a target of 40%, it is intended to expand the amount of green space in each neighborhood. In line with it, another advisor also from the Municipality of Utrecht noted that water is carried in and distributed over greenery in the new Leidsche Rijn neighborhood. The objective is to make it simple for water to infiltrate the earth and store it there for a predetermined amount of time. This strategy aids in efficient water management and reduces flooding.

[6] This year (2023), the Green City Challenge (OK, but explain what this is about) was held for the first time, and 103 municipal authorities took part. The cities of Rijswijk and Delft were chosen as the Netherlands' greenest communities. (Delta program, 2023)

According to the Municipality's representative (F), the Rhine's movement over the years has caused variations in the soil composition in Utrecht. There are some places with sandy soil and others with clay. The potential and difficulties posed by rainwater management systems are influenced by this variability. He also mentioned the density of the Utrecht as an important challenge that the greenery approach faces:

> *"A lot of sandy soils and a bit clay but. It's, uh, more it's easier here to to find the space. Again, in the city, all the spaces are already claimed by people by functions, and now with climate change. Yeah, we want to also add storage of rainwater, and the transition of energy like this also needs to go into the soil, and more trees must take up space with the roots. So, it's getting more and more busy." (F)*

Another aspect to be considered in this topic is the integration of different goals in implementation. This approach is more environmentally friendly as well as cost-efficient. The National Water Plan (2016) acknowledges the possibilities for connecting environmental goals to the implementation of flood risk reduction, water quality, and freshwater supply initiatives. The government is aware of how crucial it is to handle water-related issues using natural solutions and green infrastructure. The Netherlands intends to increase the resilience of its water systems while fulfilling ecological goals by increasing the use of nature-based approaches, such as green spaces and natural water retention systems.

Scientific evidence supports the beneficial effects of greenery on biodiversity, climate adaptation, and health (see, Drosou et al., 2019; Ghofrani et al., 2017; O'Donnell et al., 2020). Green technologies are viewed as a goal in terms of the amount of greenery as well to reduce flooding, droughts, and heat waves and increase biodiversity. The sponge effect, which refers to the capacity of vegetation and permeable surfaces to absorb and retain water, is promoted by the Guide Urban Water Management under the Environmental Act (2021). This effect can be enhanced by the establishment of more green areas. Owners of plots and buildings are responsible for groundwater management, underlining the teamwork needed to develop green infrastructure solutions.

In line with other governance body policies, the Municipality of Utrecht aims to utilize as much work as feasible when replacing or maintaining sewers, this involves replacing non-functional pavement with trees and plants. To increase the amount of green space, lower the peak discharge of rainfall, and retain rainwater where it has fallen, the strategy also encourages the removal of paved surfaces in inner-city development zones. The Municipality of Utrecht is creating water-friendly social housing and funding programs for green roofs.

In the subject of greenery, many other benefits have been considered by the Municipality of Utrecht, such as cooling, and liveability. The respondent from the Municipality of Utrecht (F) mentioned that the Municipality is actively involved in planting more than 60,000 trees in the city to make the city shaded during the warm season along with infiltrating rainwater and

restoring it to groundwater. As an example of the implementation of this approach, the advisor from the Municipality of Utrecht pointed out that in making grey lands into green areas the process of separating sewerage from the rainwater system is an opportunity. Since these transitions require street opening, these openings offer chances to rebuild the region, adding extra green spaces or parking, for example.

The use of data and mapping was one of the aspects of the conceptual framework because of the theoretical consideration and the use of technology in flood resilience governance effectiveness. To effectively plan agendas relating to flood risk management, the Delta Program (2023), emphasizes the need of gaining access to and utilizing nationally available data as well as local and regional knowledge on climate impacts. The government highlights the importance of maintaining current versions of crucial databases for standardized data. Stress testing is necessary to fully comprehend the effects and necessary steps for water management, spatial planning, essential networks, functions, and crisis management. The nation seeks to standardize the basic concepts of stress tests while considering climatic variables and adverse weather conditions.

The government wants to improve mapping skills and enable informed decision-making for urban water management by using spatial information and data-driven tools such as sensor technology, mobile applications, radar, and satellite pictures. The HDSR's Handbook emphasizes that regional maps are aimed at giving a general overview of rivers, assisting in the processes of spatial planning and decision-making. The Province of Utrecht in the document the Towards One Climate Resistant Utrecht Program Climate Adaptation (2020), pointed out that to address sustainable civil engineering and climate adaptation, a climate adaptation ambition web is being created. The objective is to incorporate climate adaptation into the planning and construction of infrastructure. Environmental Management Act states that

The respondent from the HDSR (H) said that this organization recently presented a map of its entire territory to the stakeholders. This map shows locations where it is best to avoid building development or where careful planning and design considerations are necessary owing to flood concerns. Since successfully draining off water is difficult during times of severe rains.

The Rijkwaterstaat and the Municipality now make maps available for stakeholders and residents to be informed of the possible damages and necessary actions. The representatives of the Municipality of Utrecht showed these websites during the interviews.

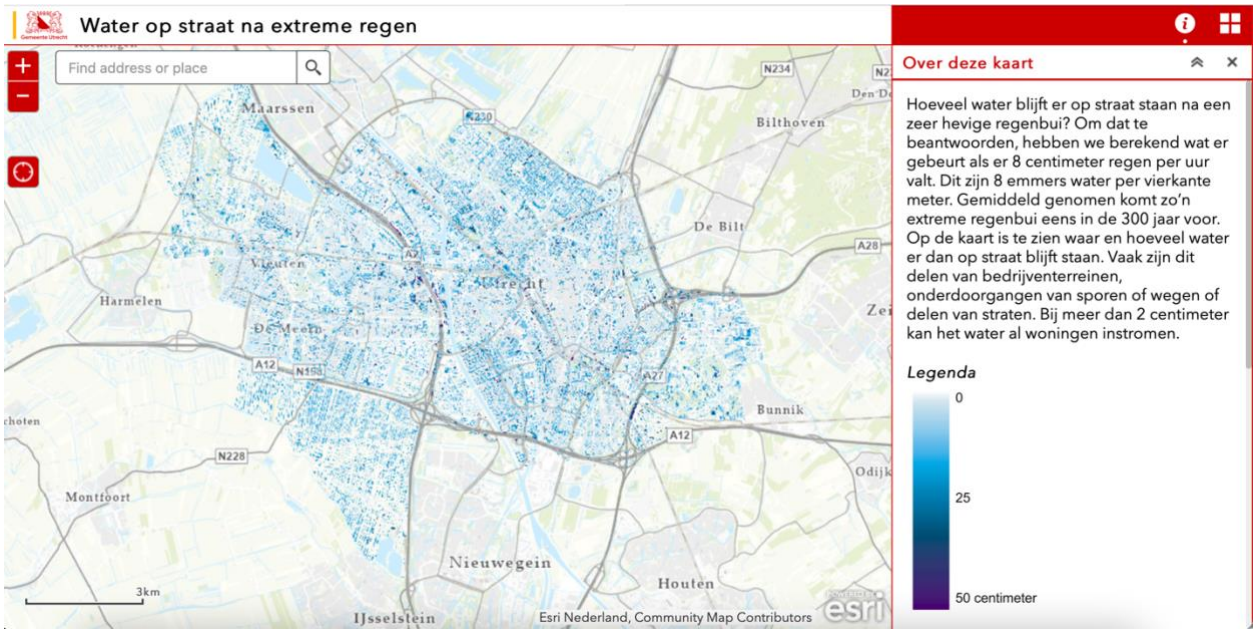
1. Water on the street after extreme rain *(Water op Straat na Extreme Regen)*- **Municipality of Utrecht:** One of the Municipality's advisors discussed that street water levels during an 80 mm rainstorm are shown on this map. This enables locals to evaluate the risk of floods in their neighborhoods. To reduce losses and ensure that vital services like emergency services, hospitals, and energy continue to operate

during flooding, this information is made accessible. as the description in the site shows:

"We (Municipality of Utrecht) calculated what happens when 8 inches of rain falls per hour. This is 8 buckets of water per square meter. On average, such extreme rainfall occurs once every 300 years". (A)

The map below (Figure 2) in the site shows the location of the water on the street and its indicated extent. These are frequently sections of industrial parks, railroads, roadways, or sections of streets. The water can already enter dwellings at a depth of more than 2 centimeters. Although the map and information on the site have not been updated since 2014.

Figure 3. Water on the Street website and legend (Source: https://gu-geo.maps.arcgis.com/apps/webappviewer/index.html?id=486867c9fe84426a881e445d6e4af8f0, 2014)

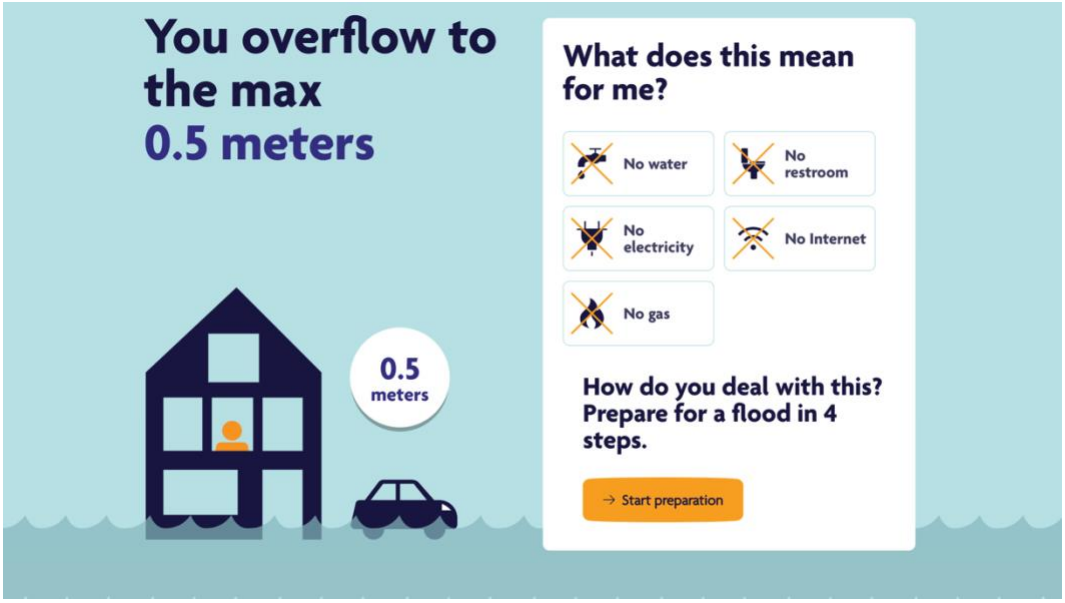


1. How high does the water get to you? (*Hoe hoog komt het water bij jou?)* - Rijkswaterstaat, the Safety Regions, the water boards, the Ministry of Infrastructure and Water Management, the Ministry of Justice and Security, and the Delta Programme: For citizens in various locations, this website gives information on river floods. The website informs users of the water level and the necessary preparations for them based on the postcode they enter. A postcode in the southern part of Utrecht, close to the Amsterdam Canal, was looked up in the image below (Figure 3). The "Start Preparation" also offers films and information to homes in four stages, including "Your Situation During the Flood", "Prepare Yourself", "Stay Home", and "To Leave".

"If you go more to the river area like the area between the Waal and the Rhine you get different results this is a national tool. and it will describe how to deal

with it, stay home or leave and what to take with you, what can help, what you have to bring, and mostly about leaving during the flood." (A)

Figure 4. Website "How high does the water get to you, Postcode: 3439MA (Source: https://overstroomik.nl/)



In conclusion, resilient infrastructure and technology are acknowledged as effective solutions in theories regarding flood management, there is a considerable emphasis on sufficient drainage systems and nature-based solutions in academic articles (see, (Ellis & Viavattene, 2014; Ghofrani et al., 2017; Kabisch et al., 2016; O'Donnell et al., 2020; Zhou, 2014)). The Dutch government understands the significance of resilient infrastructure in the context of climate change. To reduce the risk of floods, green infrastructure, separate sewage systems, and spatial design strategies are used. Priority is given to preserving biodiversity and incorporating natural solutions. Infrastructure that is robust and sustainable is the focus in order to mitigate the effects of climate change.

4.5. Community engagement and participation

Community engagement and participation play an important role in the effectiveness of water management governance according to scholarly studies ((Mees, Crabbé, et al., 2016; Puzyreva et al., 2022; Wehn et al., 2015b), and there seems to be recognition of this in the field of Dutch water and flood risk management. In the Dutch political approach, similarly, the participation of citizens in various decisions and policy makings was emphasized. The 2021 completion of the participation plan, according to the Delta Program (2023), enables effective engagement and communication, notably with NGOs and government agencies. Participation takes place on a range of scales, from small communities to the entire country. Younger generations and entrepreneurs are encouraged to get involved in community initiatives, non-governmental collaboration, and public participation as they get ready for the future:

> *"The goal of the Delta Programme is to keep the Netherlands safe and liveable for future generations. That is why importance is attached to the input and involvement of the younger generation. Like last year, the Delta Commissioner spoke to a number of students about the administrative introduction to the DP2023 … At the same time, consideration of the floods in Limburg in 2021 is important because they made people aware that floods caused by extreme rainfall are possible everywhere. The students called on the Delta Commissioner to give the text a greater sense of urgency: we have to start now." (Delta Program, 2023)*

General frameworks for policy developments are provided by the national government, while public participation is also considered through events and workshops where individuals can voice their opinions and ask questions. A climate panel for the Municipality of Utrecht meets frequently to talk about subjects and offer suggestions. Private stakeholders may participate in workshops and other engagement initiatives but are not heavily involved in decision-making. A strategic policy advisor on urban water and climate adaptation (E) emphasized that collaboration takes place through regional cooperation on teams, working groups, and collaborative policy and action planning for water and climate adaptation. He added that although COVID-19, restricted direct workshops, and community engagement, spatial projects still aim to incorporate the public. Decision-making also involves national government information campaigns.

An area advisor on water and climate from the Municipality of Utrecht (A), clarified that workshops with participants from different areas of Utrecht encourage participation and promote collaboration in solving rainwater problems. The coordinator for flood risk management from Rijkwaterstaa (I) also explained that locals are invited to actively participate in developing projects during design workshops with them. The community's ideas and preferences are considered when determining the project's specifications, such as whether the dikes should be wider, higher, or made of different materials. To make sure that the projects meet the requirements and preferences of the impacted communities, public input is solicited. The objective is to establish an inclusive and cooperative decision-making process. Respondent (G) from the Municipality of Utrecht named another way of communication with the public as phone calls and email which anyone can make to connect or ask questions from the Municipality.

The cooperation and consultation between the Municipality and the water board play a vital role in the decision-making and implementation process. To meet its obligations regarding wastewater in the outer area, the Municipality undertakes assessments in conjunction with the water board. The Municipality and the Waterboard's shared accountability and coordination are essential for guaranteeing effective decision-making and implementation procedures connected to infrastructure maintenance and development since they are the two main stakeholders that share responsibility in this matter. This is also emphasized in interviews along with Guide to Urban Planning under the Environmental Act (2021).

A water and climate adaptation advisor of the Municipality of Utrecht (G) explained that to make sure that decisions and activities are in line with the objectives of keeping the city waterproof, climate-proof, and resilient, municipalities work with various organizations, including the waterboards, safety regions, and provinces. The Verenigde Nederlandse Gemeenten actively participates in decision-making processes with municipalities (Strategic policy advisor on urban water and climate adaptation, the Municipality of Utrecht (E). According to him, there may be a difference between government organizations and other stakeholders in terms of engagement and impact, although it is recognized that private owners and households do not participate in policymaking to a great extent (E). On the other hand, the pursuit of profits by private businesses and the implementation of protective measures by governmental agencies can lead to conflict. To resolve disagreements and guarantee the legitimacy of decision-making, it is essential to find common ground and develop open lines of communication (water and climate adaptation advisor, the Municipality of Utrecht (G)).

Different levels of government are involved in addressing the legitimacy of governance in flood risk management policies they work together to develop policies. Collaboration between several ministries, including the Ministry of the Interior and Kingdom Relations, the Ministry of Infrastructure and Water Management, the Ministry of Agriculture, Nature and Food Quality, and the Ministry of Health, Welfare, and Sport, ensures the legitimacy of governance in flood risk management in the Netherlands. The overall control is overseen by the Delta Commissioner, who reports politically to the Minister of Infrastructure and Water Management. In addition, the Delta Program (2023), claims that the participation of the business sector, Safety Regions, and knowledge institutes ensures the development of an effective organizational structure that determines preferred tactics, streamlines execution, and supports collaborative finance. When setting agendas and forming recommendations, the active participation and suggestions of government authorities, corporations, the public, and interest groups are considered.

The National Water Plan (2016), identified collaboration, trust, transparency, and equality as the four guiding principles for how the government should interact with stakeholders. The Cabinet Approach to Climate Policy approach (2023), acknowledges that successful private water firms require effective public embedding. The strategy broadens the search for financing from predominantly public funds to include private earning models and creative concession giving to strike this balance. The policy seeks to minimize reliance on public funds by increasing chances for private gain and strengthening governance in the management of flood risk the Guide to Urban Water Management Under the Environmental and Planning Act (2021), also pointed out that sewage fees can be levied on residents and businesses by the Municipality to help pay for the upkeep and financing of the sewerage system. This strategy makes sure that the funds are obtained for maintaining the huge sewerage infrastructure. The approach improves the legitimacy of government in urban water management by enlisting residents and companies in paying the costs.

Respondent (F), an area advisor from the Municipality mentioned that there are ongoing attempts to actively publicize strategies and data linked to flood risk management, and transparency is prioritized. However, widespread observance of the law of open government is still lacking. While some sensitive information, such as those involving safety, may be given special treatment, most spatial planning initiatives are thought to be open to the public and available for viewing. Another area advisor from the Municipality concurred, adding that Workshops and interaction with various neighborhoods promote public participation. By posting public information about river and rainwater flooding on specialized websites, transparency is preserved (A).

In the National Water Plan (2016), a balance between public and private governance is sought, and proper public participation is emphasized. By ensuring that all viewpoints are considered, this method promotes flood control governance that is more effective and long-lasting. The Guide to Urban Water Management Under the Environmental and Planning Act (2021), underlines that water management is a combined effort of the government, market, and community and cannot be accomplished by the municipality alone. Effective urban water management requires close collaboration, coordination, and cooperation between the government, society, and other stakeholders.

According to Respondent (I), the coordinator from the Rijkwaterstaat, legal requirements for public engagement uphold the legitimacy of governance in flood risk management. Every national and provincial plan is required by law to go through public consultation and an environmental impact assessment. People can express their concerns and complaints at town hall gatherings. By interacting with the public, disseminating accurate information, and emphasizing the benefits of the projects for the public, the goal is to decrease the number of legal proceedings. Although some people, particularly rich coastal dwellers, may adamantly oppose projects, efforts are made to interact with them and provide them with information.

The respondent from Rijkwaterstaat (I) emphasized the importance of public participation based on the law. He mentioned that public presentations are held whenever there is an infrastructure project, such as a canal extension or new road building, to involve the neighborhood. There are opportunities for the residents in the project area to voice their ideas and concerns. The affected individuals also play a role in land expropriation cases. There are several opportunities for public interaction, such as the chance to legally express disagreement or even protest.

Connectivity is the breadth and depth of interaction between various stakeholders, such as governmental and non-governmental organizations, educational institutions, and specialists in various fields among themselves and with the community. To effectively plan for climate change, governing agencies should share their limited expertise. To investigate ideas for

speeding up climate adaptation, the Delta Commissioner regularly has conversations with the financial industry. The creation of a yardstick for flood risk management is consistent with current regional developments and private-sector engagement. To create frameworks, strike a balance between aspirations and efficacy, and guarantee successful execution, according to Delta Program (2023), coordination and collaboration among numerous parties are crucial.

Municipality's water and climate advisor (G) emphasized the importance of connection, sharing information, coordinating activities, and considering the viewpoints of various stakeholders is vital. To address land use and development plans and ensure effective water management, collaboration with private businesses and developers is also stressed. A more inclusive and thorough approach to flood risk management is made possible by connectivity and communication. A Municipality's advisor (F) pointed out that discussions are required to develop mutually acceptable solutions in situations when there are competing regulations or awkward placements. Effective decision-making and implementation are made possible by the water board and the Municipality's cooperative approach. In addition to the relationships between governmental parties, cooperation and communication with individuals and private businesses are essential components of efficient flood risk management governance.

> *"That's communication. It takes time. But to make good decisions, good documents, and good answers. Sometimes that is sort of the weight in the sacrifice to get a good answer. But I think it is really important to take the time to get good answers instead of just quick answers that maybe have not taken each stakeholder into consideration." (Water and climate adaptation advisor, the Municipality of Utrecht (G))*

Conversely, (D), the specialist risk and security from the Safety region, emphasized that there is no sign of deliberate resistance, but there does seem to be a lack of awareness of the requirements and expertise of other departments. Each department largely concentrates on its own objectives and tasks, which can result in a limited viewpoint. The accessibility of full information necessary for making educated judgments may be hampered by this lack of connectivity. Broader thinking is required, as is a clearer understanding of the responsibilities and areas of specialization of the many parties involved. (E), a Municipality's representative named the difference in perspective as an obstacle to these collaborations besides being time-consuming. He identified the hesitation to participate as an issue and provided two justifications, including proximity and urgency:

> *"…when we do surveys on specific areas or have projects in specific areas then you are always having a lot of information and participation with the inhabitants, but the experience showed that when you do it project level in the small area residents are more interested, than when you do it on the municipal scale then you don't get so many reactions from people. It's too far from their own home. Mostly they just*

do more intensive participation in projects that are directly involved with their surroundings." (E)

In another part of the interview, he added:

"… you need some sort of urgency to get them on the title. So, when you have the flooding from my 2021 in the Limbaugh, then you have urgency then people will come but now you see it with the energy and the gas prices and so on." (E)

Any sort of effective participation and collaboration necessitates good awareness and proper knowledge among different stakeholders and residents. Besides, since floods and other natural disasters have a direct effect on people's lives and property damages It should be part of the management governance to make people aware of the way to be safe in the face of disasters. Based on the National Water Plan (2016), it's critical to raise public awareness of water issues to win support for policies and get the required funding. According to the Delta Program (2023), it is expected that participation by government agencies, corporations, the public, and interest groups will help to raise awareness of and mitigate the effects of climate change. The public is encouraged to become more aware of water issues and to practice climate-resilient behaviors through programs including competitions[7], public-private networks, and communication campaigns. To effectively handle climate change concerns in the Delta Program (2023), increased knowledge among the public and stakeholders is thought to be a key aspect. In addition, the National Water Plan (2016), mentions the "Our Water" public awareness campaign[8], water education programs in schools, and "Am I being flooded"[9] application as three strategies to raise water awareness among Dutch citizens, explain the need for new investment, and increase participation and coping skills.

The HDSR's Handbook mentions its main goal as increasing public awareness of the significance of taking water and climate issues into account throughout planning procedures by offering advice and information to diverse parties. The province of Utrecht also holds internal meetings and risk dialogues to raise awareness and find connections between other policy topics and climate adaptation. In municipal level campaigns like "Waterproof 030" and subsidy programs are used, according to Vision Water and Sewage Utrecht (2020), to strengthen the incentive strategy for existing structures. The goal of the strategy is to

[7] Such as National Paving-Stone Removal Championships, the first National Championships for removing paving stones were held in 2021, with participation from 81 municipalities over six months. This competition's objective was to replace as many paving stones as possible for environmentally friendly substitutions and, in doing so, to raise public awareness of water issues in their local communities.

[8] Our Water is a public awareness campaign initiated by the Ministry of Infrastructure and the Environment, Rijkswaterstaat, Unie van Waterschappen, the provinces (IPO), municipalities (VNG), water companies (Vewin), and the Delta Programme to increase water awareness among Dutch people. On the website, there were facts, tales, and advice.

[9] The "am I being flooded" app is made available so that users may quickly learn what levels the water around them can reach and what should be done.

overcome the difficulties related to connections to wastewater and rainwater sewer systems by raising knowledge and encouraging owners' voluntary cooperation.

An interviewee from the Municipality (F) emphasized the importance of ensuring that people are aware of flood risks and have information on how to respond. He mentions that the government can be contacted for information, and although most of it is not secret, the challenge lies in making people aware of the available resources, such as websites containing relevant information. The climate adaptation coordinator from the Waterboard described the efforts made to interact with citizens through community meetings, bus tours, and marketing. To make sure that people are educated and active in flood risk management, these activities seek to provide information, present plans, and maps, and gather feedback from the community.

In addition, a strategic policy advisor on urban water and climate of the Municipality (E) discussed the Municipality's strategy for increasing awareness, which involves getting in touch with residents of communities that are more vulnerable to flooding. They serve as examples and encourage people to act on their own property. The Municipality of Utrecht also promotes citizen involvement through monitoring programs and surveys to collect data and involve citizens in projects to control flood risk. While a water and climate adaptation advisor from the Municipality admitted the need for a coordinated effort across several government agencies, she also points out that private corporations can have competing interests.

Additionally, as previously indicated in part 4.2 (P.51), websites are made available at various levels on a national, regional, and municipal level so that individuals and stakeholders can be informed about the level of risk in their area and the potential actions they need to take in case of any flooding incidents. A map showing the state of Utrecht in the event of an 80 mm per hour rainfall is available on the website Water op straat na extreme regen included a map with the condition of Utrecht in the event of 80 mm per hour rainfall. The website Hoe hoog komt het water bij jou? Provides information about river flooding including the water level and the actions and preparations for disaster (Further information can be found in section 4.2). Additionally, numerous plans and recommendations can be found on the websites of various organizations (e.g., Rijkwaterstaat, HDSR, Utrecht Province, Gemeente Utrecht, etc.).

In conclusion, it is acknowledged in theories that community engagement and participation are essential to the governance of water management (see, Begg et al., 2018; Wehn et al., 2015). In Utrecht, through participation initiatives and events, the government places a strong emphasis on public participation. Stakeholders are urged to actively participate, and workshops and consultations are used to get public opinion. It is crucial for the Municipality, Waterboards, and other parties to work together. The key principles are transparency, trust, and collaboration. Legal requirements promote public participation and sustain the

legitimacy of governance. For an implementation to be effective, stakeholders must be connected and share information.

4.6. Concluding overview

The policy and planning component covered in the policy documents contained details on how various organizations at various levels view flood mitigation strategies. Along with financial public-private cooperation and cost savings through simultaneous installation, collaboration is valued. Policy documents and interviews suggest that regional collaboration is deemed essential for the creation of plans and policies Different policy texts consider the freedom of regional parties and the mitigation of climate impact. Additionally, emphasis is placed on the evaluation of effectiveness, teamwork, and recovery. Creating green and climate-adaptive cities, integrating various objectives, combining maintenance work with flood risk reduction, ensuring the functionality of critical infrastructure, collecting water, raising floor levels, and implementing retention strategies are all examples of spatial resilience measures that are mentioned in policy documents. Measures of spatial resilience are highlighted during interviews, such as stress testing in new developments, making room for water and fostering greener landscapes, collecting rainwater, and incorporating various climatic goals. Lastly, policy documents and interviews both emphasized the three safety levels in the Netherlands preventive, effect limitation, and disaster response. During interviews, respondents draw attention to the fact that the third level of safety—responding to disasters—does not get enough consideration.

In terms of technology and infrastructure, policy documents place an emphasis on wastewater collection and treatment, stress tests, risk dialogues, flood-proof infrastructure, enough space for water, dependable water and sewerage system management, and connecting rainwater discharge to stormwater sewer systems. According to what was learned from the interviews, the infrastructure and technology component puts a strong emphasis on issues including wastewater treatment, separating sewerage systems, releasing precipitation into surface water, operating, and maintaining dikes, and other related issues. Other priorities from documents include keeping databases up to date, enhancing mapping abilities, utilizing blue-green infrastructure for rainwater storage and drainage, enhancing the resilience of public spaces, and advancing greenery goals by replacing broken pavement and allocating money for green roofs and water-efficient social housing. The same goals were followed according to interviews to increase resilience including protecting public spaces from heavy rain, temporary water storage, infiltration with green roofs and gardens, integrating goals with greenery, and turning unused land into green spaces.

Concerning the third pillar, policy documents place a strong emphasis on stakeholder involvement, working with entrepreneurs and the younger generation, and engaging with NGOs. They respect cooperation, trust, transparency, and equality in interactions and strive for a fair balance between public and private interests. They also advocate active engagement

in creating agendas. The importance of minimizing reliance on public funding, guaranteeing the legitimacy of governance, keeping open lines of communication, and involving all pertinent parties are emphasized. Competitions, marketing, websites, maps, and the HDSR Handbook are used to increase public awareness.

The importance of national frameworks, interaction within the Municipality, and participation of governmental players are stressed in the interviews. While cooperation between local organizations is essential, the law places a strong emphasis on the project involvement of the community. Private owners and households take part in particular initiatives, not in the formulation of policies. Citizens' involvement is encouraged by workshops and phone interactions with the Municipality of Utrecht. Websites are used for spreading information, and environmental studies and public consultations are conducted. Although collaboration between departments is crucial, this needs to be strengthened within the Municipality of Utrecht. According to interviews, different departments only collaborate on some relevant documents and policies, while there is a need for more knowledge transition among them. To increase awareness, initiatives including bus tours, neighborhood gatherings, and marketing are made. Table 4 provides the summary of goals, principles, and measures:

Table 4. Summary of data analysis and results from semi-structured interviews and policy documents

Components	Policy documents	Interviews
Policy and planning	• Value of collaboration • Financial publiv-private cooperation • Cost savings with simultaneous installations • Freedom of regional parties • Mitigating climate damages • Assessment of effectiveness, collaboration, and recovery • Spatial resilience: measures: green and climate adaptive cities, integration of different goals, fusing maintanence work with flood risk reduction, functionality of essential infrastructure, water collection, Elevating floor level, retention. • Three safety levels: preventing (by dike maintenance), limiting the	• Regional collaboration for developing plans and policies. • The third level of safety (responding to disasters) not getting enough attention. • Spatial resilience measures: stress test in new developments, space for water, greener, retaining rainwater, integration of different climate goals (such as drought and heat)

	effects (spatial planning), and responding to disaster	
Infrastructure and technology	• Collection and treatment of wastewater • Stress test and risk dialogues for vulnerable functions • More flood-proof infrastructure • Guarantee enough room for water • Compel owners to connect rainwater discharge to new stormwater sewer system • Management, replacement, and maintanence of reliable water and sewerage systems • Maintaining current versions of crucial database • Improve mapping skills using data-driven tools and spatial information • Using blue-green infrastructure for storing and draining rainwater • Resilience of public spaces • Integration of greenery goals • Replace non-functional pavement with greenery • Bulding water friendly social housing and funding for green roofs	• Operation and upkeep of surface water and the dikes • Releasing precipitations into surface water • Strengthening critical functions • Wastewater treatment • Seperating sewerage system • Resistence of public areas to 80mm rainfal • Temporary water storage • Infilteration with green roofs, gardens, and public places • Integration of goals with greenery • Turn unused lands into green spaces. • Mapps of risk, potential damages, and preprations available for public
Community engagement and participation	• Importence of participation of different of different stakeholders • Collaboration with younger generation and entrepreneurs • Participation Plan (2021) gives priority to engagement with NGOs and government body • Seeking balance between public and private • Consideration of active participation and suggestion in setting agendas • Collaboration, trust, transparency, and equality are four principles the government cosiders for interaction • Minimize reliance on public fund • Governance legitimacy with putting responsibility on private developer • Maintaining clear chaannels for communication with stakeholders and public	• Involving different governmental stakeholders • Interaction between regions within the Municiplaity of Utrecht • General frameworks from national government • The law emphasized on participation in projects • Municipality collaboration in evaluation of the process and coversation to decide best course of action • Private owners and households only participate in specific project but not policy making • Workshops for interaction with neighborhoods • Citizens can do phone calls with the Municipality of Utrecht. • Posting information in special websites for public

	• Keep all relevant parties involved and informed • Raising public awareness by comptitions, public-private networks, communication campaign, websites and maps, and the Handbook from HDSR	• Public consultant and environmental impact assessment for every plan • Connection is important for sharing information, coordination, and considering different viewpoints • There is a lack of connection between different departments • The necessary information is accessible for every one • Bus tours and community meetings and marketing aim to raise awarness

5. Discussion

The goal of this study was to evaluate flood-proofing techniques required for resilient water management governance to protect urban areas from the damaging impacts of precipitation and climate change. The evaluation of the multi-level governance and policy-making procedures used to improve flood management resilience focuses on the city of Utrecht. By answering the central research question, "Which measures have been undertaken in order to make Utrecht's flood management governance resilient, and with what results?" On the basis of the answers to the research questions in this part, recommendations will be made on how the flood management and governance of Utrecht can improve to shape a more effective and resilient approach in the conclusion part of this research…

The Netherlands has created a robust flood defense system made up of dikes, dams, and dunes since a sizeable amount of its area is below sea level. Despite this sophisticated protection system, the 1953 flood tragedy and the growing problem of pluvial flooding have shown the need for a paradigm shift toward resilience. As a result, programs like the Room for the River program and the Delta Program have been put in place to manage flood risks and adapt to the increasingly severe weather conditions brought on by climate change in this coastal delta. Due to past severe flooding incidents, the Municipality of Utrecht has come to understand the need for climate adaptation governance, which has led to the implementation of policies intended to increase resilience.

A thorough literature study was used to accomplish the first sub-question "*How is resilient flood management conceptualized in the academic literature?*" along with drawing a conceptual framework for assessing the governance of flood management (see Table 1). Three components were identified as the main aspects of resilience flood management governance. This operational methodology was then applied to the case study of Utrecht to answer two other sub-questions and ultimately the main research question.

This Conclusion chapter will provide a synthesis by tying to provide a connection between the theoretical framework and the Utrecht observations will be made in this chapter. A review of Utrecht's flood resilience effectiveness will be done for each component. As a result,

suggestions are made for improving the flood management and governance of Utrecht. There will then be the theoretical reflection of this study and the implication to the theory. The relevance of assessing flood risk management and governance in other contexts will be provided, and recommendations for future studies will be made to conclude this thesis.

5.1. Which measures have Utrecht flood management and governance taken toward being flood-proof?

In this section, two aspects of the conceptual framework which are policy and planning and infrastructure and technology are discussed for the Utrecht case to answer the second sub-question: Which measures have Utrecht flood management and governance taken toward being flood-proof? The actions taken in the Municipality of Utrecht in relation to these two pillars will be examined in this section.

5.1.2. Policy and planning

The definition of "mobilization capability" is "The capacity of major players to cooperate" (Healy et al., 2017 discussed by De Magalhães et al., 2017; Restemeyer et al., 2015), set common purposes and objectives, and mobilize the necessary resources and support to achieve these goals. In the flood management governance of Utrecht to build regional policies and programs, cooperation among national regional parties—including the national government the Waterboard, Safety region, Province, and Municipalities—is essential. These stakeholders can create successful policies that address the particular problems presented by floods in the area by combining their knowledge and resources. Despite the fact that not all the parties are satisfied with the quality of the partnership, efforts have been made to put four partnership principles into practice (collaboration, trust, transparency, and equality) to improve involvement.

The Waterboard has the most notable involvement with the Municipality. On a variety of issues relating to flood management governance, these two organizations work together. Since they both have the same goals, disagreements between them are rather infrequent. However, it does occasionally happen when the Municipality decided to build a new neighborhood near a river that could flood. To make the best conclusions in these situations, they will participate in additional conversations; otherwise, the court will make the decision according to the interview (with…), although this may happen rarely. As the interviewee mentioned that most of these agreements are gained through discussions and meetings of organizations.

Additionally, Utrecht Municipality is divided into many regions that cooperate with one another in knowledge and experience transitions. Although the Vision Water and Sewerage Utrecht paper was created in collaboration with various water and infrastructure experts and consultants within different departments of the Municipality, respondents noted that several municipal departments in various disciplines do not work together well.

According to Vis et al. (2003), resilient flood risk management strives to minimize the effects of floods while yet allowing for floods to occur. While the construction, maintenance, and prevention of dikes continue to be the main priorities of all Dutch flood management, a change has begun to prioritize mitigation. In some cases, people only consider flooding from rivers and believe that Utrecht is safe because it is surrounded by dikes. The capacity to absorb and recover acknowledges that floods cannot always be prevented and that additional measures should be put in place to adapt to flooding when it occurs (Dai et al., 2018). Even though the city is not particularly at risk from river floods, the city has experienced damage as a result of extreme precipitation and run-off in the last decades. These experiences made the flood management governance of Utrecht consider the uncertainty of flood events and prepare for more extreme water events. The administration of floods in Utrecht is centered on reducing climatic damage and considering all responsibilities and points of view in urban planning that show the mitigation has already started.

According to Restemeyer et al. (2018), adaptive tactics, the acceptance of uncertainty, and the range of damage-prevention strategies are all part of the evolutionary resilience approach to managing flood risk. The safety level in the Dutch flood resilience perspective is a three-tiered approach. Preventive measures, such as regular dike maintenance, are implemented to minimize the risk of flooding. Limiting the climate effect by integrating Spatial planning and flood resilience considerations into urban development projects, higher building levels, employing stress tests for new developments, creating space for water, and promoting greener environments. And the response to damages after a disaster, is the third layer, while it was noted that this level lags and needs more actions.

In conclusion, the flood management governance of Utrecht has implemented several measures to enhance flood-proofing capabilities. In terms of policy and planning, cooperation among various stakeholders, including the national government, Waterboard, Safety region, Province, and Municipalities, has been crucial in developing effective policies and programs. Efforts have been made to improve partnership principles, such as collaboration, trust,

transparency, and equality, to address the specific challenges posed by floods in the region. Additionally, Utrecht has recognized the importance of adaptive tactics and the acceptance of uncertainty in flood risk management, prioritizing both prevention and mitigation strategies to minimize the effects of floods and prepare for extreme water events.

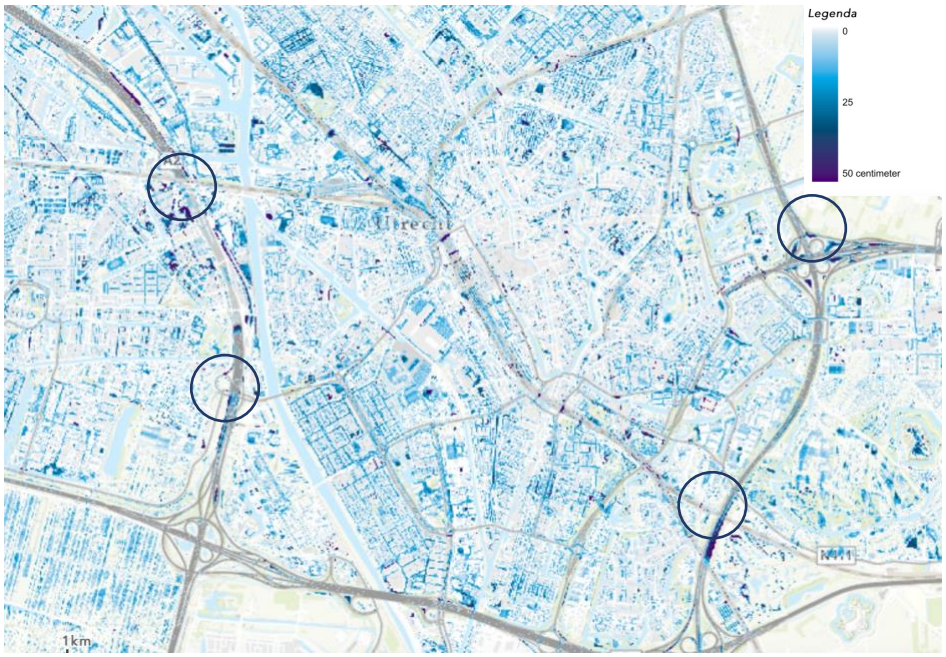
5.1.2. Infrastructure and technology

Infrastructure and technology are key elements in attaining flood-proofing goals, and they are the focus of the second component of flood management governance in Utrecht. The methods and actions made by Utrecht's flood management governance to improve the city's infrastructure and make use of technological breakthroughs for flood resistance are examined in this section.

Assuring proper operation and maintenance of surface water and dikes is one key measure put in place in the Netherlands and Utrecht. The western part of the Netherlands, which is a low-lying area with a significant contribution to the Netherland’s economy, is enclosed by levees (dikes). Utrecht makes sure these essential components of the flood management system are reliable in reducing flood risks by routinely examining and maintaining them. Although the prevention measures are important to be taken to a certain extent, structural protection cannot totally remove the risk of being affected by flood flows and the associated mud, debris, and pollutants (Silva et al., 2004). The practice of releasing precipitation into surface water has been adopted by Utrecht's flood management governance to manage precipitation effectively. This strategy aids in controlling water levels and lessens the chance of flooding during periods of heavy precipitation.

According to Meyer et al. (2015), infrastructure resilience is the capacity of infrastructure systems to endure and recover from flood disasters. By guaranteeing the robustness and resilience of these fundamental services, the city will be better able to handle disruptions brought on by flooding and continue to provide key services like energy and communication. This measure is acknowledged as important for the management of floods both nationally and locally. The city of Utrecht aims to make sure that infrastructure and crucial functions can withstand the event of heavy downpours to 80mm in an hour. Although based on the map the Municipality of Utrecht has provided (Figure 5) there are still some roads that will be blocked in this amount of rainfall.

Figure 5. The amount of water in case of 80 mm per hour of rainfall (Source: https://gu-geo.maps.arcgis.com/apps/webappviewer/index.html?id=486867c9fe84426a881e445d6e4af8f0, 2014)



According to Hamilton (2009), flood concerns, particularly malfunctioning drainage systems, provide the most obvious threats to the urban environment. Sewer system overload can be avoided and the risk of sewer backups during heavy rains can be reduced by taking steps like dividing domestic wastewater from rainfall. This division makes sure the wastewater treatment facilities can control the water flow and stop flood-related damage. Utrecht highlights the significance of developing and putting in place different systems for handling rainwater in new structures. This division of systems lessens the chance of flooding in newly built areas and aids in preventing the overload of drainage systems. Although, an interview with the Municipality representative showed that this implementation is slow in comparison with Rotterdam and Amsterdam at about 4 to 5 km per year.

Future change will present possibilities that must be taken advantage of in addition to the ability to respond to threats (with built-in flexibility) (Gersonius, 2012). The city also makes use of the potential to add vegetation when developing street drainage systems. Utrecht increases its flood resistance by including green infrastructure inside existing systems, such as employing street openings for drainage development, while also gaining other advantages.

The city lessens its reliance on larger pipelines and conventional drainage systems, allowing for more sustainable and environmentally friendly flood management strategies. Measures like temporary water storage and landscaping are also implemented. Blue-green infrastructures are crucial to the resilience to flooding. To protect natural water cycles, enhance environmental renewal, and revitalize urban areas, BGI is a cutting-edge technique that combines green infrastructure with water management (Drosou et al., 2019). Utrecht also places a strong emphasis on increasing infiltration by gardens, green roofs, and public spaces. These methods make it easier for rainwater to seep into the ground, easing the strain on surface water systems and lowering the risk of flooding. Furthermore, the governance for flood management in Utrecht uses grey land to create green spaces. This renovation not only improves the physical appeal of the city but also adds more spaces for water storage, aiding in attempts to reduce flooding.

Urban infrastructure design must consider a range of benefits to produce sustainable solutions (Lundy & Wade, 2011). In Utrecht's approach to infrastructure and technology, integration is a fundamental tenet. Blue-green infrastructure can improve people's quality of life, reduce heat and dust levels, and increase biodiversity, among other beneficial consequences on individuals and societal systems (Hartmann et al., 2019). By using green infrastructure, the city aims to manage runoff while achieving several objectives, including managing heat, drought, and groundwater issues. This strategy not only improves flood resilience but also improves freshwater supply, biodiversity preservation, water quality, and climate control.

Regarding infrastructure and technology, Utrecht has focused on maintaining and enhancing the reliability of surface water and dikes to reduce flood risks. The city also emphasizes the use of technological breakthroughs and green infrastructure, such as rainwater management systems, blue-green infrastructure, and green spaces for water storage. These measures aim to improve the city's infrastructure resilience and minimize the impact of flooding on essential services while promoting sustainable solutions that benefit both the environment and the well-being of the population. Overall, Utrecht's flood management governance has taken comprehensive steps to enhance flood-proofing capabilities through a combination of policy, planning, infrastructure, and technological advancements.

5.2. How are different actors and stakeholders in governance cooperating to make the city resilient?

The conceptual framework contains the element of community engagement and participation to address the third sub-question. The community and other public and private players' actions in the Municipality of Utrecht regarding collaboration and cooperation will be compared to the theoretical framework and addressed in this part.

5.2.1. Community engagement and participation

Community engagement and participation are key factors in effective water management governance in the Netherlands. According to studies, public involvement in climate change can affect both the direct and indirect levels of support for individual climate mitigation efforts as well as for climate policy (Borongan & NaRanong, 2022). The Dutch political approach emphasizes the involvement of citizens in decision-making and policy development. The completion of the participation plan in 2021 enables effective engagement and communication, particularly with NGOs and government agencies. Participation occurs at various levels, from small communities to the entire country, with a focus on engaging younger generations and entrepreneurs.

Van Rijswick et al. (2014), claim that the scope and depth of stakeholder involvement in the development of water policy processes determines the strength of the policy. The term "depth of involvement" refers to the extent of stakeholder influence over the governance process, while "width of participation" refers to the degree of community inclusion (Van Rijswick et al., 2014). The national government provides general frameworks for policy development, while public participation is encouraged through events, workshops, and climate panels.

Due to the complexity of flood threats and the requirement for more innovative and adaptive solutions, there has been a recent change in the governance of flood management, where private players are now more involved in policy-making processes (Meijerink & Dicke, 2008). Private stakeholders can participate in engagement initiatives but have limited involvement in decision-making. Collaboration is fostered through regional cooperation, working groups, and collaborative planning for water and climate adaptation. Despite the challenges posed by COVID-19, efforts are made to incorporate public input into spatial projects.

The academic literature on the governance of flood risk management places a strong emphasis on the value of an integrated and adaptive approach that entails the cooperation of various stakeholders, including governmental organizations, communities, and private organizations, in the development and implementation of flood risk management strategies (Klijn et al., 2015). Collaboration and consultation between municipalities and water boards play a vital role in decision-making and implementation processes in the Netherlands. The shared accountability and coordination between these stakeholders ensure effective governance in infrastructure maintenance and development. Close collaboration with various organizations, including safety regions, water boards, and the province, is necessary to achieve waterproof and climate-proof cities. While the involvement of the community in making policies and agendas can be encouraged more by local flood governance.

If the legitimacy of governance structures is questioned, flood resilience cannot be achieved; input, method, and output must all be legal and societally acceptable (Driessen et al., 2018). In the Netherlands public participation is upheld by legal requirements, such as public consultations and environmental impact assessments for national and provincial plans. In Utrecht, opportunities for public interaction, expressing concerns, and even protesting exist. However, there may be a lack of awareness and expertise among different departments, hindering connectivity and broader thinking. As a result, transformability may be aided by a variety of activities meant to increase local inhabitants' understanding and empowerment, such as brochures and public campaigns, and even early teaching in the school (Restemeyer et al., 2015).

Raising awareness among both public and commercial players is essential for making the shift to more resilient systems more viable in the future (Restemeyer et al., 2015). Public education campaigns, water education programs in schools, and communication campaigns are conducted to raise awareness and gain support for policies. Efforts are made to provide information, engage communities, and ensure that people are aware of flood risks and know how to respond. Websites and tools are available to inform individuals about the level of risk in their area and the actions they need to take during flooding incidents.

6. Conclusion

Urbanization, climate change, and economic growth have all increased the risk of flooding in cities, making it necessary to build "climate-proof" cities and carry out adaptation plans globally to manage the effects of flooding while preserving economic growth and societal well-being. To enable effective adaptation techniques and fair decision-making, the management of floods and their effects requires a coordinated and inclusive strategy combining the public and commercial sectors, stakeholders, and public engagement frameworks. The goal of this research was to assess the efficiency of flood management and governance to mitigate the effects of flooding, especially in metropolitan areas. Extreme water events and disruptions result from changes in precipitation patterns brought on by urbanization. Flood dangers have increased in the Netherlands due to a considerable rise in rainfall and precipitation extremes. The study emphasized the necessity for quick and effective flood management strategies, emphasizing the significance of rules and public participation. The study gave tips for improving flood resilience and water resource management by examining Utrecht's flood-proofing systems. Resilience is essential for disaster management because it helps policymakers improve community recovery and adaptability.

This chapter will serve as a reflection of both the theoretical and conceptual frameworks and limitations of the methodology of this study. On the basis of the findings and discussion in the previous part, recommendations for Utrecht's flood management and governance will then be made. In order to complete this thesis, recommendations for future studies will be made, allowing other cities to apply and improve the operational framework for water governance.

6.1. Theoretical reflection

The theoretical insights on flood resilience, resilient flood risk management, and governance were the most applicable to this study. Different components were extracted from these theories to create the conceptual framework for this research. Flood resilience was applied in the policy and planning and infrastructure and technology components. To evaluate the effectiveness of communication and stakeholder participation, studies on resilient flood risk management, and governance were used in ‘filling in’ the community engagement and participation component.

The policy and planning component's application of flood resilience theories highlights the need for flexibility and resilience in decision-making processes and recognizes the dynamic nature of flood management. This also emphasizes the need to create resilience by including strategies that lessen the effects of floods while acknowledging that floods cannot always be averted. It emphasizes the significance of taking both preventive and response actions into account when forming the policy and planning component.

In order to provide focused and effective flood management methods, the examination of infrastructure and technology focus on the combination of sustainable and eco-friendly approaches in flood management is encouraged by sustainable drainage systems. The sustainable drainage system is a crucial part of the analysis of infrastructure and technology in the study and incorporates green infrastructure like gardens and absorbent pavements.

Flood management cannot be separated from other urban planning issues, according to resilient flood risk management, and governance, which highlights the necessity to consider a variety of sectors, disciplines, and policies during the planning process. This idea aids in coordinating and aligning flood management measures with more general planning objectives. The resilient flood risk management and governance emphasizes the value of including various stakeholders in the decision-making process. This idea enhances communication and engagement in flood management governance by promoting cooperation, trust, and transparency.

The research framework offers a thorough instrument for assessing flood control and governance by combining these theories and using them in the context of Utrecht. It acknowledges the multidimensional character of flood management and makes it possible to comprehend urban water management in Utrecht properly. The framework enables a thorough examination of the elements relating to policy, planning, infrastructure, and communication, resulting in recommendations for improving flood management operations.

6.2. Theoretical-conceptual contribution

Cities are having difficulty implementing flood resilience, thus Hartmann & Driessen (2017) suggest a new flood risk management strategy for Europe that combines established flood protection systems with flexible tactics. Vis et al. (2003) emphasized the importance of resilient ways as well as the role that participation plays in such an approach and its transition governance. In this study, flood management and governance were assessed in order to better understand how these two ideas interact with one another in context-specific evaluations.

A framework for evaluating Utrecht governance's ability to control pluvial flooding with the involvement of residents and various governmental stakeholders was presented by Brockhoff et al. (2019), Folke et al., 2010; Van Rijswick et al., 2014. Extreme flooding disasters have occurred in the city of Utrecht recently, underscoring the necessity of strong governance for climate adaptation. This thesis examined the practices and policies already in place for more resilient flood risk governance and management in Utrecht. Therefore, the primary contribution of this research to theory was to translate various evaluation frameworks literature into a comprehensive conceptual framework (see p.20), that cities that are vulnerable to more extreme water events due to climate change can use as a tool to assess their resilience as well as how they can further develop and improve their flood management and governance.

4.1. Limitations

This thesis employed a triangulation strategy that included a literature study, an examination of policy documents, and semi-structured interviews. Several limitations were found in the data collecting and analysis of policy document analysis. Insufficient detail was cited by Bowen (2009) as a limitation of document analysis in qualitative research. He pointed out that because these documents are typically supplied for purposes other than research, they frequently do not include enough information to address a research topic. To address this issue, other sources (such as journal articles and the respondent's experiences during interviews) were used.

The data collection and analysis of the semi-structured interview approach might be see as limited in three different ways. The snowball approach was used to choose interview candidates. Although the network itself is important in this thesis, which examines how related stakeholders are to one another, snowball sampling might impose restrictions including the possibility of bias and non-randomness in sample selection, the opinions may

be somewhat more focused if individuals are chosen via links to other participants. Convenience sampling is rarely random or representative, which frequently leads to selection bias and external bias (Cohen & Arieli, 2011). To maximize the validity of the study results, it is crucial to consider this constraint and, if practical, supplement snowball interviewing with other sampling strategies. A possible method is to choose a small number of individuals who best reflect the range of possibilities, and then create a few smaller snowballs from that varied starting sample (Tracy, 2019). Along with snowball sampling, multiple respondents were identified through the LinkedIn profiles of various organizations to guarantee that the bias is greatly mitigated.

The qualitative method has its own drawbacks. Generally, these limitations rang from social desirability bias, (Hennink et al., 2020; Miles & Huberman, 1994; Tracy, 2019). According to Grimm (2010), the term "social desirability bias" describes the common tendency of investigators to select responses that they perceive to be more socially desirable or acceptable as opposed to selecting responses that are representative of their actual thoughts or opinions. A method called 'the neutral question' is one of the popular methods to overcome this problem (King & Bruner, 2000), This implies that the item is being consistently evaluated by certain members of various social groups as not being subject to social desirability; the potential effect of dissenters is thus somewhat, but not entirely, diminished (Nederhof, 1985). The interview questions were tried to be as neutral as possible with the use of this technic. In this research since the interviews were conducted with professionals and experts so the neutrality test took place among spatial planning and Urban planning students from different universities in Europe. Even with the delicate subject matter, neutral queries increase the likelihood of a thorough response.

The most popular interview method in qualitative research is the semi-structured style (Kallio et al., 2016). Although it is a valuable qualitative method for gathering qualitative data, it has drawbacks. In this research, the fact that the interviews were conducted in English, a foreign language both to researcher and respondents has implied disadvantages such as biases, and miscommunication. In order to mitigate these errors, questions were told slowly and repeated and rephrased severely and all interviews were recorded and checked constantly with recordings. Ten interviews total were done for the goal of gathering data, seven of which took place online with Microsft Teams. The connectivity and other technical issues that can arise when using the online approach for semi-structured interviews can be one of issues. To get over this restriction, the internet connection was examined, and interviews tried to take place in a quiet setting, however, this did not always work. However, there are certain benefits to doing interviews online, including the redundant nature of geographic distance, online recording, and transcription. The transcripts that Microsoft Teams provided were

verified and required modifying, but they were still incredibly helpful for time management during this process. Along with being used to examine and revise transcripts, recorded interviews provided a way to manage any potential connection issues.

4.2. Future recommendations to improve flood management and governance of Utrecht

Although improvements to partnership principles have been made, there is still a need to strengthen coordination and collaboration among the relevant parties. This can be done by setting up regular forums or working groups where officials from various municipal agencies and disciplines can get together to share knowledge, exchange information, and collectively design flood management plans. For the efficient execution of policies and the mobilization of resources, it is also essential to strengthen cooperation between municipalities and other regional parties, such as the Waterboard and Safety region.

Utrecht should place a high priority on sustainable urban design and development methods that take into account flood resistance. This may entail enacting stronger restrictions for new construction projects to ensure that they are built with flood-proofing features in mind, such as higher building elevations and the establishment of green spaces for water storage. The Municipality of Utrecht can also provide incentives for the installation of green infrastructure, such as rain gardens, permeable pavements, and green roofs, to better control stormwater runoff and increase flood resistance. Natural approaches to urban planning can not only lower flood risks but also have other positive effects on the environment and society.

By investing in cutting-edge flood prediction and monitoring technology, Utrecht can significantly enhance its capacity to control floods. This entails the use of real-time monitoring tools, such as sensors and remote sensing equipment, to gather information on rainfall, river levels, and soil moisture. Flood alerts that are timely and accurate can reduce losses and support proactive emergency response plans. To adjust to changing climatic conditions and new dangers, flood control methods must be evaluated and updated on a regular basis. To evaluate the success of its flood management strategies and pinpoint areas for development, Utrecht has to set up a framework for monitoring and assessment. This may entail performing post-flood evaluations, participating in knowledge exchange with other municipalities and specialists, and keeping up with the most recent developments in flood risk management.

Utrecht may strengthen its flood-proofing efforts and guarantee long-term resilience by aggressively pursuing continuous improvement and incorporating lessons learned into future measures.

Last but not least, it is critical to raise public knowledge of and comprehension of Utrecht's flood dangers. The local government can fund extensive efforts to inform the public about the risks associated with flooding, the best ways to respond, and the value of individual preparedness. This can involve sharing information via a variety of platforms, including websites, social media, educational initiatives, and community involvement activities. The Municipality can improve its overall flood management efforts by establishing a culture of flood resilience and making sure that residents are informed.

4.3. Suggestions for future research

In order to get a deeper understanding of the topic, some recommendations for future research are given based on the findings of this study. The most important recommendation for additional research is to examine more cities in the Netherlands and also other countries in order to evaluate the operational framework and develop more accurate generalizations. Nijmegen, which is taking steps to become more flood resilient rather than preventive and also located beside the major river of Waal, is another scenario that may be interesting inside the Netherlands.

Additionally, by analyzing public engagement and integrating surveys or interviews with residents and neighborhoods, a more thorough study and set of suggestions can be developed for improving participation. Furthermore, as was also mentioned in this study, one obstacle to participation is citizens' hesitation to participate in projects with broader goals than those in their own neighborhoods. As a result, future studies can conduct more in-depth analyses of community members' willingness to participate. To learn more about how they see their roles and responsibilities, private businesses that are involved or could be affected can be contacted for interviews.

Other ideas for additional research include choosing a different, more comprehensive set of documents and reviewing the juridical regulation. Other suggestions for further research include selecting a new, more inclusive group of documents and analyzing the legal

framework for the policy documents analysis to see if any key elements have been missed in this Thesis.

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Appendix 1

The table below includes a List of keywords that have been used to search through policy documents, Main codes and themes of the analysis come next in this Appendix.

Components	Keywords	Components	Keywords
Policy and planning	assessment	Infrastructure and Technology	information
	resource		green
	adaptive	community engagement and participation	participation
	capacity		experties
	management		involve
	Utrecht		discipline
	spatial		legitimacy
	municipal/ provincial		governance
	governance		public
Infrastructure and Technology	infrastructure		community
	resilience/resilient		awarness
	waterway		cooprate
	map		residen(ce/nt)
	drainage		private
	measure		stakeholders
	thechnology/engineering		workshop
	Data		owners
	test		collaboration

Themes	Codes (interview)	Initial codes
Policy and Planning	Adaptive Capacity (D)[10]	Learning from past and experiences
		Changing circumstances
		Climate adaptation approach
	Sustainable land-use techniques (D)	Resilience measures
		Recover after flood
		Prevention of flood
		Government resources
	Evolutionary Resilience (D)	Uncertainty of flood events
		Preventing damages
		Flood risk assessment
		Minimizing the damages
	Institutional Capacity (D)	Collaboration within the governance
		Governmental stakeholders
		Financial resources
		Decision-making process
		Implementation process
	Diversity (D)	Knowledge varieties
		Adopting pre-existing laws in other fields
	Adaption with othe measures and goals (I)[11]	Combination of different adaptation and climate measures
	Efficiency (I)	Approach to use resources efficiently
Infrastructure and technology	Infrastructural resilience (D)	Material use
		Drainage system
		Preventing vulnerablitiy of vital infrastructures
	Mapping (D)	Information about flood risk
		Maps and data publicly available
	Blue-green infrastructure (D)	Use greenery in cities
		Benefits of blue-green infrastructure
		Drainage to rivers and waterways
		Rivers and surface water management
	Maintenance (I)	Maintenance of infrastructure

		Greenery maintenance
Community engagement and participation	Decision-making and implementation process (D)	Different discipline involvement
		Cooperation within private owners in implementation process
		Cooperation within private owners in descison-making process
	Legitimacy of governance (D)	Legally acceptable input and outcomes.
		Societally acceptable input and outcomes.
		Community invovlvement amount
		Community invovlvement ways
	Connectivity (D)	Communication between different party involve
		Communication between public private partnership involvemennt
		Transformative pathway in governance
	Raising awareness (D)	Risk awareness
		Public discources
		Information available for residents

[10] (D): Deductive codes
[11] (I): Inductive code

Appendix 2

The list of general topics for interviews is provided in the table below:

Main Topic	Sub-topics	Goals for the research
Collaboration and Cooperation	- What public parties are involved in the governance? - What private sectors are involved in the governance? - In what part of the processes do they collaborate?	- Governance's networks - Different governmental and non-governmental involvements
Regulations and laws	- What regulations are in place about the governance approach? - What kinds of regulations? - How they will be set? - What obligations are in place?	- Responsibilities and actions of different governmental levels? - Importance of different act in implementation process?
Policy and plans	- What documents are being used as sources? - What organizations are responsible for these publications? - What are the main puposes of the organization?	- Decision-making in different levels and the role of planners
Resilience measures	- What measures are set? - How the measures were selected? - What task division is in the governance?	- Resilience Measures in flood management governance - Role of stakeholders in setting the measures
Implementation	- What organization is responsible for what task? - To what extent do they collaborate? - What is the implementation process?	- The implementation of policy and decisions that are being implemented by different local, national, and private stakeholders
Awareness	- How important is the awareness? - What is the approach for increasing awareness?	- Citizen awareness amount and place within stakeholders

	- How effective do the organizations set policy for public awareness?	
Private sector	- What spatial planning consultant companies are involved? - What private companies are involved from fields other than spatial planning? - How do they collaborate?	- Knowledge transition in flood resilience - Public-private partnership