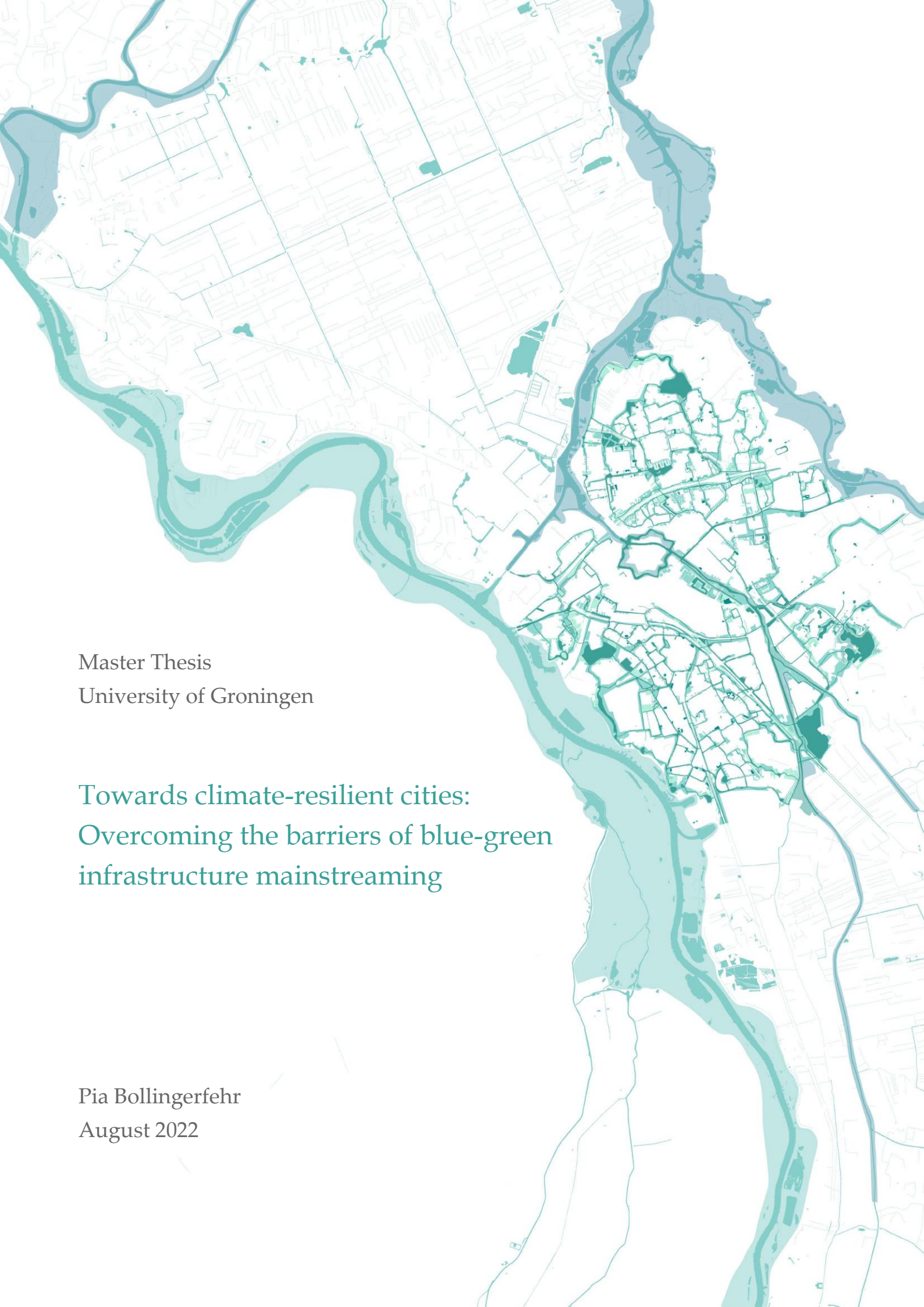

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Towards climate-resilient cities: Overcoming the barriers of blue-green infrastructure mainstreaming

Pia Bollingerfehr
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Colophon

Towards climate-resilient cities: Overcoming the barriers of blue-green infrastructure mainstreaming

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Abstract

Blue-green infrastructure (BGI) is seen as a promising adaptation measure which deals with the negative impacts of climate change and urbanization in cities while simultaneously providing multiple social and ecological co-benefits. Against this background, this thesis unpacked gaps and opportunities of blue-green infrastructure policies as an effective means for climate-adaptive urban development. This research shows which mainstreaming barriers occur along the policy process on the strategic level and how they can be overcome. With the help of desk research, a policy analysis, and semi-structured interviews the two cases of Zwolle and Dordrecht were analyzed. The Dutch cities and frontrunner in climate adaptation within the Netherlands both employ a set of mainstreaming strategies to integrate BGI into their spatial planning. Driven by their vulnerable, spatial location the municipalities have high climate adaptation ambitions. Six kinds of barriers which hinder the mainstreaming in the policy process are examined: cognitive barriers, organizational and institutional barriers, social and political barriers, resource availability, BGI-related barriers and time barriers. Drawing on insights from the case study research, this thesis provides empirical evidence of mainstreaming strategies and their barriers. Four enabling mechanisms could be identified in order to overcome these barriers. The synergy exploitation mechanism, the organizational learning mechanism, the policy entrepreneur mechanism, and the funding mechanism provide action pathways for overcoming the mainstreaming barriers of BGI in the Dutch context.

Keywords: Climate adaptation, blue-green infrastructure, mainstreaming barriers, policy integration, enabling mechanisms

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List of abbreviations

BGI	Blue-green infrastructure
EbA	Ecosystem-based Adaptation
EPI	Environmental Policy Integration
NAS	Dutch National Climate Adaptation Strategy
NbS	Nature-based solutions
NOVI	Dutch National Environmental Vision

1. Introduction: The need for blue-green infrastructure in urban areas

1.1. Background

Urbanization, the effects of climate change and the need for more ecological sustainability pressure the existing urban environment (Brown et al., 2009; Sörensen et al., 2021, p. 125). Cities and their inhabitants are becoming more vulnerable due to climate change impacts. As an increase in intensity and frequency of precipitation is predicted globally in the next decades, urban areas will experience more flood events (IPCC, 2022; Jahn, 2015; Rosenzweig et al., 2018). This may cause higher numbers of property damage and lowers public safety (Dhakal & Chevalier, 2017; Hattum et al., 2016). Changes in land-cover and an increase in impervious surfaces connected to the trend of urbanization also impact and alter the natural landscape and its hydrological cycle (Hattum et al., 2016; McGrane, 2016). Municipalities increasingly experience shifting conditions and demands for their urban water management (Brown et al., 2009; Geyler et al., 2019; O'Donnell et al., 2021). Confronted with aging grey infrastructure, urban areas have to be made proof against severe climate change impacts like higher risks of drought, flood, and water pollution (Jones et al., 2012). Therefore, urban climate adaptation will be one of the greatest challenges that spatial planners are facing during the coming decades (Matthews et al., 2015).

The historical trend of building grey water systems is based on the aim of draining rainwater into the closest water body (Brears, 2018). This mechanism alters the local hydrological cycle, increases water flows also downstream and leaves no room for the increasingly changing weather conditions (Casiano Flores et al., 2021). Mainly technical flood control strategies e.g., remediation of sewage systems, were implemented to reduce flood hazards (Jeskulke et al., 2017; Vis et al., 2003). Although this infrastructure has been effective, it limits the ability to adjust the system's performance in the face of uncertainty (IPCC, 2022; Kapetas & Fenner, 2020). The lacking adaptivity of traditional water management therefore asks for supplementary or additional measures to cope with future climate-related water challenges (Dolman, 2019). In the past decades, the Netherlands ushered in a new era of a "more adaptive and participatory form of water management" (Van der Brugge et al., 2005, p. 21). New approaches to accomodate and integrate the water into the urban environment are emerging since more resilient solutions reduce vulnerability and adaption to future climate scenarios is needed (Ghofrani et al., 2017; Jones et al., 2012; Verweij et al., 2021).

Blue-green infrastructure (BGI) is considered to enable sustainable climate adaptation in urban areas (Brears, 2018). This adaptation involves moving from traditional to multifunctional infrastructure. Hence, increasing resilience to climate change requires a holistic approach that includes inter-organizational collaboration (Casiano Flores et al., 2021).

BGI as a network of "strategic and planned infrastructure" provides social services, protects biodiversity and offers potential ecosystem services which are paving the way for more resilience (Casiano Flores et al., 2021, p. 2). Local measures for water retention, rainwater use, and the greening of buildings are a few practical examples of BGI (Brears, 2018; Geyler et al., 2019). Within the scope of climate adaptation and beyond, BGI provides benefits such as improved air quality, noise reduction and contributions to health and well-being (Fenner, 2017; IPCC, 2022). Nonetheless, the use of green spaces within urban areas is facing obstacles and the uptake of water-sensitive practices remains slow on a local level (Dhakal & Chevalier, 2017; Jerome et al., 2017; Matthews et al., 2015). Whereas urban flooding remains a severe issue. Consequently, there is the need to develop adaptive strategies to conserve and increase the amount and quality of blue and green spaces within urban areas and start a transition towards more resilient water management (Dhakal & Chevalier, 2017; Sörensen et al., 2021).

The implementation of BGI contrasts with the provision of mono-functional grey infrastructure and requires urban governments to adjust policies and develop new competencies (Fletcher et al., 2015). Efforts across all sectors are needed to respond to climate change and to build resilience for future scenarios (Davoudi, 2009). By systematically integrating and coordinating climate adaptation efforts across sectors and levels, mainstreaming triggers changes in policies, in institutional and financial procedures plus it allows for synergy effects and policy coherence (Braunschweiger & Pütz, 2021; Runhaar et al., 2018; Wamsler et al., 2014). Although urban water managers are typically handling water-oriented BGI, its spatial integration often overlaps with other disciplines and functions (Willems et al., 2020). Since mainstreaming of climate adaptation policies is suggested and beneficial for a sustainable transition towards more resilient cities, coordination of multiple efforts is needed and capacities of various actors must be mobilized (Nesshöver et al., 2017; Runhaar et al., 2018). Promoting BGI as a means of climate adaptation within urban development hence requires an understanding of mainstreaming such policies across levels and sectors (Wamsler et al., 2017; Willems et al., 2020).

1.2. Problem statement

Policy interventions to promote BGI for urban resilience and climate adaptation have gained momentum, and yet knowledge on associated policy processes is scarce and fragmented (Wamsler et al., 2017). Even though recent developments show the acknowledgement of potential benefits, the uptake of mainstreaming interventions has been hampered by barriers especially at the municipal level (Jerome et al., 2017). Therefore, the implementation of BGI is also low and scattered. In the light of these challenge, the barriers of mainstreaming needs to be investigated to ensure the successful mainstreaming and therefore the increase of BGI in cities.

1.3. Research objectives and questions

Against this background, this thesis explores blue-green infrastructure as an effective means for climate-proofing urban areas. The aim of this study is to acquire an understanding of the mainstreaming strategies for blue-green infrastructure and the barriers that hinder successful mainstreaming. In addition, this research aims to identify which enabling mechanisms help to overcome those barriers. Even though recent developments show the acknowledgement of potential benefits, the uptake of mainstreaming interventions has been hampered by barriers especially at the municipal level (Jerome et al., 2017). Therefore, research at the municipal level "where international and national legislation and policies are translated into practice" is needed (Rauken et al., 2015; Wamsler et al., 2020, p. 1). Here, synergies between the policy domains are best visible (Kern & Alber, 2009; Uittenbroek et al., 2012). Building on the blue-green infrastructure concepts in the two Dutch municipalities of Zwolle and Dordrecht, this study answers the following **main research question**: **How can municipalities successfully overcome barriers of mainstreaming blue-green infrastructure to become climate-resilient?**

To facilitate answering this question, **four sub-questions** will support the stepwise analysis:

1. What does "mainstreaming BGI" entail and which barriers are connected to it?
2. Which are the current policies for mainstreaming BGI in the Netherlands?
3. Which strategies are employed to mainstream BGI in Zwolle and Dordrecht and which barriers have occurred during the process?
4. Which mechanisms were used to overcome the barriers of mainstreaming BGI in Zwolle and Dordrecht?

1.4. Relevance of the research

Research has focused on optimizing green infrastructure for ecosystem services (Ahern et al., 2014; Young et al., 2014). More recent contributions also centered on harnessing green infrastructure as a climate adaptation measure, especially regarding urban water management, and its impacts on reducing heat-stress within urban areas (Liu & Jensen, 2018; Zuniga-Teran et al., 2020). Multi-functional urban green spaces are therefore seen as a way forward in planning (Liu & Jensen, 2018). The benefits of blue-green infrastructure and the obstacles to its implementation are identified in literature (Özerol et al., 2020; Zhang et al., 2020), and also mainstreaming of climate adaptation policies has already been investigated (Runhaar et al., 2018; Uittenbroek et al., 2012). Also, perceptions and self-assessment within BGI projects which are focusing on urban stormwater management have been researched (O'Donnell et al., 2021; Özerol et al., 2020). As pointed out by Restemeyer et al. (2015, p. 59) "flood resilience should not be a separate policy but integrated into a broader urban agenda". In recent years, more attention has been drawn to BGI but its mainstreaming has not been investigated yet and remains a challenge for policy-makers (Liao et al., 2017).

Hence, this thesis adds to the needed research on how to successfully mainstream BGI measures, compiles more evidence from case studies and gives insights into the mechanisms of overcoming mainstreaming barriers (Henderson et al., 2022; Uittenbroek, 2014; Uittenbroek et al., 2012). Since only a By doing so, this research closes a knowledge gap identified by Liao et al. (2017) contributing to research on how to overcome the barriers of BGI mainstreaming.

1.5. Reading guide

This thesis consists of six chapters. The first chapter explained the challenges of climate change with regard to traditional urban water management and the need to integrate BGI into the built environment and across policy domains. The research aims and questions are described and the need for further investigation of BGI uptake was set out. The second chapter introduces the theoretical framework of concepts of climate change adaptation and BGI. In this chapter the origin, strategies and associated mainstreaming barriers are discussed. An assessment of mainstreaming is introduced, and the two concepts of climate change adaptation and BGI are placed inside the frame of a policy processes. The chapter closes with the conceptual model for this thesis. The third chapter is assigned to the methodological approach, providing an overview of the research methods and the research strategy. Chapter four presents the findings of the qualitative analysis of the experiences gained in integrating and implementing BGI in the municipalities of Zwolle and Dordrecht. The discussion of the results and answers to the sub-question can be found in chapter five. The thesis closes with a conclusion in chapter six, including implementations for planning practice and recommendations, a reflection and limitations, as well as the need for further research.

2. Theoretical framework

In this chapter the theoretical framework is presented. First, climate adaptation and its role in the urban context is described. The subsequent section focuses on the concept of blue-green infrastructure and its contribution to climate adaptation. An examination of policy mainstreaming elaborating on mainstreaming strategies and associated barriers follows in the third section. The chapter closes with the conceptual model.

2.1. Climate adaptation

When addressing climate change science mostly follows two strands: climate mitigation and climate adaptation. Without diminishing the importance of mitigation efforts and as a response to the above-mentioned pressures of urbanization, changing weather patterns and aging infrastructures, adaptation measures must be taken. While mitigation ambitions address global issues, climate adaptation has a regional impact. Although adaptation suffers from a negative connotation, being regarded a "passive acceptance" of climate change, it offers potential for adjusting to its irreversible effects (Pielke, 1998, p. 162). Adaptation is understood as a behavioral change in order to reduce the society's vulnerability to climate change (Pielke, 1998). The Intergovernmental Panel on Climate Change (IPCC) (2022) defined climate change adaptation as the process of adjustment to expected and actual climate and its impacts, to minimize its negative effects or exploit benefits in human and natural systems. This definition further emphasizes the use of windows of opportunity for climate adaptation (such as urban renewal and changes in land-use plans). Adaptation should not be seen as separate ambition but rather as an integral part of urban planning. By embracing the interdisciplinarity and aiming for a coherent integration, various benefits can be generated from synergies of sectoral policies (Kok & de Coninck, 2007; Wamsler et al., 2014). However, climate adaptation measures might also run the risk of resulting in mal-adaptation (IPCC, 2022).

While the IPCC (2022) regards the natural and human system as two, Moser and Ekstrom (2010) use the holistic perspective of combining these two to a socio-ecological systems. Their understanding of adaptation also goes beyond solely meeting climate change goals. Being aware of different interpretations of climate adaptation across sectors, coherence in managing adaptation is important (Moser & Ekstrom, 2010). Many policy areas such as energy, agriculture, housing, infrastructure, and water management have overlapping targets. To allow for using synergies, the subject must be mainstreamed into all policy sectors. This also increases the chances for innovations and higher effectiveness and efficiency (Uittenbroek et al., 2012). Runhaar et al. (2012) distinguish between "proactive" and "reactive" measures. Proactive measures describe any preventive action taken before climate effects occur, whereas reactive measures are used during or after the effects are occurring. Both types of climate adaptation are considered in this research.

2.1.1. Climate resilience

Resilience as the ability to bounce back and adapt to a shock event is the most widespread concept in planning science and practice when it comes to dealing with uncertain futures (Davoudi et al., 2012). Davoudi et al. (2012) distinguish between three types of resilience: the engineering, the ecological and the evolutionary resilience. Stemming from the Latin term resi-lire, "to spring back", the underlying idea of engineering resilience is to return to an existing equilibrium. Ecological resilience offers a more adaptive understanding of the bounce-ability, as it describes the potential of bouncing forth, towards a new stable state. The evolutionary turn understands resilience as the "ability of complex socio-ecological systems to change, adapt, and, transform in response to stresses" (Davoudi et al., 2012, p. 302). Drawing from a concept of the field of water management, Restemeyer et al. (2015) describe resilience in flood risk management as minimizing the probability of flooding and its consequences at the same time. Their strategy-based framework for assessing flood resilience focuses on three main characteristics of resilience: robustness (reducing the probability), adaptability (reducing the effects), and transformability (promote societal change) (Restemeyer et al., 2015). This can also be applied to climate resilience. Robustness describes the preparedness of a city for the future impacts of climate change. Therefore, the municipalities are asked to adapt physically and societally, creating space which e.g., allows for controlled flooding without causing significant damage. Building this adaptability asks for a common societal endeavor and a change in mind-set of society (Restemeyer et al., 2015).

2.2. The concept of blue-green infrastructure

2.2.1. Framing blue-green infrastructure

Based on Jochimsen (1966) and his theory of infrastructure, an infrastructure is the totality of material, institutional and personal facilities, equipment and conditions available to economic units. Urban infrastructures can be subdivided into technical, social and commercial infrastructures (Libbe, 2015). Basically, infrastructure consists of physical, informational, spatial, and organizational components (Libbe & Moss, 2006). Technical infrastructure enables the flow of materials and energy within and between cities and their surrounding areas (ibidem). They are the functional prerequisite for urban life and mediate between nature and its natural resources on the one hand and society and its needs on the other (Libbe, 2015; Libbe & Moss, 2006). Thereby infrastructure can be divided in two different types: Technical infrastructures, often also referred to as grey infrastructure, includes water supply and disposal as well as energy supply and waste disposal. In addition to the grey, technical infrastructures, urban green spaces and water bodies can be conceptualized as blue and green infrastructure, as they fulfill societal supply functions based on their ecosystem services and biophysical processes (Kozak et al., 2020).

According to Brears (2018) and the European Commission (2013), blue-green infrastructure is understood as a mix of urban green spaces, and urban blue infrastructure, related to aquatic ecosystems, as a strategically planned network that runs through the city. BGI connects single patches of green and blue within the city (Deely et al., 2020; Ghofrani et al., 2017). Since blue and green infrastructures are strongly intertwined, they are often referred to as blue-green infrastructure (Eyink & Heck, 2017). This blue-green infrastructure can consist of natural and artificial elements. BGI is an important tool for urban flood attenuation (Ghofrani et al., 2017). Making use of its ecosystem services, stormwater quality and quantity are managed by infiltration, detention, storage and the filtering of pollutants (Liao et al., 2017). Therefore, BGI addresses both, the rainwater and the stormwater runoff (Suleiman, 2021). The goal is to infiltrate, capture, attenuate and retain surface water close to the source of effluent (Fletcher et al., 2015).

Thereby these systems provide a variety of services which help urban landscapes to cope with water-related threats (flood risk reduction, water quality treatment), the revitalization of urban biodiversity and the regulation of temperatures (Liao et al., 2017). In practical terms, BGI in cities can be found most commonly in the shape of green roofs and bioswales. Also rain gardens, retention and detention basins and artificial wetlands fall under the concept of BGI (Liao et al., 2017). Figure 1 shows the effectiveness of BGI measures in reducing flood risk across different scales. The effectiveness is based on peak runoff volume reduction and peak flow reduction in percent (Ruangpan et al., 2020).

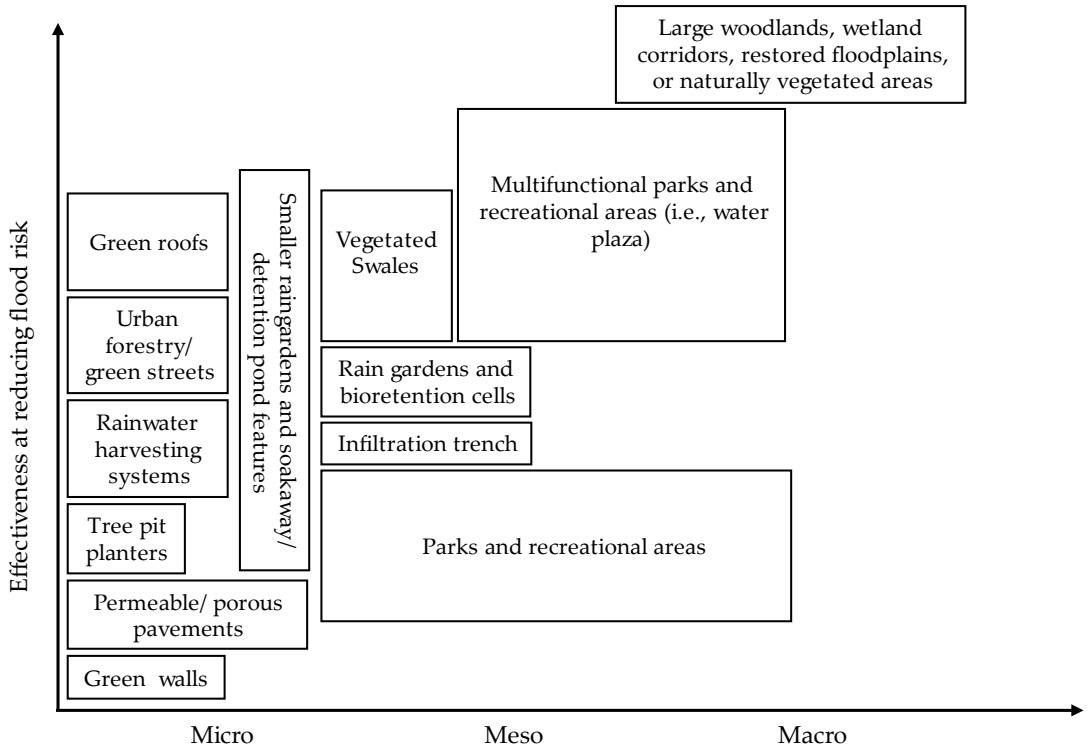


Figure 1 Conceptual diagram of effectiveness at reducing flood risk and the scales of BGI measures (Green et al. (2021), checked and supplemented with data from Ruangpan et al. (2020))

Whereas the term BGI has only recently appeared in literature, the idea and practice of this concept have existed for a long time. The evolvement of the more diverse terminology also reflects the paradigm shift in urban water management, from a drainage focused, engineering approach towards more holistic, integrative water management and the involvement of multiple professions in the planning process. Therefore, the sole focus on technical advantages has been broadened by the consideration of local embeddedness and multifunctionality (Fletcher et al., 2015). Often the terms Sustainable Urban Drainage Systems (SuDs), Ecosystem-based Adaptation (EbA) and Nature-based Solutions (NbS) are used synonymously in literature (Henderson et al., 2022; Thorne et al., 2018). These related terms, their year of origin and places where they are commonly used can be found as a glossary in Table 1.

Terminology	**Definition, objective, and purpose**	**Year and place of origin**
Low impact development (LID)	"LID is often used as a retrofit designed to reduce the stress on urban stormwater infrastructure and/or create the resiliency to adapt to climate changes. Stormwater quality regulations are another major driver for the adoption of LID as some controls have also been implemented to improve water quality. In order to achieve storm-water objectives, LID relies heavily on infiltration and evapotranspiration and attempts to incorporate natural features into design." (Eckart et al., 2017, p. 414)	1977, USA/ New Zealand
Water-sensitive urban design (WSUD)	"Manage the water balance, maintain and where possible enhance water quality, encourage water conservation and maintain water-related environmental and recreational opportunities."(Hawthorn & Thompson, 1994)	1994, Australia
Sustainable urban drainage systems (SuDs)	"Replicate the natural drainage processes of an area – typically through the use of vegetation-based interventions such as swales, water gardens and green roofs, which increase localized infiltration, attenuation and/or detention of stormwater." (Ossa-Moreno et al., 2017)	2001, UK
Nature-based solutions (NbS)	"NbS aims to help societies address a variety of environmental, social, and economic challenges in sustainable ways. They are actions inspired by, supported by, or copied from nature, both using and enhancing existing solutions to challenges as well as exploring more novel solutions"(European Commission, 2015)	2008, Europe
Ecosystem-based adaptation (EbA)	"The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change."(Convention on Biological Diversity, 2009)	2009, Canada/ Europe
Blue-green infrastructure (BGI)	"BGI […] as a network of landscape systems, which often combines both natural and artificial materials and is purposefully designed and managed to provide stormwater-related ecosystem services. The essence of BGI as an approach to stormwater management is that it is ecosystem-based, relying on natural processes as opposed to engineering structures." (Liao et al., 2017)	2013, UK

Table 1 Glossary of terminologies and their geographical usage sorted by year of origin(author's compilation based on Fletcher et al. (2015); Nesshöver et al. (2017); Ruangpan et al. (2020))

All concepts are based on a holistic, integrated approach with a participatory turn. Across all terminologies nature is used to lower the risk associated with hydro-meteorological events

(Ruangpan et al., 2020). Some concepts are closely connected or used interchangeably. Although BGI and NbS are understood as two stand-alone concepts with separate focuses, some researchers and practitioners frame BGI as the key approach for implementing NbS (Henderson et al., 2022). BGI also supports the creation of adaptive capacity to build resilient cities. The concept promotes vegetation development, biodiversity, and habitat connectivity, and offer opportunities for recreation use (ibidem). Besides the maintenance of the natural ecological cycle, green and blue structures sustain air quality and water resources, contributing to a healthy environment and increased quality of life (Deely et al., 2020; Ruangpan et al., 2020). By keeping water in the urban landscape and encouraging more evapotranspiration which leads to dropping local temperatures, BGI is also able to alleviate excessive urban heat (Zhang et al., 2020). BGI provides a sustainable and flexible approach to tackle future uncertain climate conditions and contributes to climate resilience. The concept has been recognized as a spatial adaptation measure which is increasing urban (flood) resilience while improving biodiversity and supporting public health (Willems et al., 2022).

Among the diverse terminology of nature-related climate adaptation measures, this research uses BGI due to its broad adoption in theory and practice (ibidem). Additionally, the term blue-green infrastructure is the most common in the European Union and also the most recent term within the debate (Casiano Flores et al., 2021; European Commission, 2021; Ruangpan et al., 2020).

2.3. The idea of mainstreaming policies

2.3.1. Origins of mainstreaming and its importance for climate adaptation

Environmental policies, such as for climate adaptation, have a weak profile and need additional support in integration (Zuidema, 2016). Although climate policy mainstreaming is regarded as important in policy practice and scientific literature, the concept is still lacking a universal terminology and common understanding of what *mainstreaming* entails precisely (Brouwer et al., 2013). Klein et al. (2007, p. 25) define it as "the more efficient and effective use of financial and human resources rather than designing, implementing and managing climate policy separately from ongoing activities".

Although a shared terminology for mainstreaming does not exist, researchers do agree on the goals of mainstreaming. By mainstreaming climate adaptation policies potentials of other policy areas and sectors are combined to create climate-proof development pathways (Kok & de Coninck, 2007). Hence, mainstreaming aims for an increased policy coherence and efficiency (Rauken et al., 2015). It is regarded as a means for handling trade-offs and providing synergies to build adaptive capacity (Jordan & Lenschow, 2010; Kok & de Coninck, 2007; Mickwitz et al., 2009). This also applies to budgetary terms (Kok & de

Coninck, 2007). For this purpose, capturing synergies and building adaptive capacity are essential (Jordan & Lenschow, 2010; Uittenbroek et al., 2012). In practical terms, climate adaptation must be incorporated in existing and future projects. Therefore, policies and adaptation measures must be integrated into sectoral decision-making and planning processes (Klein et al., 2007). Besides the need to build substantial capacity, mainstreaming requires coordination across various decision-making levels and policy domains and a set of different strategies (Schleyer et al., 2015). Existing attitudes and ideas within this sphere are challenged as mainstreaming oughts to change the dominant policy paradigm across levels (Wamsler et al., 2014; Wamsler & Pauleit, 2016).

With its roots in development policies, mainstreaming is understood as an instrument to integrate policy goals into the existing policy landscape. Many researchers view adaptation mainstreaming as a particular form of environmental policy integration (EPI). This understanding is also consistent with the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, which synonymously refers to the integration of climate change adaptation "with other concerns" and mainstreaming (IPCC, 2022, p. 968). Therefore, the concept of mainstreaming used in this study is based on existing literature on EPI.

The idea of mainstreaming is closely linked with environmental policy integration as both ideas center on the integration of environmental concerns into the existing policy landscape. The European Environment Agency defines EPI as "moving environmental issues from the periphery to the center of decision-making, whereby environmental issues are reflected in the very design and substance of sector policies" (EEA, 2005, p. 12). There are two interpretations of mainstreaming in EPI. Jordan and Lenschow (2008) distinguish between weak and strong EPI. While the strong approach uses principled priority as basis for the integration of environmental concerns (EEA, 2005; Jordan & Lenschow, 2010), weak EPI says that climate adaptation issues have to get attention within various sectors (Jordan & Lenschow, 2010). Mainstreaming that was investigated in practice usually is considered weak (Rauken et al., 2015).

Critics of the climate mainstreaming claim that solely relying on this approach is a pitfall. Especially, when compared to a dedicated approach which assigns new institutions with financial resources and an explicit political remit to adaptation, mainstreaming goals and ambitions might play a subordinate role. It runs the risk of climate adaptation being understood as an option rather than a necessity (Braunschweiger & Pütz, 2021). Runhaar et al. (2018) mention the decreasing attention and political visibility of the mainstreamed topic as these policies might "drown" and "dilute" in the sectoral strategies. Although mainstreaming is no "silver bullet" (Schleyer et al., 2015, p. 179), in the context of climate adaptation it offers opportunities for achieving a sustainable transition (Braunschweiger & Pütz, 2021; Runhaar et al., 2018). Within the political discourse, climate adaptation strategies often compete with other pressing societal problems, which manifests the need to integrate climate policies within all sectors (van Buuren et al., 2014). The degree to which climate

adaptation is integrated into policy documents and processes within a municipality, also affects the chances of a society becoming climate proof (Uittenbroek et al., 2012). It does so by modifying ongoing and existing projects which consequently increases the resilience of its stakeholders (e.g., neighbors) and by prioritizing strategies which are fruitful for successful climate adaptation. The latter type of mainstreaming affects the early stages of projects while policy mainstreaming can only trigger adjustment for already existing developments (Klein et al., 2007). While some researchers consider mainstreaming climate adaptation policies in all sectors indispensable for a societal transition, others highlight the positive impacts on policy coherence, reduction in duplicating or contradicting policies and mismatches (Jordan & Lenschow, 2010; Kok & de Coninck, 2007; Rauken et al., 2015).

2.3.2. Mainstreaming strategies

There is a variety of options to integrate new policies into the existing policy landscape. Whatever approach is taken, the traditional hierarchy of policy objectives has to be altered, lifting environmental policies to the higher end of the scale (Lafferty & Hovden, 2003). Lafferty and Hovden (2003) identified two ways of pursuing this kind of policy integration:

- *Vertical:* the extent to which a governmental sector is incorporating the environmental objectives into their sectoral action plans
- *Horizontal:* the extent to which the central authority develops a cross-sectoral policy integration strategy for the long term

Vertical Environmental Policy Integration (VEPI) describes the degree to which the sector is adapting their objectives to the newly implemented policy, while in Horizontal Environmental Policy Integration (HEPI) an overarching governmental strategy for mainstreaming a new policy is created (Lafferty & Hovden, 2003). While this approach refers to the "policy process leading to changes in policymaking and outputs", also shifts in "political decision-making, behavior and learning" are needed for environmental policy integration (Kivimaa & Mickwitz, 2006, p. 729).

Building on the horizontal and vertical classification, mainstreaming approaches are classified. This categorization distinguishes between governance relations of different actors involved in policy integration (Lafferty & Hovden, 2003; Wamsler et al., 2014). Whereas vertical implementation goes along with dominant governmental bodies, horizontal integration is most often guided by less powerful bodies. During a VEPI , the core legislative powers take the lead, while the horizontal integration mainly is nudged by a single actor who is not powerful enough to implement the policy top-down and therefore mainstreaming relies on sectoral support (Nunan et al., 2012). Wamsler et al. (2014) conducted a literature review sorting the different strategic mainstreaming activities into six categories (see Table 2).

The strategies incorporate both, the output of the policy and the process. The strategies have to be regarded as one set in the sense that they are complementary necessary to achieve a profound transformation (Wamsler et al., 2014).

Dimensions	Strategies	Description
Horizontal mainstreaming	Add-on mainstreaming	Refers to the establishment of specific on-the-ground projects or programs that are not an integral part of the department's core objectives but directly target ecosystem-based adaptation or related aspects.
	Programmatic mainstreaming	Relates to the modification of department's core work by integrating aspects related to ecosystem-based adaptation into on-the-ground projects or programs
	Inter- and intra-organizational mainstreaming	Promotes collaboration of individual sections or departments with other stakeholders (departments, organizations, committees, or governmental bodies) to inform, consult, advise or collaborate for shared knowledge generation, competence development and action-taking for advancing ecosystem-based adaptation.
Vertical mainstreaming	Regulatory mainstreaming	Refers to the modification of planning procedures and related activities by formal and informal plans, regulations, policies and legislations that lead to integration of ecosystem-based adaptation.
	Managerial mainstreaming	Refers to the modification of organizational management and working structures including related internal formal and informal norms and work descriptions as well as the configuration of sections or departments to better address aspects related to ecosystem-based adaptation.
	Directed mainstreaming	Supports or redirects the focus onto aspects related to integrating ecosystem-based adaptation by providing topic-specific funding, promoting the initiation of new projects, supporting the education of staff, or directing responsibilities

Table 2 Mainstreaming dimensions and related strategies (Wamsler et al., 2014, p. 191)

Even though a dedicated approach, integrating climate adaptation as a separate policy domain supported by direct political commitment, has been applied in the past, mainstreaming is considered the more efficient and effective approach (Uittenbroek et al., 2012). With the complement of add-on mainstreaming, the framework now also includes a dedicated approach to advancing adaptation goals (Braunschweiger & Pütz, 2021). Although the add-on and managerial mainstreaming strategies are applicable on all levels, the interaction between levels are not concerned within these approaches. Therefore, inter-, and intra-organizational strategies were added, addressing interactions within and outside the governmental organizations. Programmatic mainstreaming relies on the initiating of projects and programs, mostly both, project and program managements are employed. While project management focuses on context-specific challenges and ensures a timely delivery within a predetermined budget. The strength of program management is to ensure mainstreaming of a specific focus across projects and connecting it with other projects (Busscher et al., 2019). Regulatory mainstreaming enhances the vertical integration of climate adaptation policies by the means of modified planning procedures or legislation. Same does the managerial

mainstreaming, focusing on modified working structures and norms instead. Finally, vertical policy integration can also take place in a top-down manner, such as mainstreaming "directed instructions from higher decision levels" (Wamsler et al., 2014, p. 191).

Mainstreaming efforts are needed iteratively throughout the whole policy process. It provides a classification of different phases in the cycle since every policy development and implementation requires structuring. The policy process is classically divided into nine steps. For the purpose of simplification, these nine steps are condensed to the three main phases of understanding, planning and managing. The first three steps are summarized under "*understanding*". They encompass (i) awareness raising and problem framing, (ii) gaining a deeper understanding of the issue and assembling information and (iii) the (re)definition of the problem. The steps (iv) development, (v) assessment and (vi) selection of adaption options are part of the *"planning"* phase. The last phase, the "*managing"*, consists of (vii) the implementation, (viii) monitoring and (ix) evaluation of the selected option(s) (Moser & Ekstrom, 2010). The non-linear, iterative nature of the policy process implies the revision of the stages for the policy to progress (Uittenbroek et al., 2012).

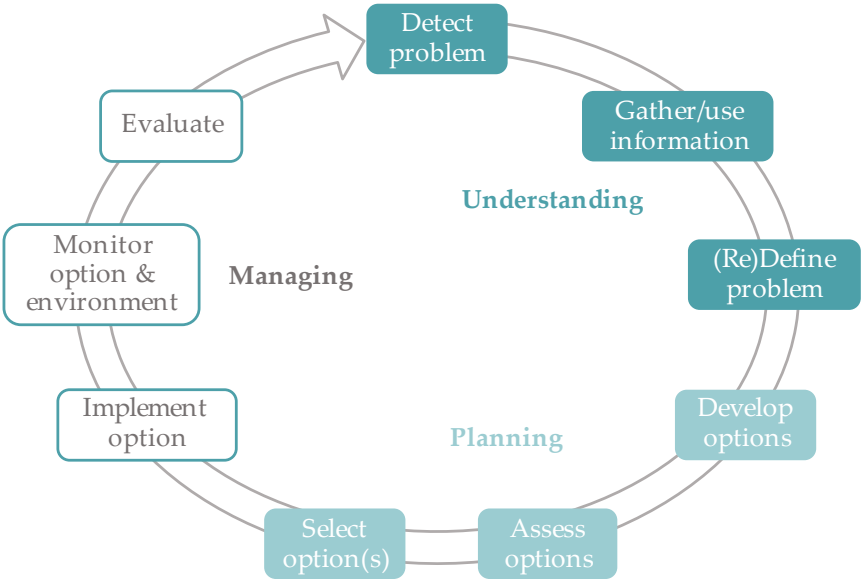


Figure 2 Steps of the policy process (Moser & Ekstrom, 2010, p. 22027)

2.3.3. Barriers of mainstreaming BGI

Although the mainstreaming approach sounds promising from a theoretical point of view, it is often hampered by unexpected, context-dependent obstacles in practice. Barriers may prevent the climate adaptation measure from being considered in the policymaking or inhibit their implementation (Uittenbroek et al., 2012). They hence influence the selection of policies and define the extent of their mainstreaming. Climate change literature has extensively studied limitations and barriers of mainstreaming efforts (Adger et al., 2009; Jordan et al., 2010; Uittenbroek, 2014). However, focusing on mainstreaming barriers has also

been criticized as a purely functionalist approach which does not add to the understanding of the causal mechanisms behind the process (Biesbroek et al., 2015). Still, this thesis makes use of the approach as it enhances the understanding of why mainstreaming is not always successful and forms a basis on which overcoming mechanisms and tools can be developed.

Adger et al. (2007) composed a holistic framework for limits and barriers to climate adaptation, encompassing five main obstacles: First, physical and ecological constraints referring to the existing natural circumstances and adaptive capacity of the system; second, technological limits connected to technological solutions which can be culturally undesirable and economically unsustainable; third, financial barriers pointing at missing resources for implementing adaptation measures and covering potential damage; fourth, informal and cognitive barriers addressing knowledge gaps and lacking understanding of complexity of climate adaptation; finally, social and cultural barriers to 'adaptation [which] can be related to the different ways in which people and groups experience, interpret and respond to climate change' (Adger et al., 2007, p. 17). This classification serves as a general starting point to build a mainstreaming barrier framework for implementation of climate adaptation. Moser and Ekstrom (2010) developed this scheme further putting emphasis on the mainstreaming concept. They included an additional category which focuses on policy domains, institutional context, and the moment of occurrence within the process of mainstreaming. These institutional barriers are addressing leadership, political support, public pressure, and the prioritization of the adaptation problem at issue next to other objectives in the policy process. These considerations are not only applicable for climate adaptation, but the institutional barriers also occur in other policy domains. Organizational barriers such as fragmentation and poor coordination add another category to the scheme (Moser & Ekstrom, 2010). Building on these categories and findings of Uittenbroek et al. (2012), the barriers of mainstreaming can be grouped in six categories: cognitive, organizational and institutional, social and political barriers, resource availability, BGI-related barriers and time barriers. The following paragraphs describes these barriers in more detail.

Cognitive barriers

Psychological elements for cognitive decision-making process have been ignored in climate adaptation literature for quite a while. Belief systems, ethical norms and values and societal attitudes influence the willingness to mainstream climate adaptation (Biesbroek et al., 2011). Missing awareness that adaptation (in form of BGI) is needed is the biggest barrier as it is also the starting point of the mainstreaming. No sense of urgency and a low threshold of concern also hamper the initiating of mainstreaming (Moser & Ekstrom, 2010). Moreover, high levels of uncertainty do not support mainstreaming (Runhaar et al., 2018). Uncertainties in this context concern the "quality and quantity, availability and accessibility, legitimacy and credibility of data and information that is used in decision-making" (Biesbroek et al., 2011, p. 185).

Organizational and institutional barriers

The 'institutional void' defined by Biesbroek et al. (2011) is one of the institutional barriers impeding climate adaptation. It describes the missing willingness of institutions to mainstream adaptation policies. Regulations and legal obligations support the integration of climate adaptation. If no regulation is in place, mainstreaming is highly dependent on the willingness of the policy domains to promote adaptation (Runhaar et al., 2018; Uittenbroek, 2014). Besides the complexity of translating long-term climate resilience into short term strategic decisions, missing leadership and guidance constitute motivational barriers (Biesbroek et al., 2011; Runhaar et al., 2018). Here, the cultural context and the way of explaining the matter through the use of topic-specific language and an elaborated, detailed definition are of importance (Schleyer et al., 2015). As all domains operate in different spheres, communication and understanding of the sector-specific langue must be considered (Kok & de Coninck, 2007). Failures in communication cannot only affect the understanding of the problem at issue but also trigger different interpretations of the concept of mainstreaming itself, ranging from the compulsory incorporation to "window-dressing" (Schleyer et al., 2015).

Moreover, mainstreaming will be less successful without the willingness to act, as motivation and dedication are required (Uittenbroek, 2014). The absence of clarity about responsibility for climate-related actions (problem ownership) forms another obstacle (Runhaar et al., 2018). Similarly, shared responsibility holds another organizational barrier. It can be problematic because it requires actors to assume responsibility of other departments beyond their own areas of operation (Uittenbroek, 2014). Therefore, organizational routines and practices also influence whether mainstreaming is successful (Uittenbroek, 2016; Wamsler et al., 2014). A silo attitude, meaning lacking "cooperation, coordination and joint decision-making on different levels "also hinders intraorganizational mainstreaming ambitions (Kok & de Coninck, 2007, p. 588). Synergies do not always arise among all sectors which facilitates the implementation of the mainstreamed policy only for a few domains (Kok & de Coninck, 2007). Hence, fitting interests into the sectoral adaptation plans, and the absence of a supportive regulative framework are major obstacles. International policy frameworks and vested interests in their organizational structures do not provide the most beneficial conditions to promote mainstreaming, too (ibidem). Finally, power imbalances within the existing structures can lead to mainstreaming petering out (Mickwitz et al., 2009).

Social and political barriers

Climate concerns also compete with other policies for the limited amount of political attention (Biesbroek et al., 2011). The inflationary adoption of international treaties is consuming political maneuvering space. Regimes with their differing rules, ambitions and cultures might face tensions in keeping up policy coherence and mainstreaming climate adaptation simultaneously. Policy inconsistency across levels or a mainstreaming overload might fail the environmental policy integration (Kok & de Coninck, 2007). Besides that, the

level of political commitment to adaptation and the public awareness or support might become barriers, when correspondence between science, policy, and society is missing (Biesbroek et al., 2011). Other interests which conflict with adaptation goals and the inflexibility of legislative and policy context are additional obstacles for mainstreaming (Runhaar et al., 2018).

Resource availability

Researchers argue that tangible and intangible resources are important to climate adaptation. Accordingly, the lack or unequal distribution of financial resources across departments present major obstacles (Biesbroek et al., 2011). Economic benchmarks also regulate the policy mainstreaming process (Schleyer et al., 2015). Besides funding also from higher institutional levels, the availability of skilled staff with expertise and knowledge on climate adaptation is essential (Runhaar et al., 2018). Moreover, physical and natural resources (such as land availability) are considered to be major barriers if not available (Biesbroek et al., 2011).

BGI-related barriers

Many of the above-mentioned barriers also relate to the mainstreaming of climate adaption. Still, there are a few barriers which are especially relevant when mainstreaming BGI: As pointed out in chapter 2.2.1, the definition of what BGI exactly entails is vague and open for interpretations (Zhang et al., 2020). Hence, the missing clear definition and framing of BGI is an obstacle when operationalizing the concept (Henderson et al., 2022). Ecological and physical barriers might occur, which are specifically related to the characteristics of the adaptation problem (Moser & Ekstrom, 2010). These relate to issues from physical conditions such as soil composition to missing maintenance standards for BGI (Deely et al., 2020). Predetermined approaches which have been applied for decades when handling increased water volumes within the city (path-dependency & reliance on grey infrastructures) hamper mainstreaming of new approaches (Henderson et al., 2022). Since BGI as a structural solution consists of dispersed interventions, it requires decentralized management and an adaptation approach which includes long-term synergies and multifunctionality, including benefits for biodiversity and the building of resilience. Therefore, the lack of multidisciplinary governance arrangements also hinders BGI mainstreaming (ibidem).

Time barriers

Additional to the occurrence of the above-mentioned barriers, missing "windows of opportunity" like urban renewal and waiting for the optimal moment for climate adaptation to unfold creates time barriers (Runhaar et al., 2018).

Many of the categories do not only represent a classification for barriers but can also be interpreted as opportunities. Leadership and problem ownership for example might unfold in favor of or opposing climate adaptation policies. So does the presence of other policies not

only trigger competition but might create an opportunity to exploit synergies (Uittenbroek et al., 2012). Available resources such as additional funds and financial subsidies for climate adaptation measures, political and public offer opportunities, and support for mainstreaming (ibidem). The next section will elaborate further on the upsides of mainstreaming, by introducing a scheme for evaluating the success of mainstreaming.

2.3.4. Successful mainstreaming

A question not yet answered within the theoretical framework is "how to evaluate the successful mainstreaming of BGI". A variety of approaches for policy evaluation exists. Some are oriented towards the governance (process-based) and others start from the problem resolution strand of literature (substance-based) (Uittenbroek et al., 2012). Following the logic of the policy process, here, the *performance* of mainstreaming is evaluated in each process phase. This is also consistent with the ongoing debate in planning theory on how to evaluate strategic plans. Whereas the concept of *conformance* is based on the congruence between outcome and the purpose, *performance* is the extent to which a goal is incorporated and influences future decision making (Faludi, 2000). Conformance does not work in this context because the combination of overarching BGI objectives and mainstreaming does not coincide. The overarching goal of BGI is to make cities climate-resilient, including not only physical adaptation but also wellbeing, which goes along with reducing the vulnerability to climate change impacts to a minimum. This contrasts with the understanding of mainstreaming as the effective and efficient use of monetary and personnel resources (Klein et al., 2007). Considering, that achieving a climate-risk reduction of 100% is unrealistic (Kabat et al., 2005), the integration of associated measures within the existing policy landscape would most likely result in trade-offs (Kok & de Coninck, 2007). These trade-offs are then hindering achieving full climate resilience.

2.4. Conceptual model: Mainstreaming blue-green infrastructure

This thesis analyzes the barriers of mainstreaming blue-green infrastructure as a means to become a climate-resilient city. The policy mainstreaming strategies and the associated obstacles occurring throughout the policy process are the focus of the research. During the process of mainstreaming, cognitive, organizational, and institutional, social and political barriers, resource availability, BGI-related barriers and time constraints can arise. In order to overcome these barriers, enabling mechanisms are required to successfully mainstream BGI and consequently increase the climate resilience of urban areas.

The hypothesis of this study is that becoming a climate-resilient city can be enhanced by mainstreaming BGI across all policy areas. Establishing appropriate linkages between functionally connected issues, such as water management, spatial planning and environmental planning, increases the chance for problem solving and can increase the

efficiency and effectiveness of policy making. Limitations of mainstreaming can be overcome with the use of enabling mechanisms which will be proposed as the research outcome. Figure 3 illustrates the conceptualization of the theoretical framework.

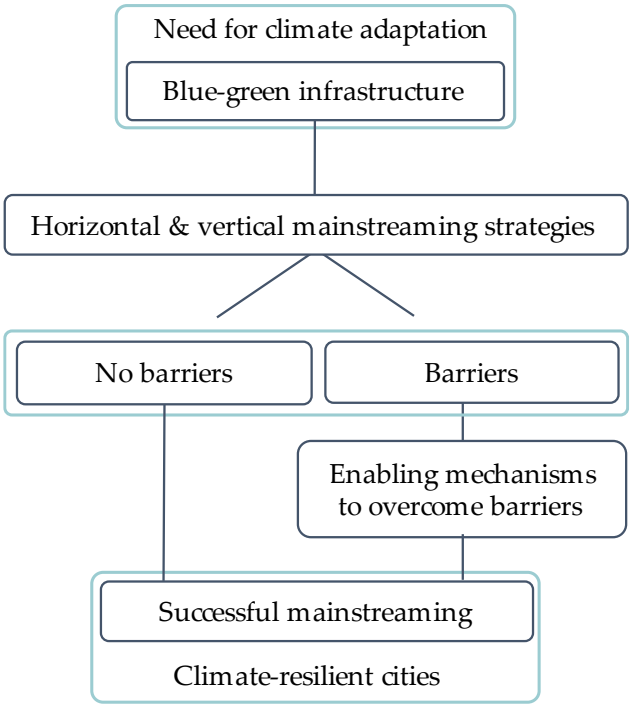


Figure 3 Conceptual model

3. Research methodology

3.1. The research design: a qualitative approach

This thesis relies on explanatory research, using qualitative research methods. The chosen qualitative research provides a more in-depth understanding of experiences and perspectives (Hennink et al., 2020). Qualitative methods are especially suitable when aiming at gaining a deeper understanding of the impacts on the studied problem (ibidem). Additionally, their use is most beneficial in examining social and institutional processes making them suitable for the topic of this research (Longhurst, 2016). Furthermore, qualitative research allows for the investigation of a phenomenon without ignoring the context and complexity it is occurring in (Hennink et al., 2020). This thesis is composed of a mix of qualitative research methods, which enables the generation of more detailed information about the investigated problem (Clifford et al., 2016).

One big contribution to the research is the use of a case study, allowing for an in-depth examination of an example case within its context (Flyvbjerg, 2011). The case study is no stand-alone research method but rather a design framework to which multiple methods can be added (Swanborn, 2010). In total three qualitative methods are used for the data collection and analysis in this study: (i) desk research, within the case study approach (ii) a policy document analysis and (iii) semi-structured interviews. Statements retrieved from the interviews are used to verify and further explain the information found in the policy documents. This also allows for a sophisticated data triangulation which increases the confidence and validity of the finding (Stake, 1995; Yin, 2017). Figure 4 gives an overview of the research questions, associated research methods and data collection strategies. The applied methods are discussed in depth in the following sections.

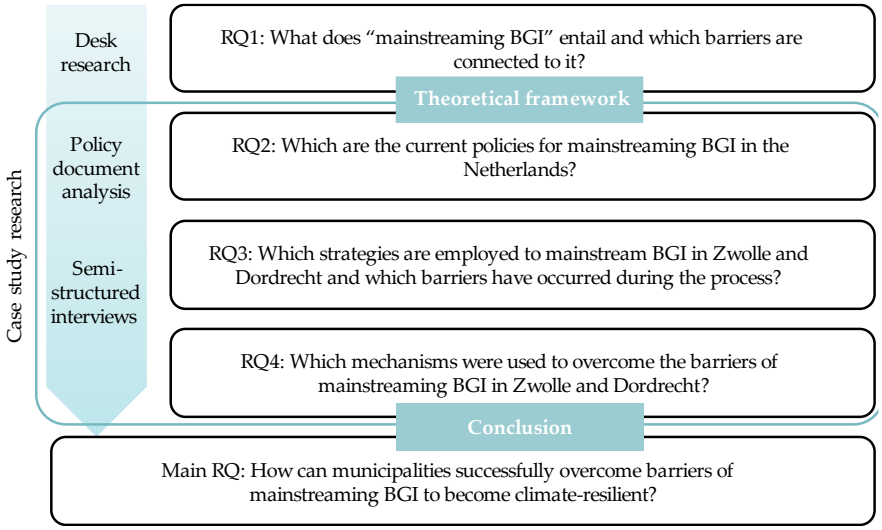


Figure 4 Methodological framework

3.2. Case study and selection

In order to analyze how municipalities can help implementing more BGI within the urban built environment a case study approach was chosen. It is an intensive analysis of a contemporary phenomenon within its environment (Flyvbjerg, 2011; Yin, 2017). Moreover, case studies are used to elaborate on the reasoning ("why") and method of realization ("how") of projects, also with focus on *explanatory research* (Baxter & Jack, 2008). As this research is aiming to explore how to overcome mainstreaming barriers, it focuses on the "how". Applying the case study approach allows for a holistic view and as well as zooming into the many facets of the case. This makes it suitable for research which seeks to investigate reasonings and casual relations within complex contexts (Taylor, 2016). Within the large quantity of case study approaches, the explanatory was chosen for this thesis. According to Yin (2017) it provides an understanding of how new organizational practices are realized. A *typical case* study, like this, focuses on a case that is an example of a solid, inter-case relationship. Since the *typical case* is well described by an existing model, the focus of interest lies in this case. More specifically, the typical case contains a particular phenomenon which helps to better explore the causal mechanisms in a general relationship (Seawright & Gerring, 2008). Although the single-case study is acknowledged as a valuable approach, they are likely to provide weaker evidence than a multiple-case study (Yin, 2017). Therefore, this thesis investigates two cases of BGI mainstreaming. Although it is the minimum of cases to make it a multiple-case study, using a "two-case" study is considered a worthy approach (ibidem).

The explanation of causal mechanisms, in this case the overcoming of mainstreaming barriers, can lead towards different learnings and conclusions. Either the connection made in the theoretical framework exists in empiricism or not. In case the connection cannot be made, the researcher will prove that the mainstreaming strategies differ from those that had previously been identified in the theoretical framework. Another outcome could be, that no reasonable connections between the independent variable and the mainstreaming of BGI in urban renewal and development projects can be made. In that case, this research may weaken evidence of a general suggestion (Seawright & Gerring, 2008).

The investigated cases must be clearly defined in case study research. By setting theoretical temporal and spatial boundaries, the scope of the research is limited since inclusive and exclusive contents are defined (Baxter & Jack, 2008; Yin, 2017). Chapter 2 already sets the theoretical boundaries. Temporally, the research is limited to the data collection period, which lasted from Mai 2022 to August 2022. Further, the spatial boundary is defined by the selection of two Dutch cities. Since climate adaptation actions on a local level are widespread within the Netherlands, it is a relevant and substantial case study area (Uittenbroek, 2014). Moreover, the Netherlands is internationally renowned for their expertise and long tradition in water management. It has come a long way from an engineering, safety-driven approach and is currently undergoing a transition towards an integrated approach (Restemeyer et al.,

2018). The knowledge and expertise of water-related challenges and context bound within water authorities and governmental bodies and the awareness of Dutch citizens are unique. Against the background of the shift towards an integrated water management approach, the Netherlands provide a valuable case for investigating barriers of BGI mainstreaming.

The case selection is connected to the spatial boundary of this research. The two Dutch cities Zwolle and Dordrecht were selected based on their participation in an Interreg North Sea project. Both projects aim to showcase how cities can become water-sensitive (CATCH) or demonstrate how cities can improve their climate resilience (BEGIN) by using blue-green infrastructure (Interreg North Sea Region, n.d.-b, n.d.-c). Accordingly, the cases are concerned with the mainstreaming of BGI within cities, focusing on retrofitting blue-green infrastructure into existing neighborhoods and show a high ambition in adapting to climate change (Interreg North Sea Region, n.d.-c; Willems et al., 2020). Zwolle and Dordrecht are front-runners and are advanced in the managing of BGI policies, allowing a retrospection on the policy process (ibidem). A brief introduction of the cases follows in the subsequent section.

3.3. Introducing the case study areas

3.3.1. Zwolle in the middle of five waters

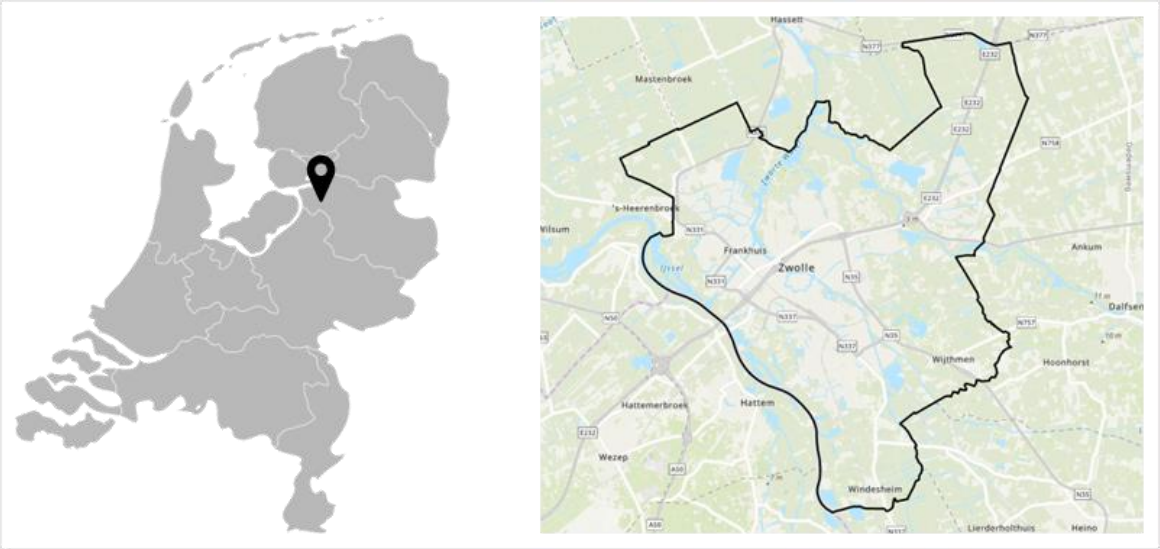


Figure 5 The city of Zwolle and its location in the Netherlands (Author's illustration, ArcGIS Pro, 2022)

Zwolle is a mid-sized delt city, located in the province of Overijssel, Netherlands (Figure 5). Three main rivers flow through and around the city: The rivers Ijssel, Vecht and Zwartewater (Duijn & Van Popering-Verkerk, 2018). Additionally, Zwolle is crisscrossed by the Sallandse Weteringen canals which directly connect to Lake Ijssel. The location of the inner center outside the dike line also makes the city more vulnerable to flooding and the weak spot of the region (Kolkman et al., 2007). Besides the river system, also heavy rainfall is

increasingly pressuring the local water management. Like in other cities in the Netherlands, the current sewage infrastructure is ageing and cannot handle the climate change-related increasing amounts of rainwater anymore (Van der Most, 2017).

The municipality perceives Zwolle's precarious situation rather as an opportunity for new developments instead of a threat. With going beyond today's norm, the municipality has a high level of ambition to become climate-resilient in the near future (ibidem). As part of the City Deal for Climate Adaptation and in its role as a demonstration delta, the municipality of Zwolle is in lively exchange with other Dutch climate-active municipalities, regional and national authorities, and science (Van der Most, 2017). Joining the Interreg North Sea CATCH project (water sensitive Cities: the Answer To CHallenges of extreme weather events) in 2018 opened a platform for international knowledge exchange. In the context of this project, a transition towards the development of water-sensitive cities is nudged and climate change resilience promoted as a future goal (Interreg North Sea Region, n.d.-a). Within living labs and several pilot projects, Zwolle already demonstrated its ambition in climate adaptation especially with regard to water challenges, which are already part of many designs, building plans and activities (Van der Most, 2017). In 2019, the municipality created its own climate adaptation strategy and set out the goal to become a blue-green city by 2050 (Dolman, 2019; Dolman et al., 2019b).

3.3.2. The resilient island of Dordrecht

Figure 6 The city of Dordrecht and its location in the Netherlands (Author's illustration, ArcGIS Pro, 2022)

Dordrecht is located on an island surrounded by the rivers Oude Maas, Beneden Merwede, Nieuwe Merwede, Wantij, Dordtse Kil and canals in the middle of the Dutch Delta in close vicinity to the Biesbosch National Park (Figure 6) (Van Herk et al., 2014). A single polder area in the north-west of the city forms the main residential area. Unlike the higher-lying,

unembanked districts of the city, this area is protected by a 37 km-long dike (Van Herk et al., 2014). The unique location between tidal waters and the river system makes the city prone to sea level changes and fluctuating volumes of river discharges (Gersonius et al., 2012).These dynamic tidal influences create a unique area for living with the water. Additionally, the soil of the area is mainly sea clay which has a high density and therefore poor infiltration properties. This combination of water challenges makes it harder to climate-proof the city (Interreg North Sea Region, n.d.-b). This variety of challenges and changes gives Dordrecht's Island unique development opportunities (ibidem). Dordrecht joined the MARE project (Managing Adaptive Responses to Changing Flood Risk), which is a practice-oriented and demand-driven research project in flood- and climate-proof urban developments. It provides insight into approaches to protect cities from water stress in form of pluvial and fluvial flooding (Jesse, 2010). The municipality also participates in the follow-up program BEGIN (Blue-Green Infrastructure through Social Innovation) (Willems et al., 2022). The focus lies in spatial planning concerns and the retrofitting of blue-green infrastructure into existing neighborhoods, the municipality shows a high ambition in adapting to climate change (ibidem). Additionally, the city set up their own environmental vision, a green-blue program and a strategy to make Dordrecht a blue-green, climate-resilient island (De Urbanisten et al., 2020; Gemeente Dordrecht, 2021a; Gemeente Dordrecht & idverde Advies, 2021).

3.4. Data collection and analysis

Producing convincing and meaningful results requires systematic analysis and interpretation of the collected data (Cope & Kurtz, 2016). Three methods are used to collect and analyze data in this thesis. First desk research is conducted to outline the concepts of blue-green infrastructure and mainstreaming and position it in the spatial-scientific discourse. The findings are the basis of the theoretical framework and contribute to an informed and targeted guideline for the semi-structured interviews. The policy document analysis also provides further input for the context of the case study and forms a knowledge base for the semi-structured interviews, too. The desk research employed material in English, German and Dutch, whereas the policy document analysis relies on Dutch and English resources.

Desk Research

In order to build a theoretical framework, desk research was conducted. According to Healey and Healey (2016) reading about the subject matter enhances broadening the image of the issue and refining ideas. In iteration, the researcher expands its understanding and knowledge of the area of research. The aim of desk research is to identify relevant key literature, determine the scope of the study and build theoretical knowledge on the investigated topic (ibidem). The second chapter of this thesis is based on desk research, describing the concepts of blue-green infrastructure and mainstreaming. The desk research was limited to open access resources, SmartCat searches and available scientific resources at the (online) library of the university of Groningen and Oldenburg.

Semi-structured interviews

As all interviews, semi-structured interviews provide in-depth information on a defined topic and are relevant for research of complex problems by acquiring multiple perspectives (Bryman, 2016; Longhurst, 2016). Partially structured interviews follow a predefined guideline but leave room for additional, spontaneous questions (Longhurst, 2016). Hence, the interviewer can dive deeper into topics of special interest which emerge during the conversation. Consequently, semi-structured interviews function as a suitable data collection method for explanatory research and when the state of knowledge of the interviewee is unknown to the interviewer (ibidem).

For this research, interviews with both, external policy advisors and water managers of the municipalities were conducted between the 2nd and 26th of August 2022. In order to make a firm selection of interviewees, a set of criteria was used to identify suitable interview partners (Bryman, 2016). The interviewees were selected purposively (Hennink et al., 2020). The selection of the interviewees was based on their (i) familiarity with the cases of Zwolle and/or Dordrecht, (ii) expertise on blue-green infrastructure and climate adaptation, and (iii) their knowledge of the policy process. Furthermore, the snowball sampling method was used to acquire additional interview partners based on recommendations from interviewees (Robinson, 2014). Interviews with four experts per case are conducted. In total, two external and six internal experts are interviewed. Except the interview with respondent 8 which was conducted as a phone interview, all interviews were held online via video calling. Table 3 shows an overview of the interview partners, including their affiliation, the date of conduction and duration of the interview.

Index	Affiliation	Date	Length
R1	Consultant and leading professional in water resilient cities, Royal HaskoningDHV	02.08.2022	70 mins
R2	Strategic advisor water and climate, Municipality of Zwolle	03.08.2022	55 mins
R3	Advisor spatial adaptation, Municipality of Zwolle	11.08.2022	50 mins
R4	Team leader water and sewage & program manager climate adaptation, Municipality of Dordrecht	11.08.2022	60 mins
R5	Coordinating urban designer, Municipality of Dordrecht	17.08.2022	45 mins
R6	Program manager climate adaptation, Municipality of Zwolle	19.08.2022	40 mins
R7	Assistant professor, University of Amsterdam	25.08.2022	40 mins
R8	Environmental planner & member of the task force “blue-green city”, Municipality of Dordrecht	26.08.2022	45 mins

Table 3 Overview of interviewees, date and medium of conduction

An interview guideline (see Appendix B - Interview Guideline) was used to collect comparable data sets from both municipalities and to ensure an overlapping query of data. The guideline consists of a fixed set of questions and some additional questions according to the case and expertise of the interviewee. The interviews were held in English and - in consultation with the interview partners - all interviews were recorded, and the recordings

were transcribed. A qualitative content analysis is conducted to process the interview data (Mayring, 2000, 2014). Therefore, the interviews were coded using the online software solution Atlas.ti. For the coding, a deductive coding scheme, as well as an inductive codebook, were applied. The deductive coding scheme was created ex ante based on the theoretical framework, determining the sections of the transcripts taken into account (Mayring, 2000). After conducting the interviews, the inductive codes were added, including relevant, striking themes which were identified during the data analysis. The coding scheme can be found in Appendix A - Code book.

Policy document analysis

A document analysis is a process in which documents of a relevant research area are reviewed and assessed. This method allows the researcher to obtain understanding, uncover meanings and gain knowledge about a particular topic within its context (Bowen, 2009). Accordingly, this analysis contributes to the gathering of evidence on the investigated subject matter and the context in which they operate.

For this study, the second sub-question is investigated using a policy document analysis. Climate adaptation strategies, BGI visions and additional policy documents which apply in Zwolle and/or Dordrecht are analyzed to find out if and to which degree blue-green infrastructure is integrated in strategic plans and policies. The analyzed material includes policy documents from the national, regional, and local level from the field of spatial and environmental planning and water management. The policy documents were browsed for information on policy goals and integration approaches. Whenever available, the official English version of the plan or strategy was used. An overview of the analyzed policy documents can be found in Table 4.

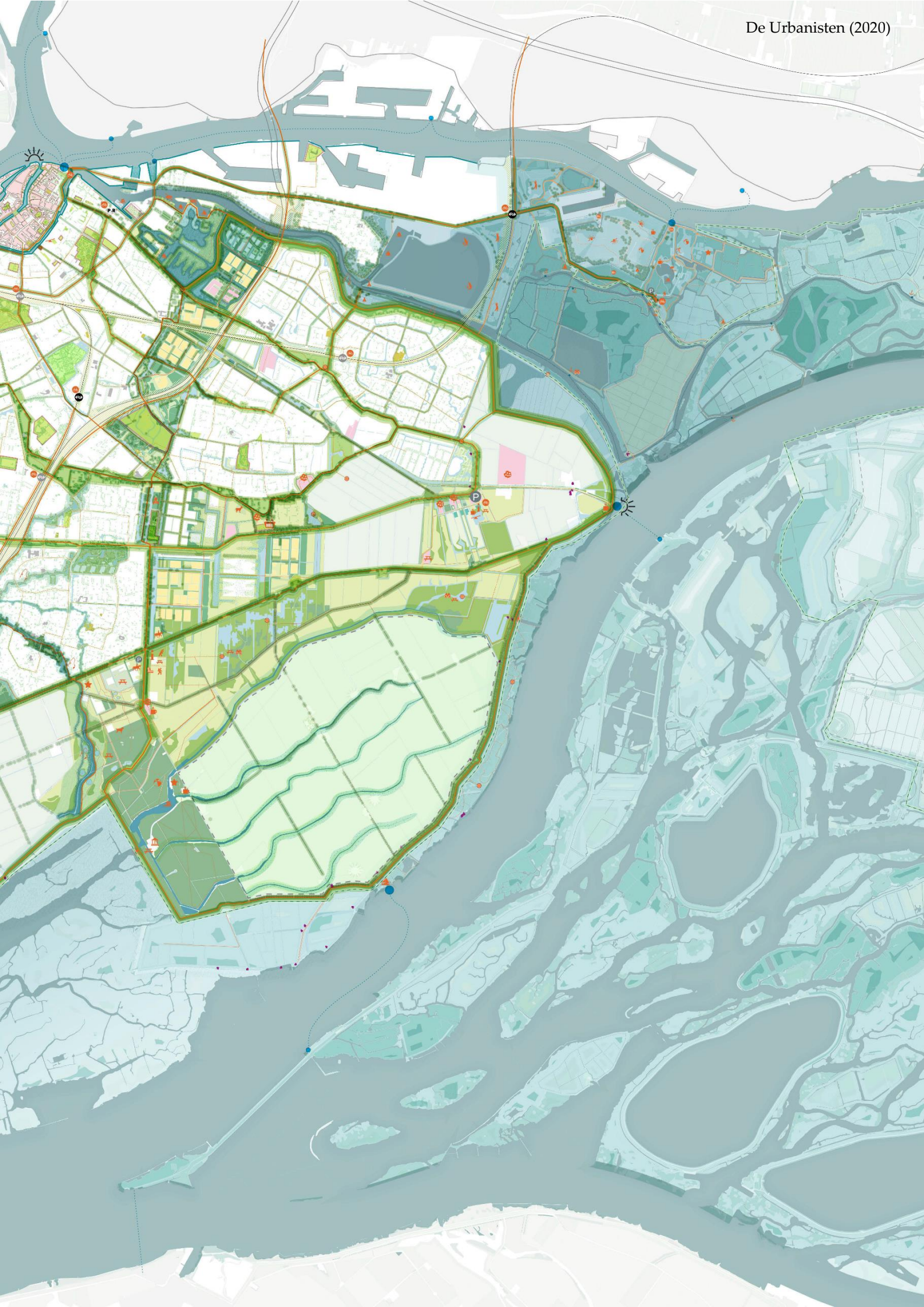
Level		Title	Year
National		National Climate Adaptation Strategy	2016
		Environmental & Planning Act	2017
		Delta Plan Spatial Adaptation	2020
		National Strategy on Spatial Planning and the Environment	2020
Regional	Zwolle	Climate adaptation strategy Province Overijssel	2021
	Dordrecht	Climate Adaptation Strategy Zuid-Holland	2021
Local	Zwolle	Climate Adaptation Strategy Zwolle	2019
		Environmental Vision Zwolle 2030	2021
	Dordrecht	Green-blue program Dordrecht	2021
		Environmental Vision Dordrecht 1.0	2021
		Spatial Vision Dordrecht	2021

Table 4 Overview of analyzed policy documents

3.5. Ethical considerations

Not only within the scope of this study, confidentiality, integrity and privacy are major compounds to conduct ethical research (Hay, 2016). Therefore, the interviewees stay anonymous, unless they request otherwise (Longhurst, 2016). As their names are never mentioned in the research, their function or an index specifies which respondent provided which information. Additionally, at the beginning of each interview, the participants were informed about their options to withdraw from the interview at any time, and not answering questions. The gathered data from the interviews is also kept safely and is exclusively used for the purposes of this study (Longhurst, 2016).

The interviewer is a Master student in the field of Environmental and Infrastructure Planning at the University of Groningen. She does not have any affiliation to the case and is independent of any other organization. As the researcher immerses herself in the theoretical background and setting of the case study beforehand, preconceived ideas have to be avoided (Yin, 2017). Although research can never be completely objective, this position of the researcher helps minimizing bias (Hay, 2016).


De Urbanisten (2020)

4. Research findings and analysis: Towards the successful integration of blue-green infrastructure

This chapter presents the findings and results of this research. The initial aim of this research was to examine the blue-green infrastructure mainstreaming within the regional policy and determine factors that might hinder this mainstreaming. In order to reach this goal and to answer the main research question, this study is based on several sub-questions. The first part of this chapter provides an overview of the underlying governmental structures in the Netherlands. It also gives insights into the efforts which the municipalities are making to date with regard to the integration of blue-green infrastructure into leading policies and strategies. The second section of this chapter presents the identified barriers which hinder the integration process. Both sections aim to answer the second sub-questions separately for the two cases: Which strategies are employed to mainstream BGI in Zwolle and Dordrecht and which barriers have occurred during the process? The subsequent, last section refers to the third research question, which aims to identify mechanisms of overcoming mainstreaming barriers. This chapter relies on the theoretical framework and data collected in the interviews. The interviewees are referred to according to their index R (respondent) in Table 3.

4.1. Dutch ambitions for blue-green infrastructure

Several national policy documents such as plans, strategies and acts describe the use of blue and green in cities as a contribution to climate resilience. This section gives an overview of the current national policies in the field of spatial planning and environment, climate adaptation and water management.

The Dutch *National Climate Adaptation Strategy (NAS)* rates the impacts and costs of flooding due to heavy rainfall as low but highlights the urgency for measures as these events are already occurring these days. In this regard the initiation of crossovers is promoted in the strategy. Here, the necessity to address multiple problems of several sectors at the same time on the local level is emphasized. As a possible solution the spatial integration of more blue and green spaces in the urban environment and the creation of green climate buffers are promoted (Ministry of Infrastructure and the Environment, 2016). In addition to the *National Climate Adaptation Strategy*, the *NAS Implementation Program* was published by the Ministry of Infrastructure and Water Management in 2018. This strategy provides a set of general steps for enhancing climate adaptation. Although no evidence of blue-green infrastructure visions can be found, the embedding of climate adaptation within policy and legislation are placed on the agenda, stressing the need for the integration of climate adaptation policies in regional

climate adaptation strategies and the *National Environmental Vision* (Ministry of Infrastructure and Water Management, 2018).

The *National Environmental Vison (NOVI)* encompasses national policies for the physical environment. It contains the main long-term objectives for spatial development in the Netherlands. One of them is the aim of redesigning and redeveloping the urban landscape with nature as a building block. The underlying vision of the strategy predicts "more building density, fewer unoccupied buildings and less decay, more green and more water" in Dutch cities in the future (Ministry of the Interior and Kingdom Relations, 2020, p. 28). The contribution of blue and green spaces to a health-enhancing living environment for humans as well as for insects are emphasized and its synergies with climate adaptation functions are acknowledged. The vision makes climate adaptation their priority and a recurring pattern in policies:

> *"In 2050, the Netherlands is climate resilient and water robust. In (re)development processes, a greater risk of damage and victims due to flooding and extreme weather must be avoided wherever reasonably achievable. We retain and reserve sufficient space for future water safety measures."* (Ministry of the Interior and Kingdom Relations, 2020, p. 76)

The reinforcement of blue and green structures is not only following the goal of robust urban designs but also to enhance the quality of life and the attractiveness of cities. To enable sustainable and high-quality living in dense urban areas, blue and green structures are demanded. Climate adaptation hence must become a vital and stable element of spatial developments. Adding to the "blue", also a policy for green space is proposed:

> *"We are enhancing the range and quality of green in the city and improving links to green areas outside the city in a coherent approach to the urban green structure, based on the underlying principle of nature-inclusive development of urban regions and nature-inclusive building."* (Ministry of the Interior and Kingdom Relations, 2020, p. 123)

Here, municipalities - in coordination with water authorities and other stakeholders - are expected to take the lead in planning how and when adaptation measures are needed in the city. Special attention has to be paid to the maintenance of green space and its connections to the surrounding natural landscape. An urban green fund relying on public and private contributions is proposed as a basis for a coherent greening approach (Ministry of the Interior and Kingdom Relations, 2020). As a legal support of this the vision, the *Environment and Planning Act* will enter into force in January 2023. This allows and obliges municipalities to add official requirements in their environmental plans for the construction and redesign of buildings and areas in a nature-friendly way. It will bundle the separate dispersed laws on the physical living environment and is expected to provide regulations with regard to climate adaptation in urban areas (Gemeente Dordrecht, n.d.; Ministry of the Interior and Kingdom Relations, 2020).

In addition to the environmental vision and climate adaptation strategy, the *National Delta Programme* was published. It centers on plans for flood protection, policies for mitigation of extreme weather events and secure freshwater supply. It includes three components: The Delta Plan on flood risk management, on freshwater supply and on spatial adaptation (Ministry of Infrastructure and Water Management et al., 2020b). The overall program points out that municipalities have multiple responsibilities in coping with climate change: Besides setting out goals and an environmental vision for their cities, also rain- and groundwater management falls under their responsibility (ibidem). In that regard, storing water above ground via green spaces and bioswales are recommended. The climate-proofing of societal real estate and public space "creating more greenery and open water" is proposed as a municipal merit (Ministry of Infrastructure and Water Management et al., 2020b, p. 125).

Climate adaptation is incorporated in policies of both spatial planning and water management. Indications of the utilization of blue and green structures are highlighted within the policy documents and a clear responsibility for the further integration and implementation is assigned to the municipalities. In the following section, the study dives deeper into the policies of the provinces and ambitions on the municipal level, first for the case of Zwolle and second for the case of Dordrecht.

4.2. Zwolle: Policy goals and mainstreaming strategies

4.2.1. The local blue-green agenda

Zwolle's becoming a water-sensitive and robust city is manifested in several programs and strategies. One major cornerstone is the *Climate Adaptation Strategy Zwolle*, which is composed of six building blocks, of which one is the blue-green network (Dolman, 2019). This important component centers on three principles which are connected to the three spatial scales it is applied on. The first principle asks the municipality and its residents to design their own plots as sponges, so that rainwater can be used on-site, retained or its drainage delayed. On the neighborhood-/ district-scale the second principle applies. It refers to a wider blue-green network which collects and stores the drained rainwater from the plots. On a regional scale, the strategy intends the implementation of emergency valves for the city-wide blue-green network and the design of floodable areas, which can temporarily store excess water (Dolman et al., 2019b). The co-benefits of working towards a blue-green city in Zwolle relate to spatial quality, living environment, health, biodiversity, real estate value, etc. In addition to strengthening or adding flood defenses, overflow areas and water drainage through and around the city via lower lying areas and green-blue networks are considered an essential part of the climate adaptation in Zwolle. For each district or sub-area, an interdisciplinary team will create a blue-green solution map. The multi-year plan for the city started with the priority focus areas in the 2019-2023 program. Together with the water board and the province Overijssel the study *Water robust Zwolle* is carried out, including

research into pathways for a cost-benefit analysis in determining a future new standard for the regional water system (ibidem). With every spatial development the municipality is responsible to contribute to the robust network of green and blue, including its sponge effect. Additionally, the *Climate Adaptation Strategy* indicates possible legal requirements for further exploration in practice (efficiency and enforceability), including (1) water storage requirements for new buildings and renewal projects, (2) a minimum of elevation for new buildings to prevent flooding or groundwater in areas outside the dikes and prone to flooding, and (3) a maximum percentage of paved surface for private house owners to decrease drainage of rainwater into the public space (Dolman et al., 2019a). Moreover, the municipality of Zwolle works with strategic partners to apply for subsidies and funding regionally (Climate Campus, Werkregio), nationally (Delta Funds) and seeks to attract EU-subsidies (Dolman et al., 2019b).

The goals of the *Adaptation Strategy of Zwolle* are included in the sections "Climate adaptation" and "The green-blue structure in the city of Zwolle" of the *Environmental Vision of Zwolle*, published in 2021. The vision states that as a reaction to climate change, the city is expanding its blue-green infrastructure network. Not to fight negative climate change impacts but also to increase its biodiversity and the attractiveness of the city. The municipality anticipates that this improved living environment will attract economic growth in the region, since people might consider living and working in this pleasant city (Gemeente Zwolle, 2021).

In addition to local policies also regional strategies of the province Overijssel have an impact on BGI integration in the city of Zwolle. In the *Climate Adaptation Strategy 2019-2023,* the need for more green and (space for) water is acknowledged. Therefore – similar to Zwolle's strategy – the province highlights the contribution of BGI for a more pleasant and healthier living environment that also enhances biodiversity. The province challenges municipalities and developers to bridge contradictions and make climate-smart decisions. In case of lacking or hesitant decision-making, the province will provide direction. For the purpose of balancing new urbanization, other regional claims on space (such as nature and water) and climate adaptation, the province will develop suitable instruments under the *Environment & Planning Act*. Examples are area programs at provincial or (sub)regional level (Lienden et al., 2021). The climate-proofing of their policies (water, nature, agriculture, infrastructure, urban design, and housing) is on their agenda for the upcoming years. Since it is in the nature of the housing and infrastructure sectors to require long-term planning, mainstreaming climate adaptation in these sectors is important (Runhaar et al., 2018). The province understands its own role as stimulating by offering and acquiring knowledge (e.g., in pilots), creating awareness and perspectives for actions (Lienden et al., 2021).

In the following section the mainstreaming strategies employed in Zwolle are identified. It gives an insight into how the climate adaptation and BGI policies are strategically integrated into spatial planning and water management in the municipality.

4.2.2. Mainstreaming strategies in Zwolle

The municipality of Zwolle employs five mainstreaming strategies to integrate more BGI into its city. The *add-on mainstreaming* is operationalized in the integration of BGI as one of the objectives in the local policy and specific design of on the ground pilot-projects. BGI is one out of six building blocks of the local climate adaptation strategy, which makes it a focal point for the climate adaptivity in Zwolle. The municipality aims at making it a "leading principle in decision-making" [R6]. This is also part of the *programmatic mainstreaming*. Across the city several on the ground projects can be found, such as swales around roundabouts, the green corridor from the station to the inner-city and buffer areas within the boundaries of the city [R1]. The municipality also implemented rain gardens and a water wall [R1]. These micro- and meso-scale measures have a low to medium effectiveness in reducing flood risk caused by heavy rainfall (Ruangpan et al., 2020). With cooperation among departments, knowledge sharing and exchange *inter- and intraorganizational mainstreaming* was promoted. Therefore, a climate adaptation program was established which is aiming at sharing knowledge across departments, exchanging thoughts on new implementation possibilities and continuously raising awareness of the topic [R1, R6]. As part of the program for climate adaptation, a blue-green infrastructure project group was launched, setting an even narrower focus on the implication of concrete on-the-ground measures [R2]. In collaboration with external organizations and experts, such as consultants, the province Overijssel and the water authority, the integration of BGI is designed as a joint effort [R1, R2, R6]. The Climate Campus initiative as a knowledge exchange platform also contributes to inter-organizational mainstreaming [R1]. The Climate Campus connects different topics and network partners by bringing together interests, know-how and resources (Climate Campus, n.d.). Within the municipality, spatial planners, representatives from the infrastructure sector (including water management), urban drainage experts and landscape architects were included in the development of the climate adaptation program [R1]. The mobility and transport department was not part of the process, although it is regarded as an important stakeholder [R1]. Developing a shared vision for climate adaptation and spreading awareness within the municipal organization was a time-intense effort [R2]. Thus, it is the first step in the policy process to detect and understand the problem (Moser & Ekstrom, 2010).

In Zwolle, tendencies of *directed mainstreaming* are present. Educational trainings and workshops on the topic of climate adaptation are taking place [R3]. With initiating a BGI project and climate adaptation program, also responsibilities were assigned for the assessment of climate stress vulnerability and the development of BGI solutions tailored to the city [R2]. Moreover, *managerial mainstreaming* can be found within the Zwolle case. The municipality transformed its ambition of becoming a blue-green and climate-adaptive city into a program. To create this program, a program manager and policy advisors were employed [R1, R2, R3]. This program extends through all departments and adds an additional horizontal unit to the institutional structure. Because of the stronger focus on

climate adaptation within the municipality, also policy advisors for this topic joined the municipality [R2].

A formal rule has been developed which states that on the plot of every new development, the possibility to infiltrate or store 70mm of water must be guaranteed. This so-called sponge principle, hence, reliefs the drainage system and indirectly triggers the use of BGI [R2]. This *regulatory mainstreaming* is complemented with regulations for the development and renewal of public space. The municipality follows a 3/30/300-rule. That is, every resident of a city should be able to see at least three trees from their home, every neighborhood or district should consist of 30 percent leaf canopy, and a park or parkland with trees should be found no more than 300 meters from every residence [R6]. Additionally, with the support of flood risk maps vulnerable spots within the city were identified. For renewal or new urban development alike, the risks must be considered in the final spatial design [R6]. This criterion changes the planning procedure, as it adds another step and round of consolidation.

4.2.3. Barriers in the mainstreaming process

Cognitive barriers

Not knowing what lies ahead and for which future circumstances to plan hampers the integration of BGI policies. With including "as much flexibility for the future" the challenges of climate change have to be translated into today's policies already [R2]. At the same time, the policy goals need to be clearly defined and include all great changes for the long term. Respondent 1 points out that many decision-makers in Zwolle are willing and able to envision plans and projects for 10–30 years into the future but cannot anticipate consequences of climate change and the associated need for action for the upcoming 100 – 200 years. This hampers the mainstreaming ambitions with regard to formulating a long-term vision for the city of Zwolle. Respondent 3 finds the same barrier when translating the vision back into short-term specific measures.

Organizational and institutional barriers

Climate adaptation has just begun to become an important topic on the local level, and therefore a lack of knowledge and institutional inexperience occur as "part of developing something new" [R2]. In everyday practices the translation of BGI into concrete measures is still missing at the municipality in the sense that employees are not incorporating the challenges of other disciplines into their own core work [R3]. This is also leading to another barrier: the lack of ownership of the BGI integration, due to vaguely assigned responsibilities and accountabilities [R1]. The process of setting up a climate adaptation program at the municipality of Zwolle in order to mainstream BGI and other climate-related concepts into the existing policy domains was guided by external consultants. Having started as a working group for the climate adaptation strategy, an institutional manifestation of the team in a

program was envisioned. Due to lacking problem ownership the program was only created a year after the start of the climate initiative at the municipality [R1].

When realizing blue-green infrastructure as a local and regional cohesive network, partners such as the water board are included in decision-making.

> *"The water board lives in a world of water and flooding […]. And it is their job. And they have been doing it for quite a while and they have been doing a good job in the Netherlands" [R3]*

The Netherlands have a long history in technocratic water management with a focus on water safety, the management of water quality and quantity (Duijn & Van Popering-Verkerk, 2018). As a result, water authorities are particularly focusing on traditional, engineering solutions. Proposing BGI, based on a *living with the water* approach rather than *fighting the water*, seems difficult to combine according to respondent 3. The clear delineation of tasks hamper the water boards to go beyond water safety tasks. (Duijn & Van Popering-Verkerk, 2018). This silo attitude of only focusing on water safety concerns is no breeding ground for multi-functional concepts such as BGI [R1, R3]. The municipality of Zwolle experienced the reluctance of the national water authority, Rijkswaterstaat, in the dike renewal project *Holtenbroek*. The water board as well as Rijkswaterstaat have proven to evince a rather hesitant attitude towards multi-use design (Duijn & Van Popering-Verkerk, 2018). These vested interests and silo-attitudes do occur in both, large and small-scale projects. When envisioning regional large-scale BGI projects, like eco-corridors, more collaboration between the departments is needed [R1]. In addition to the silo attitudes of departments and institutions, also on a micro-level a lot of topic-specific expertise is bundled in specialists. Connecting their knowledge with the broader scope of climate adaptation is often perceived as a challenge [R3]. In BGI projects on a neighborhood level which are not directly linked to a water body, the water board is not obliged to be involved in the planning and does not feel responsible [R1].

Social and political barriers

Missing policy consistency on a horizontal level is an issue in Zwolle. Whereas the municipality provides a climate adaptation strategy and some principles which must be applied in new planning projects, the water board and the province may stipulate other courses of action [R3]. In January 2023 the new *National Environmental Act* will come into force, providing a new set of regulations for the use and protection of the physical environment (VNG, n.d.). With this new environmental act, respondent 6 is worried that the municipality of Zwolle might deem their ambitions on climate change and give more room to other priorities such as the energy transition and housing. The law might readjust the investments which will be made in each sector. Although this is based on a prediction, it gives an insight into the existing competing priorities and the impact of national law on local ambitions.

Resource availability

The climate adaptation team estimated a total budget of 60-120 million Euro needed for the next three decades to implement and keep up all needed BGI measures. Since no structural financing is in place yet, the municipality has only been able to raise a fraction of the needed budget so far [R1]. Another resource-related barrier of mainstreaming BGI concerns low staff availability. In Zwolle, this barrier is twofold: it concerns the availability of employees which can function as policy ambassadors supporting the mainstreaming of BGI, and the availability of officers at the municipality overseeing the increasing amount of new area developments [R3]. The first refers also to the ability of mediating between the silos, as they "speak different languages" [R2].

BGI-related barriers

A barrier which often arises at the implementation of a BGI-promoting policy in Zwolle concerns the design and construction of BGI. Project managers request concrete numbers to integrate into their design [R3]. Due to the vague definition of BGI, the municipality requires them to "*find out how far you can stretch, how much you can do*" [R6]. This also connects to the cognitive barrier of considering future developments and needs, not only for the specific project but also the broader area of Zwolle. Also, within the municipality a missing clear definition of how BGI is operationalized is hampering interorganizational communication [R3]. Besides the constraints of how to operationalize and transfer the concept of BGI into specific numbers, its network structure is a defined by its name. In Zwolle, various projects have been designed with the goal of contributing to a coherent blue and green infrastructure and yet, there are many links still to connect [R1, R2].

4.3. Dordrecht: Policy goals and mainstreaming strategies

4.3.1. Ambitions for a blue-green island

Due to the city's location and immediate vicinity to water (blue) and nature (green), climate adaptation has been high on Dordrecht's agenda [R8]. The city of Dordrecht is surrounded by rivers and the National Park Biesbosch. These valuable connections and historical green-blue structures are embraced, and the municipality strengthens them further. Hence, the *Environmental Vision Dordrecht 1.0* includes the goal to bring the Biesbosch to Dordrecht's residents door step (Gemeente Dordrecht, 2021a). This network of canals, parks, and dikes offers an opportunity to connect the front doors of the people of Dordrecht with the outlying area, the Biesbosch and the Dutch Delta. With the Dordwijk zone and the Wantijzone as the carriers of the network, it will contribute to climate adaptation. As front runner in the *Delta Plan for Spatial Adaptation*, Dordrecht aims to be climate-proof by 2035. In order to achieve this goal, the municipality is placing emphasis on increased retention of water and unsealing to revitalize the natural system of the area (ibidem). The *Groenblauwprogramma* elaborates on

this aim. Adaptation goals for the built environment concern the higher chance of extreme precipitation that cannot be processed in the sewer system and future impacts from sea level rise and a change in river runoff. The design of new and existing buildings, and their surroundings, therefore, must be adapted to these influences. This is worked out in programs, agreements and an environmental plan (Gemeente Dordrecht, 2021a).

Dordrecht's *Groenblauwprogramma* is a detailed action catalogue built on four main goals for 2030: Make Dordrecht an attractive city, a climate-proof city, a biodiverse city, and a healthy city. Blue and green structures are the lever of this strategy. Based on its smart and increased use, safe, accessible and multifunctional public space shall be created which meets the various needs and wishes of the residents. Through small structures such as tree-lined avenues and waterways connections to the surroundings of Dordrecht shall be created. The municipality aims to merge the blue and green spots into a strong, robust network. The underlying adaptive management and maintenance approach contributes to this realization (Gemeente Dordrecht & idverde Advies, 2021). The involvement of the residents of Dordrecht in all themes and scales is claimed essential. Moreover, the four separate goals require an integral approach to the outer areas of Dordrecht to realize the vision. Integral cooperation and coherence between ambitions is deemed necessary because the themes of attractiveness, climate resilience, biodiversity and health have many points of contact and can reinforce each other (ibidem). To be able to realize different ambitions, the municipality of Dordrecht uses an integrated internal working method. Thus, various "green" and "blue" experts must also be involved in the project preparation stage of spatial developments (Gemeente Dordrecht & idverde Advies, 2021). In a detailed *Spatial Vision Dordrecht* the concrete need for action is mapped out and a vulnerability analysis of the area is presented. Within this blue-green strategy four spatial adaptation measures are highlighted: The expansion of the tidal park, the strengthening of dike links and creeks and the realization of the Dordwijkpark (De Urbanisten, 2020).

The *Climate Adaptation Strategy of the Province of Zuid-Holland* was published 2019 and complemented by an *Provincial Implementation Agenda for Climate Adaptation* in 2021 (Provincie Zuid-Holland, 2021). The province utilizes strategic collaborations and a "green" task forces to put the climate adaptation theme on the regional agenda (ibidem).

4.3.2. Mainstreaming strategies

In the municipality of Dordrecht, the utilization of six different mainstreaming strategies can be found. *Add-on mainstreaming* is demonstrated in specific on-the-ground projects. A parking lot in the city-center was redesigned, replacing the sealed surfaces with green space. Similarly, the St. Nicolaasplein, a square in the city, was renewed, and additional green space was added to the area [R4]. The renewed area contributes positively to community and climate adaptation functions (Vermeulen, 2021). *Programmatic and managerial mainstreaming* happens also through program management in the city of Dordrecht [R7]. The municipality

set up an interdisciplinary "blue-green city task force" in 2016 when the Interreg BEGIN project was launched. Along with communication experts, a variety of experts from the municipality, urban development and city maintenance joined the team to create spatial designs and plans for a blue-green city (City of Dordrecht & Bax & Company, n.d.). The municipality created a program called "green-blue Dordrecht" which encompasses a mix of disciplines such as biodiversity and nature conservation as well as water and sewage. The program focus changes with the political decision-making in four-year cycles [R4]. A program director oversees it, and in representation of the departments program managers joined the team. The purpose of the program is to introduce new subjects and spread knowledge among the program managers, who then coordinate and develop implications for their departments accordingly [R4]. In a mix of *programmatic and directed mainstreaming*, the municipal staff is educated on the climate issue and conducts trainings.

Strong *inter- and intraorganizational* mainstreaming can be found in one of the major green-blue infrastructure projects in Dordrecht, the "Stadspark XXL". Here the municipality cooperates not only with the water board but also the "Stadbosbeheer" (the Dutch governmental organization for forestry and the management of nature reserves) is a constant partner [R5]. As a focal point for the BEGIN project, this project has arisen international attention and associated learnings are shared in an interdisciplinary team (City of Dordrecht & Bax & Company, n.d.). In order to share knowledge and exchange ideas, the municipality also enables interorganizational cooperation with citizen initiatives and interested residents. Mainly the knowledge exchange starts within the municipality, as an intraorganizational workshop and then is opened for the public [R5]. A close link between the traffic department and the urban design team also exists on the topic of blue-green infrastructure [R5]. Additionally, the municipality of Dordrecht is member of 'KANS', a climate adaptation network for Dutch cities [R4]. The network is a think tank and exchange platform of 20 cities which cooperate in the field of spatial climate adaptation. Mutual conversation and knowledge exchange are base of KANS (KANS, n.d.). Dordrecht is also a partner city in the City Deal, an initiative founded and financed by the national government [R4]. The City Deal on Climate Adaptation is a collaboration agreement between public and private partners who learn from each other's experiments and innovations (City Deal, n.d.). Within this decentral managed organization, Dordrecht is participating in the "Nature-based solution"-theme (City Deal, 2016). An open workspace, the SPUILAB 210, was created to foster knowledge exchange on blue-green infrastructure by hosting external organizations with expertise in the field (City of Dordrecht & Bax & Company, n.d.).

Some formal polices play an important role in the climate-adaptation endeavor. *Regulatory mainstreaming* manifests itself in these policies. Every interference in the public space and the built environment underlies the premises of integrating more blue-green infrastructure and contribute to a climate-adaptive city [R5]. These measures include i.a. green facades and green roofs. In Dordrecht and the region of Zuid-Holland, a building covenant "Natuurvriendelijke bouwen" regulates which statutes apply for climate adaptation

measures such as water storage and greening the city [R4]. Mal- or non-adaptation is not linked to any fines, but the building permit can be refused by the commission [R5]. In addition, the municipality is working on a city-wide obligatory regulation which will require all redevelopment projects to dedicate a pre-determined number of square meters to green structures and specifications for water retention / storage [R8].

4.3.3. Mainstreaming barriers in Dordrecht

Cognitive barriers

The uncertainty of the effects of climate change are challenging the integration of concrete measures. Extrapolating the most recent heavy rainfall events, the needed capacity to fully adapt seems intangible [R4]. With changing climatic conditions, predictions for the time span of 30 to 40 years are difficult to make today [R4].

Organizational & institutional barriers

For the designing and implementation of local and regional planning projects, the municipality is not the only responsible and determinant organization involved. The water boards have a stake in especially water-body-related and regional developments and projects [R4]. Having a long history in planning for water safety with a technocratic approach, vested interests within the organization impede the adaptation of new concepts. The "Hollandse Delta", the water board for the region of Zuid-Holland and responsible for the area of Dordrecht, is also a traditional organization for which *"it takes a lot of effort to change their minds"* [R4]. Also, within the municipality and the blue-green network program, interests collide [R4]. So does the maintenance department not approve of the innovative approach of BGI and prefers "*to maintain what we have*" [R8]. The lacking willingness to reconsider institutional routines impacts the mainstreaming efforts (Biesbroek et al., 2011). Since mainstreaming highly depends on the willingness to promote climate adaptation, this creates a major institutional barrier (Runhaar et al., 2018). Another example of conflicting interests is the *Wantij Zone*, a redevelopment project which transformed the riverside into a freshwater tidal park increasing the recreational value and adding to the climate-resilient city (City of Dordrecht & Bax & Company, n.d.). Within the project scope parts of existing natural ecosystems must give way for the water. This led to a clash of interests regarding the kind of nature and environment that the municipality envisioned within the blue-green infrastructure program [R4].

Unassigned clear responsibilities for BGI within the different policy domains and missing connections to their departments' core task is stopping BGI at the municipality of Dordrecht [R7]. The lack of problem ownership cannot be closed by the program team itself. Furthermore, the dedicated BGI taskforce was not assigned a R&D budget but no financial support for the execution of projects. Therefore, the team members became fundraisers for

BGI, searching for possible connections with the departments to generate and combine their financial resources [R7].

On a national, as well on the local level, competing priorities have noticeable effects on the mainstreaming of BGI. The main conflict of primacies is between the housing and BGI, representing the two biggest challenges, the Netherlands are facing: A housing crisis, which asks for the building of additional 845.000 homes by 2030 to meet the national demand (Lalor, 2022) and the effects of climate change in a densely populated country. Also on Dordrecht's agenda, there are plans to build 10.000 new houses in the city. And at the moment "*building is a bit more important than climate adaptation*" [R4]. The statement of respondent 5, urban designer, does not agree with this. To them, one challenge appears to be taken as serios as the other. Adapting to climate change requires a long-term vision and long planning horizons. While the water management and infrastructure sector in Dordrecht are familiar with planning ahead for up to 70 years, the strategic management of the municipality, which is also driven by political interests, underestimates this long-term perspective [R4].

Social & political barriers

The above-mentioned *Wantij Zone* project also demonstrates the political barriers on a project level. Whether the municipality promotes water safety and climate adaptation, or the flora and fauna is ultimately dependent on the political decision-makers and the public discourse with local initiatives [R4]. Within the municipality, a missing sense of urgency and some resistance in the maintenance department occurred, blocking the implementation of specific on-the-ground BGI projects [R8].

Resource availability barriers

The associated costs for maintenance of BGI are much higher than compared to what the municipality of Dordrecht used to spent on maintenance [R5]. Therefore, the urban design team must translate and adjust their designs according to the financial capacities of the maintenance department [R5]. With regard to rising price levels of commodities, already the upkeep of existing green and blue areas is a challenge. Extrapolating these expenses to *"making climate adaptation a normal way of working"*, financial resources for maintenance will become a major barrier of the BGI mainstreaming [R4]. For another building project in Dordrecht the additional costs for BGI implications were difficult to calculate and considered a costly endeavor [R8].

In recent years stress tests were conducted in every municipality within the Netherlands in order to assess the vulnerability of the city to climate change impacts (Ministry of Infrastructure and Water Management et al., 2020a). After having conducted the stress tests, risk maps were developed. In a next step, the municipality of Dordrecht created a plan with concrete, local measures, but the financing for these measures has not yet been approved by the local government [R4]. As a third resource space is scarce. Because of the limited

availability and other land-uses, integrating BGI into the built environment is a challenge [R5]. In addition, the importance of private landowners in the blue-green net must be highlighted, as their properties are valuable contributions to it [R7].

BGI-related barriers

The above-mentioned maintenance costs are a barrier which is directly linked to BGI. A lot of BGI pilot projects have been developed in Dordrecht, the two most famous have been mentioned already: The Stadspark XXL and the Wantij Zone. Still, creating the network which connects the single BGI spots around the city remains a barrier [R5]. The functionality of BGI measures and associated maintenance challenges raised concerns for some members of the maintenance team [R8].

Time barriers

While new developments provide opportunities to integrate BGI, ongoing projects are difficult to redesign [R5]. Therefore, big projects in Dordrecht, which were initiated 10-20 years ago and are being implemented these days are less conform with BGI demands and climate adaptation [R5]. Another time barrier concerns the duration and continuation of the BGI program within the municipality which is dependent on the political priorities within the municipality and hence might only be temporary [R7]. Since the program team functions as mediator and promoter of BGI, institutional learning and awareness are among their goals. The duration of the program therefore is crucial as reaching this goal takes time [R7]. Demonstrating the feasibility of BGI within small-scale pilot projects to evaluate its long-term functionality poses time constraints on the implementation of associated upscaled projects [R8].

4.4. Mechanisms to overcome mainstreaming barriers

Both cases, Zwolle and Dordrecht, are employing all six vertical and horizontal mainstreaming strategies. Nevertheless, the integration of BGI into local spatial planning and water management is hindered by a set of cognitive, organizational / institutional, social / political, BGI-related, resource-related and time barriers. In the two cases, barriers of all categories appeared throughout the policy process. Based on the similarity and consistency of the occurred barriers across cases, the following section presents the various approaches of overcoming the mainstreaming barriers in a cross-case manner. In total, four main mechanisms could be identified: the synergy exploitation mechanism, the organizational learning mechanism, the policy entrepreneur mechanism, and the funding mechanism. They are described in more detail in the following paragraphs.

Synergy exploitation mechanism

BGI as a multifunctional solution for spatial climate adaptation requires an integrated approach of multiple disciplines (e.g., water management and spatial planning).

Collaboration is the key to such an integrated approach [R2]. Therefore, it is worthwhile to build knowledge within the organization on how to collaborate and exploit synergies [R7]. Making use of local knowledge can also contribute to more comprehensive solutions and enhanced spatial quality (Busscher et al., 2019). Area re-development and renewal projects are often used as opportunity for BGI integration. Two examples from Zwolle and Dordrecht illustrate this: In the *Wielwijk*, Dordrecht, a neighborhood was redeveloped due to its increased decay. During the re-designing process new space for green was integrated into the area which also added value to the surrounding real estate [R5]. The *Pannekoekedijk* in Zwolle was an infrastructure renewal project, which employed the embedding of multiple stakes and their financial resources. Instead of solely renewing the dike area, synergies with the infrastructure and water management sector were created, which in the end also led to financially more efficient results [R2, R5]. The BGI taskforce in Dordrecht utilizes a multi-annual-programming tool to collect and map city-wide ambitions [R8]. These ambitions include renewal projects and area (re-)development. The interactive map allows the municipality to discover opportunities for joint efforts and brings the various stakes together: e.g., when the need for maintenance or renewal of the sewage arises, possibilities for the integration of BGI measures are considered (Gemeente Dordrecht, 2021b). The tool is coordinated by a program committee and enhances the creation and exploitation of windows of opportunity [R8]. Another tool, the "green benefit planner", translates the co-benefits of BGI into monetary values by estimating its impact per sector [R8]. These two tools are an aid for locating opportunities of synergy exploitation.

Organizational learning mechanism

"Learning and action alliances" promote interorganizational learning and bundle knowledge inside the organization. This in the end provides potential to smoothen follow-up projects [R5]. Thus, most colleagues are educated on climate change impacts and develop a solicitude which leads to a feeling of responsibility [R4]. By increasing organizational flexibility and "*going more out of the comfort zone for each of the responsibilities*" a collaborative responsibility can be created [R1]. In the case of Zwolle and Dordrecht, urban designers were described as mediators and moderators [R5, R6]. Urban designers were named as key players in helping to translate the policy into practice [R6]. Within their role, moderators coordinate through the multitude of different, partially opposing interests of the departments. Such an integration across multiple sectors impacts consistency of the policy and consequently also affects the degree of resilience reached (Davoudi, 2009). Thus, designers do not only produce designs but function as advocates for spatial integration. This is especially valuable with regard to BGI because the concept builds on multi-functionality. Structuring the municipal institution as a research and development organization facilitated interdisciplinary learning. Hence, a well-developed inter- and intraorganizational learning network fosters knowledge generation and reduces uncertainties and understanding barriers [R7, R8].

> *"Raise awareness and give people capacities and skills to do it themselves."* [R7]

No further need for an internal taskforce will be the result of successful mainstreaming because the integration of BGI in the daily planning routine would have been reached [R7]. Local knowledge and familiarity with the place which is facing an adaptation helps overcoming cognitive barriers [R3]. Creating a sense of place emphasizes qualities that distinguish a specific place from any other and highlights its uniqueness (Foote & Azaryahu, 2009). According to respondent 3, a sense of place facilitates the translation of broad concepts into concrete policies. By envisioning consequences of non-implementation of these policies and therefore non-adaptation in the city, designing tangible on-the-ground projects is facilitated.

Policy entrepreneur mechanism

Respondents 1,2 & 3 mention the importance of strong characters inside the municipality as a major contribution to overcoming mainstreaming barriers. Here it can be differentiated between two types of actors: policy entrepreneurs and moderators play an important role for mainstreaming. While the alderman in Zwolle showed high levels of commitment, in both cities also the role of the urban designer in this specific context of spatial adaptation was mentioned. The alderman, clearly a policy entrepreneur, started his journey in Zwolle around the same time when the *Delta Plan of Spatial Adaptation*, a policy document comprising all crucial measures to make the Netherlands water-resilient and climate-proof, was published [R1, R2]. The ambition of the city to become the front-runner in the region was also an influential precondition [R1]. The alderman recognized the political window of opportunity and started to open and expand it. Most policy entrepreneurs have a good reputation, networking skills and are willing to invest resources for their cause (Huitema & Meijerink, 2010). In Zwolle, such a policy entrepreneur, the alderman, was present [R1, R3]. Incentives from the national government such as hosting the *NOVI* project granted additional political and social support [R1].

Financing mechanism

Financial barriers are one of the main obstacles for BGI mainstreaming in the planning and implementation phase. In both cases, the respondents mentioned multiple attempts of generating project-specific funding for the implementation of BGI within their cities. Attracting funding from the national and European level through the participation in projects like the Interreg or *NOVI* are great opportunities to overcome financial constraints [R7, R8]. However, relying on these funding structures creates a high dependency on the funder and their approval of proposed projects. Within the municipality of Dordrecht, an innovation risk budget was set up in order to test BGI in pilot projects and to gain trust of hesitant stakeholders [R8]. Money from this fund is used in case a "innovative BGI idea" fails to fulfill its purpose over time. In that case, the budget is used to "replace it with a more

traditional solution" [R8]. This mechanism is closely related to the synergy exploitation mechanism which offers additional opportunities for funding, since the combination of project goals can also reduce the overall costs [R5].

5. Discussion: Successfully mainstreaming BGI

According to the research aims, this study explored the question: **How can municipalities successfully overcome barriers of mainstreaming blue-green infrastructure to become climate-resilient?** To answer this question, the main research question was divided into four sub-questions (SQ) which will subsequently be answered in this chapter.

SQ1: *What does "mainstreaming BGI" entail and which barriers are connected to it?*

In literature, no common understanding of mainstreaming exists (Brouwer et al., 2013). Still the theoretical framework describes policy mainstreaming based on Klein et al. (2007) as an resource efficient integration of policies in ongoing activities. Although the dissolution and perishing of non-independent policies is discussed in theory, the potential of mainstreaming for a sustainable transition towards resilient cities is also highlighted. By adapting the vertical and horizontal perspectives of policy integration, it can be distinguished between six strategies for mainstreaming. Three vertical approaches: add-on, programmatic and inter-/ intra-organizational mainstreaming, and three horizontal approaches: managerial, regulatory and directive mainstreaming. Barriers impact this performance. Based on the theoretical framework, six types of barriers were investigated in the case areas: (1) cognitive barriers revolving around the sense of urgency and awareness, (2) organizational and institutional barriers describing internal and external knowledge exchange and cooperation, (3) social and political barriers which refer to political commitment and public support, (4) resource availability concerning human and financial capital, (5) BGI-related barriers which are tailored to the physical requirements or vague definition of the concept, and finally (6) time barriers like missing windows of opportunities.

SQ2: Which are the current policies for the mainstreaming of BGI in the Netherlands?

The policy document analysis indicated that climate change is a relevant factor on national, regional and local level, across water management, spatial planning and environmental visions and strategies. While the *National Climate Adaptation Strategy* points loosely towards blue and green in the city, it indicates the need for crossovers, and hence synergies and collaboration. The *NAS Implementation Strategy* accordingly does not mention blue and green, yet it declares climate adaptation a provincial task. This strong confidence in regional structures and the delegation of responsibilities on largely autonomous governmental bodies is ubiquitous in the Netherlands. Its hybrid or polycentric governance system has evolved over centuries, combining decentralization with much sovereignty (Pahl-Wostl, 2019). The *NOVI* promotes "nature-inclusive development of urban regions and nature-inclusive building" (Ministry of the Interior and Kingdom Relations, 2020, p. 123). While the focus lies with climate change and the increase of blue and green in the urban areas in the national policies, the province of Overijssel and Zuid-Holland concretely refer to the use of the BGI concept and map its benefits for their region. As responsible governmental body for larger

regions, the policy documents referred to the municipalities as the planning and executing body (Lienden et al., 2021; Provincie Zuid-Holland, 2019).

Whereas in Dordrecht the focus lies on the large-scale development of a city park and associated greening of neighborhoods as well as a tidal park, Zwolle emphasizes area redevelopment and innovative small-scale projects always keeping the impact on the region in mind. Zwolle makes use of a threefold area-based principle which focuses on the street, the neighborhood and the regional level (Dolman et al., 2019b). In order to not only improve the climate resilience locally but to create synergies within the broader landscape. In Dordrecht the principle of BGI is made a central concept, which is also reflected in the identity of the city. The network character is highlighted and the surrounding large natural areas are invited to the city (Gemeente Dordrecht & idverde Advies, 2021). Although the two cities are both aiming for the same goals such as increased climate resilience and water robustness, the reduction of the heat island effect and enhanced biodiversity, they frame their approach differently.

Nevertheless, it can be summarized that the two case studies are embedded in a national, regional and municipal policy net, which is broad on the national level, specific on the regional and precise on the local level.

SQ3: Which strategies are employed to mainstream BGI in Zwolle and Dordrecht and which barriers have occurred during the process?

In both cities, vertical as well as horizontal mainstreaming was employed. Specific on the ground BGI pilot projects are implemented in Zwolle and Dordrecht. Additional both municipalities have published a blue-green programme with future visions and goals for their municipality. Besides the *add-on mainstreaming*, a *programmatic mainstreaming* can be found in the program structure which has been implemented and is focusing on BGI. Since both municipalities participate in an Interreg project (CATCH in Zwolle and BEGIN in Dordrecht) and they also joined the national knowledge exchange network on climate adaptation, the *City Deal.* This *interorganizational mainstreaming* is complemented by several external knowledge partners, consultants and other experts in the field of BGI. Also, the provinces Overijssel (Zwolle) and Zuid-Holland (Dordrecht) and the regional water boards are constant partners in this regard. The *intraorganizational mainstreaming* manifests itself in the programmes and the project groups that were created. Among the vertical types of mainstreaming, both cases make use of *regulatory* strategies by employing a regulation which asks every new development to integrate BGI. Directed and managerial mainstreaming was not used in Dordrecht, but some weak links can be found in Zwolle. *Directed mainstreaming* is shown in educational trainings and a clear task division. Further, additional spatial advisors were hired at the municipality of Zwolle, indicating *managerial mainstreaming*.

Throughout the policy process indicators of all six barriers could be found in Zwolle. No time barriers were found in Dordrecht.

SQ4: Which mechanisms were used to facilitate overcoming barriers of mainstreaming BGI?

The *exploitation of synergies* is highlighted in both case study areas. Building knowledge and spreading awareness in order to collaborate across sectors and make use of windows of opportunity. Since BGI is designed as a multi-functional concept, it offers links to various sectors. By combining sectoral goals and exploiting synergies also the financial burden can be equally shared. Also, *organizational learning* facilitates overcoming cognitive and organizational barriers. Moderators who bundle responsibility and problem ownership are a key component for the successful coordination of conflicting interests. With their help inter-organizational learning can also be enhanced and local knowledge can be generated. The *policy entrepreneur* mechanism is similar to the employing of moderators dependent on the willingness and commitment to change the current status quo. The policy entrepreneur is actively engaging in the policy process and enhances the political support for policy mainstreaming. Networking skills and resource investments are the main characteristics of a policy entrepreneur (Huitema & Meijerink, 2010). This mechanism cannot randomly be applied since not every municipality has a highly ambitious member that is willing to step in and create windows of opportunities. The last mechanism concerns *financing*. Municipalities can attract European or national funding to carry out pilot projects, such as the case study cities Zwolle and Dordrecht, but also an internal innovation risk budget supports the mainstreaming of BGI. This budget is intended to increase the confidence in innovative BGI projects while also preparing for drawbacks of these projects. The synergy exploitation mechanism is also closely linked to the funding since the combination of project goals can also reduce the overall costs.

It must be noted that not all mechanisms can be applied at the same time in every institutional setting, but that they are context dependent. In the cases of Zwolle and Dordrecht also not the whole set of mechanisms was employed. The mechanisms have been conceptualized based on solutions mentioned during the interviews and must be scrutinized.

6. Conclusion

This chapter concludes the findings of this research. Also, implications for planning practice are elaborated, the limits of this research are described and an outlook on further research is given.

6.1. Answering the main research question

The influences of climate change are becoming increasingly noticeable and pressure the urban environment. Therefore, many cities are aiming to become climate resilient. Policies for BGI are proposed as an attempt to move closer to this aim. However, the complexity of this objective requires new integrated approaches and policy mainstreaming of BGI. Therefore, mainstreaming strategies for BGI and associated barriers where identified which influence successful mainstreaming. Also mainstreaming is widely researched, little is known about mechanisms to overcome barriers within the policy process. This study addressed this knowledge gap by exploring mechanisms to overcome the multiple obstacles of mainstreaming BGI into spatial planning and water management, asking: **How can municipalities successfully overcome barriers of mainstreaming blue-green infrastructure to become climate-resilient?**

A qualitative research strategy was applied to investigate the integration of BGI in the two Dutch municipalities of Zwolle and Dordrecht. The cities both apply a combination of horizontal (add-on, programmatic, inter-/ intra-organizational) and vertical (managerial, directive and regulatory) mainstreaming. The presence of vertical mainstreaming within the municipality cannot be denied, still it is less pronounced than horizontal mainstreaming. Visions and strategies on the national level incorporate climate adaptation measures and emphasize the benefits and importance of increased blue and green structures for urban areas. Reduced heat stress, enhanced quality of life, health impacts and water retention capacities are logically linked with it. Also, the provinces are actively promoting climate adaptation and the need for more BGI in both cases. The provincial policy documents assign the responsibilities for integrating BGI to the municipal level (Lienden et al., 2021; Provincie Zuid-Holland, 2021). The long history of water management in the Netherlands and the polycentric governance system of the Netherlands are supportive conditions for the mainstreaming endeavors. However, data retrieved from in total eight interviews with civil servants and external experts in the case study areas of Zwolle and Dordrecht emphasize that multiple barriers impede the integration of BGI, also with regard to its implementation. The uncertainty of climate change and the translation of vaguely proposed policies on national and regional into local measures is hampering the mainstreaming from a cognitive perspective (Runhaar et al., 2018). Although the Netherlands are undergoing a paradigm shift from “fighting the water” to “living with the water”(Restemeyer et al., 2017), the integration of spatial planning and water management is still in its infancy. Silo attitudes as

the main institutional barrier for mainstreaming BGI underline the need for stronger collaboration and knowledge exchange. Lacking problem ownership also hampers mainstreaming (Runhaar et al., 2018). Within both municipalities lacking problem ownership mainly resulted from the fact that the climate adaptation programs themselves are sole research and development entities and do not command their own budget. Since the implementing actors then differ from the planning and managing actors and because of the nature of the climate change problem itself, the problem ownership is difficult to assign. Although Zwolle and Dordrecht consider themselves frontrunner in climate adaptation and water management, traditional approaches of technical solutions are still dominant in practice. Competing interests in the political sphere, like the pressing housing crisis, can be a major barrier for mainstreaming efforts, as other concerns attract more attention. Resource availability is the limiting factor when it comes to the implementation of BGI. All respondents referred to the lack of or constant search for financing BGI projects. Especially for BGI additional barriers like design challenges and the scope, cost and responsibility for maintenance connected to BGI are having an impact on its mainstreaming.

This research shows that there are multiple ways of navigating through the limited scope of action when encountering obstacles. Four mechanisms for coping with mainstreaming barriers of BGI have been found in the research cases of Zwolle and Dordrecht: the synergy exploitation mechanism, the organizational learning mechanism, the policy entrepreneur mechanism, and the funding mechanism.

6.2. Implications and recommendations for planning practice

As this thesis dived into the multitude of strategies and possible constraints for mainstreaming, this section briefly outlines some of the most striking implications for planning theory and recommendations for practice.

With this study, the researcher hoped to identify lessons for mid-sized municipalities in the Netherlands and beyond in order to further enhance the understanding of the obstacles of mainstreaming. The thesis provides insights into the operationalizing of policy mainstreaming and its feasibility and relevance for climate adaptation and climate resilience. Compared to previous research on mainstreaming drivers and enabling conditions, the investigation of barriers and supporting mechanisms are at the core of this thesis. What makes this research stand out from others in the field is the utilization of a concrete climate adaptation policy, the integration of BGI, instead of exploring climate adaptation in general. Like this, it synthesizes research contributions from O'Donnell et al. (2021), Uittenbroek (2014) and Henderson et al. (2022). Moreover, the study adds value to mainstreaming literature, as it tested existing theory on mainstreaming strategies. Thereby, the results provide further insights into possible ways of coping with the obstacles of mainstreamed policy integration. The thesis contributed to closing the research gap identified by Liao et al.

(2017), by generating a theoretical understanding and empirical knowledge which helps to tackle the barriers of BGI implementation.

The thesis provides municipalities which are aiming at mainstreaming BGI with an understanding of possible barriers which can hamper this endeavor. The enabling mechanisms of overcoming the barriers and advancing BGI mainstreaming as presented in chapter 4.4 provide a guide for practitioners. For overcoming the barriers of mainstreaming in their municipality the following recommendations are proposed: The initiation of a "blue-green" founding scheme which can function as a risk innovation fund and provides resources for pilot projects, whenever no external funding is available. To ensure the efficient use of financial resources the exploitation of windows of opportunity is crucial. These can be managed with a collaborative mapping tool as mentioned above. Making use of mediators and policy entrepreneurs is a starting point for a more integral approach and grants a specific degree of knowledge building and political support. Vertical alignment of BGI policies along the different governmental also enhances political support.

6.3. Reflection and limitations

Like any research, this thesis comes with some limitations. Hence, a few reflections on the content are deemed important. First of all, the focus of the case study selection, the cities of Zwolle and Dordrecht in the Netherlands, are limiting the findings to a national and local context. Instead of generalizing, they results must be interpreted against this background. Still, ideas about BGI policies and enabling mechanisms for mainstreaming can be derived from this research and other cities can learn from Zwolle and Dordrecht by sticking to successful BGI mainstreaming strategies and avoid unnecessary efforts or previous made mistakes.

Further, some limitations with regard to the data collection and analysis occurred. The results rely on a small number of interviews and the interviewees "framing of their experiences" can bias the findings (Cope & Kurtz, 2016, p. 662). Although the semi-structured way of interviewing provides great flexibility and allows to explore new perspectives and insights, it also impacts the validity of the data regarding comparability. Semi-structured interviews allow for more diverse outcomes than structured interviews or questionnaires. However, by applying data triangulation, most inconsistencies should be resolved. Although the interviews intentionally focused on the municipalities, interviews with the province and water boards as partner in the blue-green network were not conducted. Especially with regard to the problem ownership discussed as an indicator for an institutional barrier, these interviews could have added value to the findings. Moreover, the empirically identified barriers rely on the perception and memory of the interviewees. Although four interviews with different actors from inside and outside the municipality were conducted per case, the barriers might not be complete and therefore only represent the most prominent barriers at the moment of the inquiry. Due to the scope of the research, the

total number of interviews was reduced to four per case. The amount of time and effort collecting data in a foreign language was underestimated. Also, small language barriers during the interviews consumed additional time and effort to manage but do not affect the quality of the results.

Reflecting on the thesis, some personal constraints must be mentioned: Only having held a few interviews with fellow students before, the conduction of semi-structured interviews required some practice. Finding a way of introducing the theoretical topic and staying focused on the core issues while allowing for wide, open answers was the main challenge. By the end of the data collection, the researcher had advanced her interviewing skills. To end on a positive note, the expert interviews were very engaging, and it is outstanding that although the interviews were held in English, eight interview partners volunteered to answer the provided questions. This thesis fueled the researcher's interest in the implementation of blue-green infrastructure projects and the long-term contribution to climate adaptation as a consecutive step. It lets her reflect on an intense research process and leaves her excited to see the two cities becoming as blue and green as their strategies propose.

6.4. Further research needs

The thesis provides a first exploration of mechanism which enable the mainstreaming of BGI in public (re-)development projects. Yet, the findings of this study provide input for further research. The identified mechanisms rely on two cases only. As indicated in the discussion, the ambitions and perceived urgency for change within the two cases stems from a long history of water safety in the Netherlands in general and the vulnerability to flooding due to their geographical location in particular. Whether the mechanisms also apply for other municipalities outside this context of the Netherlands must be investigated in further research. This will also support their generalization. Although no 'one-size-fits-all' approach to integrating BGI exists, elaborations on various country-backgrounds following a quantitative approach can further test the research outcome of this thesis. Moreover, it can be interesting to investigate how the barriers affect the mainstreaming strategies by conducting an adaptive pathway analysis. Since this thesis approached mainstreaming within the field of water management and spatial planning, its applicability for other policy fields presents potential for further research. Since the findings rely on the context of the Netherlands, future research should be conducted in other context to support or complement the findings of this thesis. With this regard, an investigation of further policy integration methods, such the dedicated approach, in comparison to mainstreaming can be discussed.

Based on the main constraint for the implementation phase of BGI policies, further research on funding and financing tools and supportive asset management approaches is needed. To further reflect on time barriers, the whole policy process of a BGI policy should be investigated in a long-term study. This will also allow for more precise conclusions on possible impacts of single mainstreaming approaches as they might iteratively have been

build up on each other. Policy entrepreneurs and mediators have been identified as important support for overcoming the institutional barriers. Further research can focus on their role in mainstreaming and how different types of governance support mainstreaming efforts.

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Appendix A - Code book

Code Group	Code category	Code	Nr. of codes
Mainstreaming strategies	Add-on	Specific on-the-ground projects	6
		Additions to department's core objectives	/
		BGI as one of the objectives	1
	Programmatic	Modification of the implementing body's sector work	/
		Integrating BGI into on-the-ground operations, projects, programs	12
	Inter-/Intra-organizational	Cooperation with external experts	7
		Cooperation of departments	6
		Knowledge sharing and exchange	5
		Training for competence development	/
	Managerial	Job description and department change	1
		Modification of organizational management and working structures	3
		New configuration of sections/departments for addressing BGI	1
	Directed	Subsidies, topic-specific funding	1
		Promotion of new BGI-projects	/
		Directing responsibilities	2
	Regulatory	Changes of planning procedures	/
		Formal and informal plans, regulations, policy, and legislation	6
Mainstreaming barriers	Cognitive	Lack of awareness	3
		Uncertainty of the effects of climate change	5
		Low threshold of concern, no sense of urgency	2
	Organizational /institutional	Lacking leadership and guidance	3
		Dominant silo attitude	7
		Lacking long-term vision	3
		No legal obligation & lack of regulation	1
		Lack of communication/understanding due to topic-specific language	2
		Institutional inexperience	2
		Lacking willingness	1
		No problem ownership	6
		Vested interests	3
		High power imbalances	1
	Social/political	Competing priorities and missing policy consistency	7
		Competing policies and planning issues	4
		No sense of urgency	1
		Lacking public awareness and support	/
		Lack of political commitment	/
	Resource availability	Lack of financial resources	10
		Lack of available staff	4
	BGI-related barriers	Design and construction challenges	6
		Path-dependency	3
		Maintenance & performance challenges	2
		Unclear definition of BGI	6
		Ignoring multi-functionality and co-benefits	1
		Unavailability of space for BGI implementation*	2
		No connection to the green and blue system*	3
	Time	Waiting for the optimal moment	/

		Missing windows of opportunity	3
		Delays*	2
Overcoming barriers	Solutions indicated for coping with the emerged barriers, focus on successful approaches and learnings of failed endeavors		45

*This code was inductively coded (frequently mentioned aspects retrieved from the interview) and added to the deductive codes (based on the findings of the desk research)

Appendix B - Interview Guideline

Context interview

The interviewer briefly introduces herself, the context and aim of her research. The interviewee is informed about the duration of the interview and the exclusive utilization of the interview content for the aim of this research. The interviewer is informed about their possibility to withdraw from the interview at any time and choosing not to answer a posed question. When agreed on the conditions of the interview, the interviewee is asked for their permission to record the meeting. Any remaining organizational questions are clarified before the recording is started.

Introduction

- Can you tell me a little more about yourself: your professional background and current job?
- What are your current tasks and responsibilities with regard to climate adaptation in your city?

Mainstreaming

Agreements have been made in the Delta Plan for Spatial Adaptation, in which all government authorities have agreed that climate adaptation will be part of their policy by 2050. Also, municipalities have to take action. That is what "your city" does with its own city-wide adaptation strategy. One of the components is to become a blue-green city.

- On a strategic level: How do you work towards this goal? How is this managed at the moment?
- How do you make sure to involve all sectors and policy makers to bring forward the idea of blue green infrastructure as a means for climate adaptation?

Staying at the strategic level: I am investigating mainstreaming strategies for BGI – integration of BGI into urban development/urban renewal. We've already talked about the "blue green network", I'd like to dive deeper into how concrete policies were put forward.

- Were specific (pilot-)projects developed (add-on)?
- Would you say that your departments core work was modified? So that "on the ground" projects and programs were more related to blue-green infrastructure (programmatic)? Was it made the baseline of the department to always integrate BGI into every project?
- Were regulations introduced to "force" planning procedures to be more ecosystem-based? For example: was a regulation introduced to always include a green or blue aspect in every new planning project (regulatory)?

- Did you aim for departments to adjust their internal structure in order to make climate adaptation work? Like hiring someone who is "taking a look" at the operationalizing of the climate policy in every department (managerial)?
- Is there any topic-specific funding mechanism in place to promote the initiation of new blue green infrastructure projects or to educate staff on the topic (directed)?

Projects

- In which projects/context did you have to deal with BGI/ did you come across BGI?
- To what extent was BGI integrated in this project?
- Who made the decision to integrate BGI? Was this intrinsically motivated, based on a (signed) agreement, or enforced?
- Did you have to apply policy instruments to stimulate BGI integration? If so, which instruments were used? How did you perceive their effectiveness?

Barriers

- Unguided: Did any barriers come up? Any obstacles that were related to BGI?
- Guided: My research shows, that certain factors make it difficult to mainstream climate adaptation, especially ecosystem-based adaptation into policies. These might be of different kinds:
    - Lack of awareness and knowledge about adaptation measures (cognitive barriers)
    - Lack of (financial and personal) resources to implement adaptation measures
    - Social and political barriers such as policy inconsistencies and conflicting goals, no public support or lacking political commitment
    - Lacking "cooperation, coordination and joint decision-making on different levels, hindering any mainstreaming strategy" (organizational)
    - Timing, like waiting for the optimal moment
    - BGI-related issues: So technological barriers to implementing more BGI, or already the framing of what there is to be implemented can hinder mainstreaming

Overcoming mechanism

- And did these problems resolve themselves?
- How did you/your team deal with it?
- Why is the project nevertheless a success?

Closing

- What can other municipalities learn from the Zwolle/Dordrecht case, especially when handling all these constraints?
- What do you hope will happen in the next 5-10 years in terms of climate adaptation in Zwolle/Dordrecht? Is this goal achievable?
- Who else should I be interviewing to get the full picture of the policy mainstreaming process in Zwolle/Dordrecht?

Thank you for your time. I think I'm done, but do you have any questions, or do you like to add something?