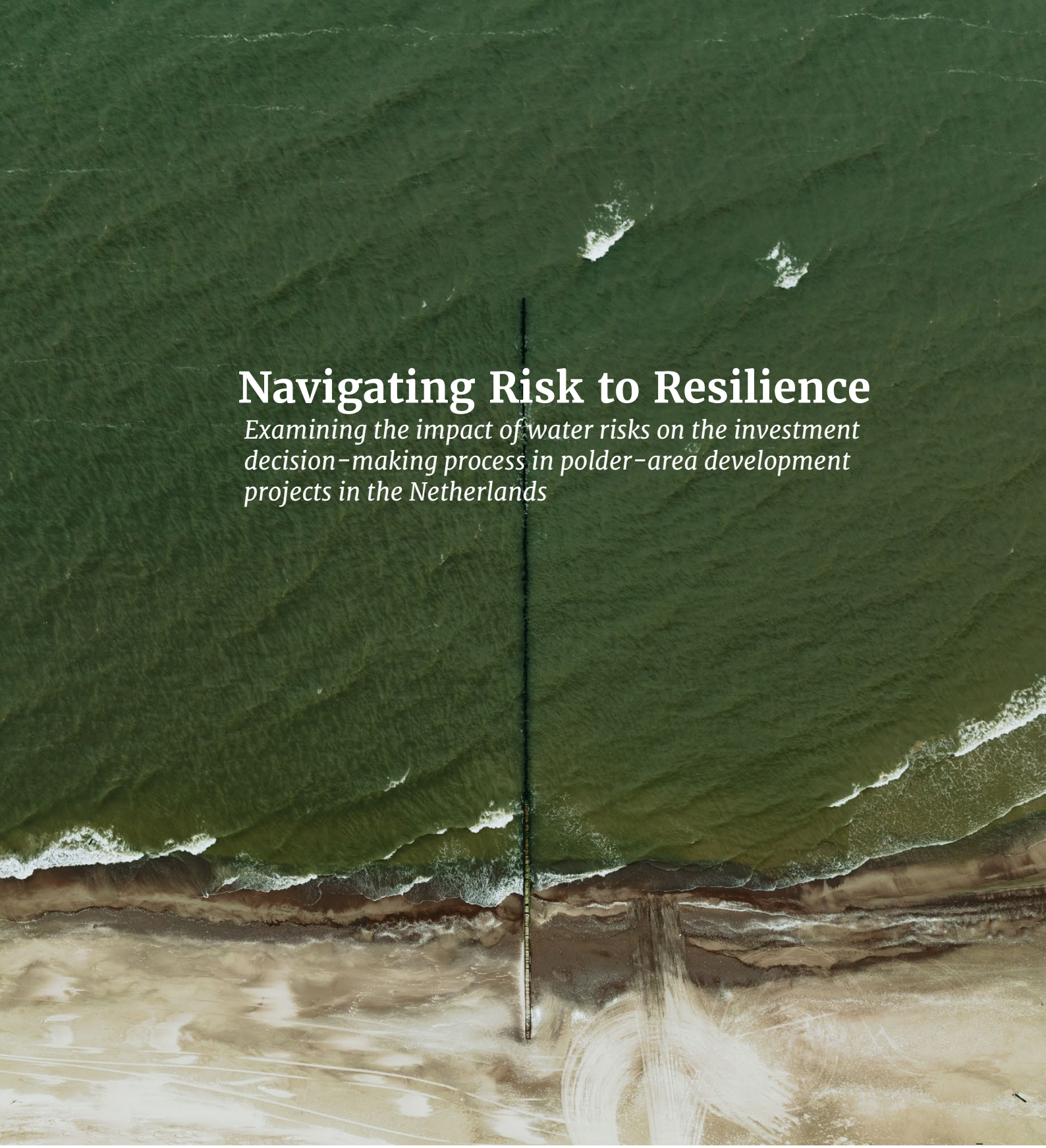

Navigating Risk to Resilience

Examining the impact of water risks on the investment decision-making process in polder-area development projects in the Netherlands

P5 | Daniël Zantinge

MSc Architecture, Urbanism and the Built Environment, track: Management in the Built Environment

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Colophon

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Abstract

In the coming years, the Netherlands is expected to face various climate change-related challenges. Until 2030, the Dutch government has set the goal for the development of nearly a million dwellings (De Jonge, 2022), whereby 600,000 dwellings are being carried out in areas prone to flooding (Deltares, Bosch Slabbers, & Sweco, 2021; Groenemeijer & van der Lelij, 2021). In literature, work has been done regarding the current use of adaptation pathways, policies and their impact on decision-makers and practitioners (Restemeyer, van den Brink, & Woltjer, 2017; van Alphen, Haasnoot, & Diermanse, 2022; Yousefpour & Hanewinkel, 2016). However, limited efforts have been made regarding their practicality in the real estate sector. This research seeks to address the fundamental question, "who pays what, when?". At its core, this research revolves around the influence of climate risks on the investment decision-making process in polder-area developments in the Netherlands and examines the research question: *"In which way do water risks impact the investment decision-making process in polder-area development projects in the Netherlands?"*. In this qualitative study, the urban area development projects Westergouwe (Gouda) and Gnephoek (Alphen aan den Rijn) are compared and analyzed. With the use of explorative interviews, and semi-structured in-depth interviews, the research strived to answer the research question. Afterward, an expert panel is held to bridge the gap to standard practice. This research found that the integration of adaptive measures into the investment decision-making process is currently insufficient. There is a need for clear policy, clear distribution of responsibilities and prioritization of water safety over financial considerations in the investment decision-making process. By navigating this complexity, driven by collaborative efforts, a holistic approach becomes imperative to forge a path toward a more resilient built environment.

Keywords: Climate adaptation, climate risk, water risk, water management, investment decision-making, public-private partnerships, polders, low-laying development, urban climate risk management, urban area development, real estate development.

Preface

Climate change has an emerging impact on us and the built environment. Students of the TU Delft are educated to bring innovation and devise solutions that enable us to live, work, and thrive better, both now and in the future. This research delves into a minute aspect of climate change: climate-adaptive urban area development in the low-lying regions of the Netherlands.

The solution lies in various small puzzle pieces that need to be assembled in the field of mitigating and adapting to climate change. However, a concrete example is lacking, and the solution can only emerge by laying each puzzle piece one by one. Just like any puzzle solver knows, it is best to start with the edges of the puzzle. These corner pieces form the foundation and framework within which the puzzle can be placed. One by one, the puzzle takes shape towards the center. The subsequent puzzle pieces are easier to place, thanks to the ones already in position. This research does not provide the ultimate solution. It is not the last puzzle piece needed; the entire puzzle is much more complex. Nevertheless, this research hopefully serves as a component of the climatological puzzle, making the next piece a bit easier to place.

Before delving deeper into this puzzle piece, I would like to express my gratitude to a few individuals for their (in)direct contributions to this graduation research. Firstly, I extend my thanks to Daan and Tim for their guidance from Fakton. Daan assisted me in initiating the topic and recognizing the urgent task related to climate adaptation. Tim provided invaluable assistance in navigating the process, sharpening the focus, and establishing priorities in my research. I also want to express my appreciation to my other colleagues at Fakton for their assistance, advice, and sometimes welcome distractions throughout this process.

In addition, I would like to express my gratitude to Ellen and Zac for their support throughout the graduation process. They consistently provided me with insightful feedback and challenged me on this subject. Furthermore, they offered essential expertise in the field of adaptation and finance.

Finally, I want to extend my thanks to my friends and family, especially Jolijn, and my roommates Job and Thijs, for their unwavering support. They patiently listened to me discuss this topic at length, provided sharp feedback or welcomed distractions, and served as a testing audience.

Many thanks.

Sincerely,

D.J. (Daniël) Zantinge
Delft, January 2024

Executive summary

The Netherlands is expected to face various climate change-related challenges in the coming years. The Dutch government has set the goal before 2030 to develop nearly a million dwellings, whereby 600,000 dwellings are being carried out in areas prone to flooding. These designated locations encompass a variety of risks, including low lying polders. The combination of climate change, low laying polders and housing demand results in a challenge of the effective implementation of climate adaptation measures. While polders offer promising opportunities for housing development, they necessitate the integration of climate adaptive measures to establish a livable environment. Following the research gap, limited efforts have been made regarding their practicality in the real estate sector. This research seeks to address the fundamental question: "who pays what, when?" and examines the research question:

> *In which way do water risks impact the investment decision-making process in polder-area development projects in the Netherlands?*

This research consists of two parts. The theoretical research focuses on a literature review, addressing water management, urban area development and the investment decision-making process. The empirical research comprises a multi-case study design, focusing on the developments in Westergouwe (Gouda) and Gnephoek (Alphen aan den Rijn).

Findings

Within the findings, the empirical research shows that end-users bear the costs of implemented measures or water risks, and therefore addresses the need for clear frameworks for mitigating risks or implementation measures. During both case studies, the decision-makers within the PPP pulled levers to steer on feasibility and incorporate climate adaptive measures, including decisions on housing density, construction speed, and public infrastructure quality. Both cases saw early PPP involvement with land ownership significantly affecting collaboration and investment choices. Private parties faced the risk of prolonged land speculation impacting area adaptability investments, raising the question whether development starts because it is a sensible place to build or due to land ownership. Also, the ministry's unusual personal involvement in decision-making highlighted a departure from typical procedures. This deviation hints at issues in the decision-making process and communication of established frameworks. Both municipalities had a large interest in the PPPs, with variable shares affecting their guidance levels in the projects. Conversely, water authorities maintained critical oversight roles in both projects, focusing on climate-adaptive designs and responsibilities but not directly contributing to measure designs.

Discussion

Responsibility

In water management, policies are primarily reactive, focusing on measures like barriers after climate events (Bogdan et al., 2022). At the national level, water management is coordinated, with responsibilities divided among Rijkswaterstaat, provinces, and water authorities. However, while responsibilities are clearly defined in the water management of the Netherlands, they become less clear in the context of urban area developments.

Ambiguity arises as municipalities can be part of PPPs, here the municipality plays a dual role as a financially driven private party and as a controlling public party (Heurkens, 2012). Therefore, a question that arises is whether ambitions for climate adaptation will consistently outweigh financial incentives throughout the process.

Risk
In contrast to the literature, Land Exploitation served as the primary tool for investment decision-making within the two case studies. The objective of the Land Exploitation is to achieve financial balance and introduce thereby risk for investments in climate-adaptive measures. The added value of these investments gets overshadowed by the discount rate applied in the land development plan.

Conclusion & recommendations

To answer the research question, water risks have an impact on the investment decision-making process in four ways:

1. Water risks demand successful implementation of climate-adaptive measures. The integration of climate-adaptive measures into the investment decision-making process is currently insufficient. Both public and private parties lack the necessary tools for guiding towards climate-adaptive development.
2. The Land Exploitation serves as primary and foremost evaluative tool for assessing climate-adaptive investment decisions. Climate adaptive investment decisions are therefore financially driven.
3. The dual positioning of the municipality complicates the investment decision-making process regarding the implementation of climate-adaptive measures and steers on these financially driven decisions.
4. Non-physical risks within polder-area developments have a large impact on the feasibility of the project, which hinders climate adaptive investments.

The prioritization of financial considerations over water safety in decision-making regarding construction locations is detrimental to both government and end-users. By navigating these complexities, driven by collaborative efforts, a holistic approach becomes imperative to forge a path toward a more resilient built environment.

This study provides a piece of the climatological puzzle, highlighting that the Netherlands can be kept high and dry if sufficient attention continues to be devoted to climate adaptation. During this research, attention has spurred other intriguing topics, including: the impact of climate events on real estate values, how to manage and finance climate-adaptive measures throughout the life cycle, assessing the impact of heat stress on investment decision-making, exploring funding opportunities for adaptation, and examining the pathway towards laws and regulations in the realm of climate adaptation. laws and regulations in the realm of climate adaptation.

List of Abbreviations

CAPEX	Capital Expenditures
CBA	Cost-benefit Analysis
CBW	Cost-benefit Water
DMP	Decision-making Process
EIA	Environmental Impact Assessment
GEM	Grondexploitatie Maatschappij
GREX	Grondexploitatie
LDC	Land Development Company
LLC	Life Cycle Costing
NAP	Normaal Amsterdams Peil
OPEX	Operating Expenditures
PAD	Polder-area developments
PPP	Public-Private partnership
VRO	Volkshuisvestering en Ruimtelijke Ordening (Ministerie)
VROM	Volkshuisvesting, Ruimtelijke Ordening en Milieu (Ministerie)

Contents

List of Figures

List of Tables

1. Introduction

On July 14, 2021, heavy rainfall combined with high water levels resulted in a river flood with significant social and physical repercussions for the province of Limburg, the Netherlands (NOS, 2021). The river discharge rates, and precipitation quantities observed during this event surpassed previous historical records (Jonkman, 2021). The estimated total economic damage caused by the flood ranged from 350 to 600 million euros. While the situation described pertains to a singular event, it is evident that the Netherlands is expected to face various climate change-related challenges such as rising sea levels, fluctuating water levels in rivers, prolonged drought, more extreme rainfall, and prolonged heat in the coming years (Deltares et al., 2021). The built environment in the Netherlands is not adequately prepared to withstand the impacts of climate change, and there is an urgent need to address the current vulnerabilities (Biesbroek, Klostermann, Termeer, & Kabat, 2013). A significant portion of the Netherlands consists of polders and low-laying areas below sea-level, especially on the western side of the Netherlands. In these low-lying polders, various issues arise due to the changing climate.

The urgency of this topic became relevant with the announcement of the Dutch government whereby the goal for 2030 is set to build 900,000 new dwellings (De Jonge, 2022). Due to the soil quality and the high population density (520 inhabitants per km2) of the Netherlands, construction options are limited (Deltares et al., 2021). In December 2021, it was announced in the coalition agreement that water and soil will be the leading factors in spatial planning (Harbers & Heijnen, 2022; Ministerie van Infrastructuur en Waterstaat, 2021). Nonetheless, according to a recent report, a significant proportion of these newbuild dwellings, approximately 600,000 dwellings (*Figure 1.1*), are being carried out in areas prone to flooding (Groenemeijer & van der Lelij, 2021). Moreover, construction is taking place in regions that are vulnerable to severe waterlogging. The dwellings are planned in areas characterized by the potential threat of flooding, without accounting for the anticipated impact of climate change that may lie ahead. As a potential solution, concurrent investment in climate adaptive measures at the front end of the construction of new residential projects have the potential to mitigate current and future disruptions and damages (Deltares et al., 2021).

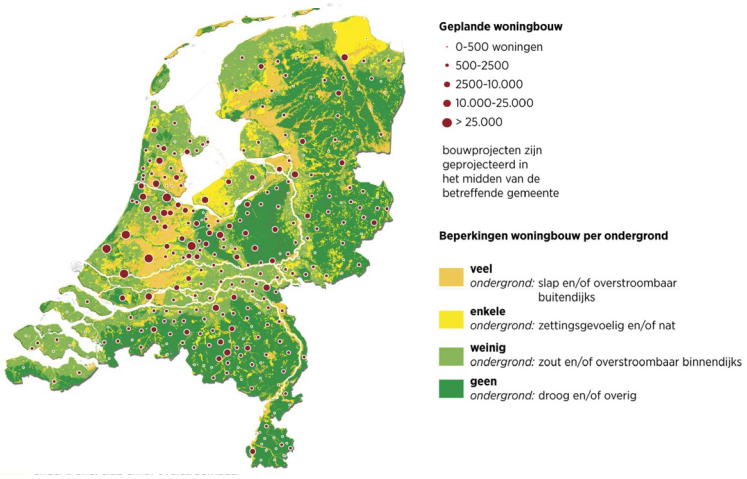


Figure 1.1. *Suitability of soil for construction with planned housing development until 2029 (Groenemeijer & van der Lelij, 2021).*

1.1. Problem statement

As mentioned, the urgency of implementing climate adaptation in an area of development in the Netherlands is clear. Within the context of urban area development in the Netherlands, several pertinent climate-related risks have come to the fore, particularly in the designated sites (*Figure 1.1*). These designated locations encompass a variety of risks, including low lying polders, areas with soft and compressible soils and regions situated beyond the protective confines of dikes. To facilitate the development of housing in these risk-prone areas, it becomes imperative to implement a suite of climate-adaptive measures. These measures are aimed at mitigating factors such as settlement susceptibility.

Figure 1.2 presents the problem statement of this research. The combination of climate change, low laying polders and housing demand results in a challenge of effective implementation of climate adaptation measures. Numerous studies have diligently mapped out the potential risks and costs of these climate-adaptive measures (Pauw et al., 2022; Singh, Ford, Ley, Bazaz, & Revi, 2020; Tall et al., 2021; Uittenbroek, Mees, Hegger, & Driessen, 2019). This sheds light on the known dimension of this multifaceted issue. However, the challenge lies in the implementation and financing of these adaptation measures in urban area developments (Javeed, 2023).

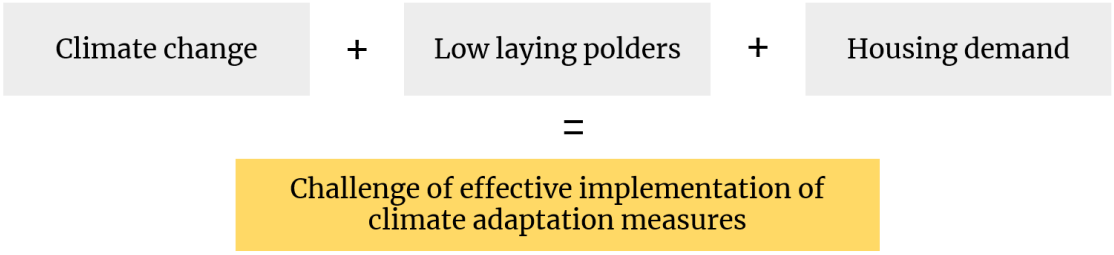


***Figure 1.2** Problem statement (author).*

The urgency surrounding the effective implementation of climate-adaptive measures is underscored by the mounting pressure on the housing market in the Netherlands, as outlined by Harbers and Heijnen (2022):

> *"We are increasingly reaching our limits now, due to intensive usage of land and climate change. By taking water into greater consideration, we can continue to live and work in the Netherlands in the future." – Minister Harbers*

This pressure continues to drive the demand for strategic and sustainable solutions. The risks addressed in the letter of van Kempen and Slootmaker (2021) is particularly pronounced in the Dutch polder landscapes.

The Dutch polders are typically sections of land that have been reclaimed from the sea (Cambridge Dictionary, n.d.). These low-lying areas are situated at or below sea level. To facilitate agriculture and housing construction, the polder regions are protected with secondary dikes and water management systems (Ministerie van Infrastructuur en Waterstaat, 2010). Particularly, the western side of the Netherlands is characterized by polder areas (*Figure 1.3*).

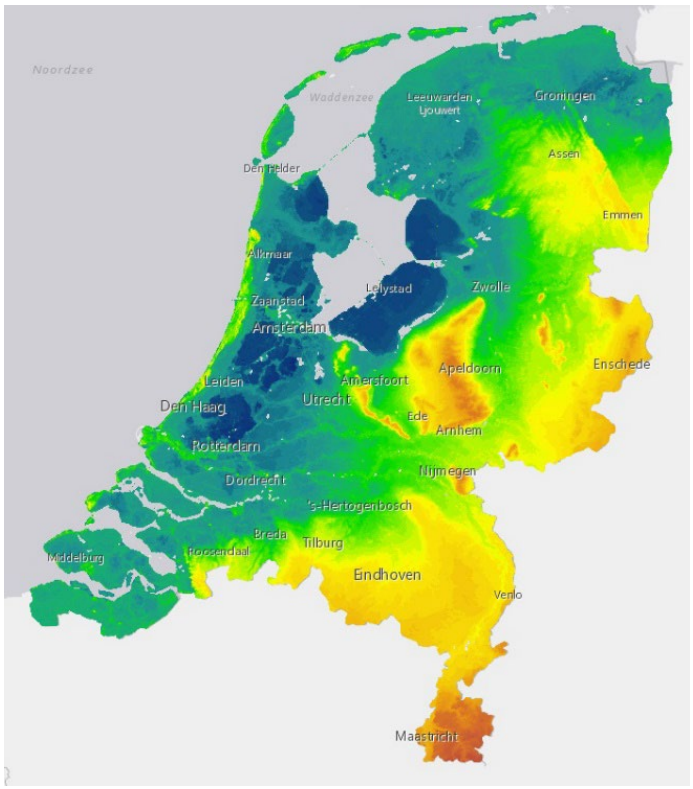


Figure 1.3. *Elevation Map of the Netherlands (AHN, n.d.)*

While polders offer promising opportunities for housing development, they simultaneously necessitate the integration of climate adaptive measures to establish a livable environment.

To comprehend the challenges associated with implementing climate adaptive measures, it is imperative to grasp the distinction between mitigation and adaptation. Adaptation efforts primarily focus on reducing vulnerabilities and improving coping mechanisms, while mitigation targets the root causes of environmental issues such as human intervention (Sharifi, 2021). Traditionally, climate change action plans drawn up by cities have tended to prioritize mitigation efforts (Grafakos, Trigg, Landauer, Chelleri, & Dhakal, 2019; Papa, Galderisi, Saretta, & Vigo Majello, 2015). This has resulted in an imbalance between the focus on adaptation and mitigation, whereby strategy plans for adaptation were often lagging and were less advanced (Ford, Dawson, Blythe, & Barr, 2018).

This trend was further noticeable in the Paris Agreement (2015) whereby mitigation has received greater attention, with specified targets outlined for mitigation measures. Adaptation measures, on the other hand, are lacking in clarification (Dovie, 2019). In addition, in early 2023, the IPCC (2023) published a new report titled 'AR6 Synthesis Report: Climate change 2023', which provides insights into projected climate changes and objectives. The report covers both mitigation and adaptation strategies. However, it is noteworthy that the report primarily focuses on the achievements and progress made in mitigation efforts, rather than highlighting adaptation measures with the same level of emphasis. In practice, better institutional arrangements for mitigation have been observed in many cities (Hoppe, Van der Vegt, & Stegmaier, 2016; Landauer, Juhola, & Klein, 2019).

Because of the focus on mitigation, a significant portion of climate funding has been allocated toward mitigation actions (Grafakos et al., 2019). This puts pressure on the quantity of investment needed for climate adaptation measures. The urgency for escalated funding toward bolstering resilience and implementing such measures cannot be overstated (Tall et al., 2021). Despite their prioritization in project proposals, financial constraints often result in neglecting the implementation of these measures. Nonetheless, direct investment into climate adaptation offers a reliable approach to mitigating overall investment risks while enhancing the area's fortitude against climate events (Ambrosio, Kim, Swann, & Wang, 2020).

Furthermore, the question arises regarding the responsibility for financing climate adaptation measures within real estate development. The parties involved do not consistently align their incentives when considering the trade-off between costs and benefits. Consequently, ensuring investments can become an even more challenging task. Public entities may advocate for these measures in the public realm, while project developers often perceive climate adaptation measures as supplementary or discretionary requirements. A significant contributor to this issue is the lack of clearly defined standards for such measures.

Research gap

In literature, work has been done regarding the current use of adaptation pathways, policies and their impact on decision-makers and practitioners (Restemeyer et al., 2017; van Alphen et al., 2022; Yousefpour & Hanewinkel, 2016). However, limited efforts have been made regarding their practicality in the real estate sector. The intricate nature of decision-making, climate change, and water management presents a significant challenge to their effective implementation. This research seeks to address the fundamental question, “who pays what, when?”. At its core, the research problem revolves around the influence of climate risks on the investment decision-making process in polder-area developments in the Netherlands.

1.2. Research objectives and questions

Following the previous paragraph, the objective of this study is to investigate how climate risk impacts investment decision-making in polder-area development. This research focusses on water risks within climate risks, in urban area development in the Netherlands, with the specified focus on polder areas. At this moment, the challenge lies in striking the delicate balance between sustainable development, risk reduction and financial responsibility. This research has the following primary objective:

> This research examined the impact of water risks, in the realm of climate change, on the investment decision-making process in the context of polder-area developments in the Netherlands. The research strived for creating a better understanding of the question "Who pays what, when?"

The theoretical background will define the borders of the research as well as getting a better understanding of the subject and its concepts. The empirical analysis strives to get a better grip on the investment decision-making process for projects in polder areas prone to flood.

1.3. Research questions

In the following section, the main research question and its underlying sub-questions are presented. This thesis examines the following research question:

> *"In which way do water risks impact the investment decision-making process in polder-area development projects in the Netherlands".*

The primary inquiry will be addressed by examining four sub-questions, which are described as follows:

1. How do policy- and decisionmakers navigate the path toward reducing water-related risks in the Netherlands over time?
2. What does the investment decision-making process in urban area development entail?
3. What are the standpoints of stakeholders involved in the decision-making process regarding adaptation investments?
4. To what extent can the allocation of costs and benefits be distributed between public and private stakeholders in polder-area development?

1.4. Relevance

This report seeks to conduct extensive research on the impact of water risks on the investment decision-making process within the context of polder-area development in the Netherlands. The research aims to get a grip on the process, seeks to get new insights from various stakeholders involved in the project and strives for key take-aways for successful climate-adaptive urban area development. Therefore, the research strives for academic and societal relevance.

Societal Relevance

The Netherlands is expected to face climate change-related challenges, such as flood hazards (Deltares et al., 2021), as more than half of the planned residential urban area development in the Netherlands is situated in areas with high climate risk (Groenemeijer & van der Lelij, 2021). Given the policy of the Dutch government to construct 900,000 dwellings in the upcoming years, the urgency of successful implementation of these measures cannot be overstated.

This study aims to conclude with insights into the impact of water risk-related climate adaptation measures on the investment decision-making process, which policy- and decision-makers can also use in the implementation process of such policies. Additionally, comprehending the strategies for successful implementation and the pursuit of resilience in urban area development can provide valuable insights for developers, municipalities, end-users, and other stakeholders involved in the process (*6.1 Recommendations*).

Scientific relevance

In the past few years, research has been conducted that focused on the measures that can be implemented to reduce the effects of climate change (Singh et al., 2020). Recently, the implementation strategy has been a strongly discussed topic (Ambrosio et al., 2020; Bloemen, Reeder, Zevenbergen, Rijke, & Kingsborough, 2018; Lin et al., 2017; Sharifi, 2021). Nevertheless, there is a research gap in the evaluation of the current use of adaptation pathways concerning the decision-making process (Lin et al., 2017). Little work has been done in creating a bridge towards the real estate domain. In addition, the theory lacks empirical assessments that show what designs of the investment decision-making process are applied in practice and with what intended outcome (Uittenbroek et al., 2019). Therefore, the scientific relevance lies in creating a bridge between theoretical background and policies and the practice of urban area development.

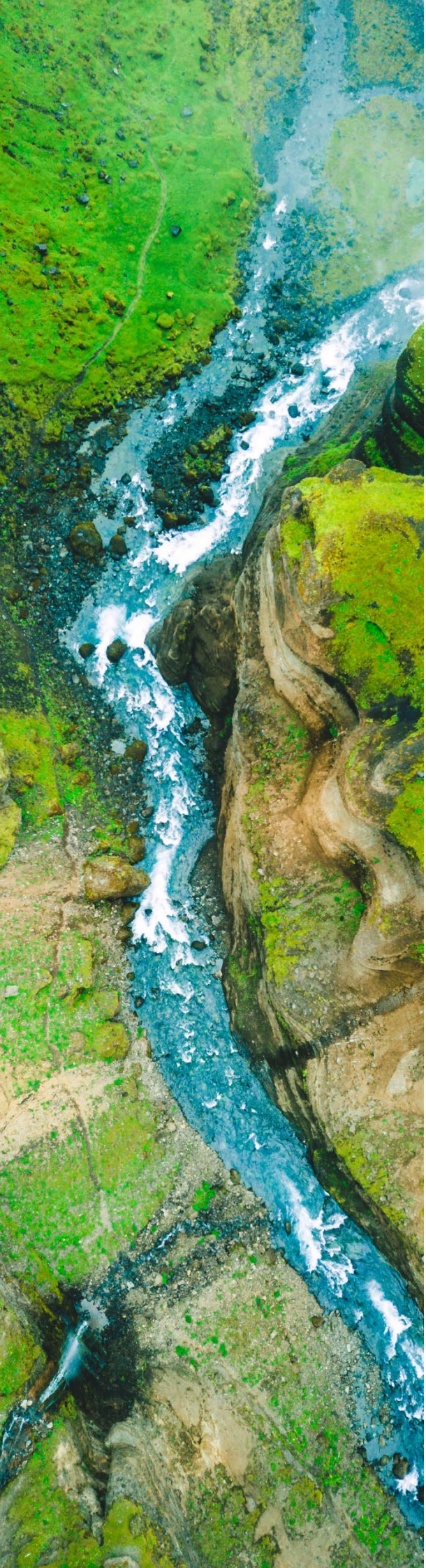
1.5. Research scope

This research focus on residential urban area development in the Netherlands, in response to the housing challenge set forth by the Ministry of Housing and Spatial Planning (De Jonge, 2022). In the wake of this challenge, the pressing inquiry is how to effectively execute climate-adaptive urban area development. Approximately 600,000 dwellings are located in areas with a high level of climate risks (Groenemeijer & van der Lelij, 2021).

The Netherlands has numerous low-lying areas where water risks must be seriously considered. Many significant spatial developments, particularly in expansion locations, are situated in the polders on the western side. These polders are typically the still undeveloped areas in the Netherlands. With a future-oriented perspective, attention is therefore directed towards the Dutch polder landscape. Developing in polders offers unique spatial opportunities, but also entails climate-related risks that demand close examination.

1.6. Dissemination and audiences

This research primarily focuses on the various stakeholders engaged in urban area development projects, encompassing both public parties (including municipalities, provinces, and water authorities) and private parties (including real estate developers, investors, and insurance companies). The scientific significance lies in providing scientists with novel insights into the impact of climate change on the investment decision-making process.



Section II

Literature Review

Water management in the Netherlands
Urban Area Development
Investment decision-making process

2. Literature Review

This chapter presents three concepts, all in the context of the Netherlands, to enhance a grasp on the path toward reducing water-related risks and what the ‘standard’ investment decision-making process in urban area development entail. The literature review zooms in on different PPP-frameworks and how the distribution of responsibility and risks works in practice.

2.1. Water management in the Netherlands

In this paragraph, the history and development of water management in the Netherlands is explored. It focusses on the built environment and the impact on urban area development. This paragraph focusses on the following sub-question: How do policy- and decisionmakers navigate the path toward reducing water-related risks in the Netherlands over time?

To answer this question, the water management approach has changed over time. Initially, the policy exhibited a reactive character in the early years. However, a recent shift is evident, transitioning from merely mitigating water to actively adapting to it. The policy, labeled 'Water and Soil-driven', serves as an initial bridge between the water and construction sectors. It also propounds principles regarding spatial planning necessary to render the Netherlands climate adaptive. Concurrently, in relation to these developments, the first instruments for climate adaptive measures are beginning to take shape. Nevertheless, these instruments still reside in a limited sphere of awareness and have not yet found a place in legislation and regulations.

Context: History of flood management

Following the catastrophic 'Watersnoodramp' of 1953, which necessitated improved water management, various committees were tasked with formulating plans to enhance flood risk management. These committees comprise policy- and decision-making parties, whose roles and responsibilities are meticulously outlined in *Table 2.1*.

Table 2.1. Overview of different water management committees in the Netherlands (Rijke, van Herk, Zevenbergen, & Ashley, 2012).

Year	Committee	Remarks
1953	Delta committee	
1970-1980	Committee Rivierdijken	Report brought out in 1977
1992	Boertien I	'Boertien I’ was tasked with reviewing critically the assumptions used in river dike strengthening
1994	Boertien II	After the threat of high-water levels, Boertien II was founded. Part of their objectives included administrative measures on land-use planning to prevent new damage.

2000	Water management 21st century	
2007	Delta committee new style	Advised in 2008 how the Netherlands should be protected from the effects of climate change until year 2200.

In 1987, a significant initiative called the Plan Ooievaar was introduced, aiming to integrate river management, nature development, and landscape architecture. This forward-thinking plan laid the foundation for subsequent experimental projects (Rijke et al., 2012). Its importance extended beyond individual endeavors and received recognition within the comprehensive framework of the third national policy brief on spatial planning.

Subsequently, in 1993, the region of Limburg faced the imminent threat of high-water levels, narrowly avoiding a devastating flood. However, in 1995, the peril resurfaced as numerous small villages in Limburg were once again confronted with rising water levels and an ensuing flood, resulting in the evacuation of approximately 250,000 inhabitants (Rijkswaterstaat, n.d.).

To address the challenges posed by climate change, rising sea levels and land subsidence in river regions of Netherlands, efforts were made to reinforce dikes. However, there was a need for a thorough reevaluation due to doubts about traditional engineering approaches' effectiveness (Van der Brugge, Rotmans, & Loorbach, 2005) . This led to the emergence of a new approach that focused on utilizing natural dynamics and water system resilience with an aim of boosting capacity management for larger water volumes while prioritizing flood safety under the 'Room for Rivers' initiative (Rijke et al., 2012). Within this strategic framework- Plan Ooievaar and its associated measures known as RftR program complementarily emerged aiming at increasing river discharge and storage capacity; thereby mitigating risks flooding poses. The ultimate objective is protecting both human settlements whilst maintaining ecological equilibrium within these areas.

This paradigm shift in Dutch policy was initially documented in the Fourth National Water Policy Document, published in December 1998 (Rijke et al., 2012). The objectives outlined in this policy document for integrated water management encompassed various aspects. Firstly, it aimed to enhance the resilience of water systems while simultaneously promoting nature development. Secondly, it sought to establish greater coherence between water policy, nature conservation policy, and physical planning policy. Additionally, the policy emphasized early engagement of diverse stakeholders and the public in the decision-making process. Moreover, the policy promoted a spatial planning and development approach, introducing a new decision-making framework that considered local and regional (spatial) policy objectives. The fifth memorandum on spatial planning, published in 2007, declared water as a "guiding principle" in the realm of spatial planning. This recognition further solidified the importance of integrating water considerations into the broader planning process (Van der Brugge et al., 2005).

Since 2000, 'Room for the Rivers' has served as the cornerstone of our approach to flood protection in river areas. Its objective is to effectively manage river water by accommodating increased volumes and adapting to the evolving consequences of climate change. The insights gained from the Room for the River initiative hold significant implications for future water management practices in the Netherlands (Rijke et al., 2012).

The established Delta Program, which spanned from 2009 to 2015, is utilizing the Room for the River approach as a model for governance and the development of integrated strategies.

The Dutch policy regarding flood risk management

The flood defense focus in the Netherlands has been characterized by a strong emphasis on discourse and institutions. This approach has led to the presence of lock-in situations, namely technical and institutional lock-ins. The technical lock-in is evident as the livability of the country heavily relies on the proper functioning of the technical flood defense infrastructure. Similarly, the institutional lock-in is manifested through the interplay of robust institutions and solid legal frameworks. However, a shift in perspective occurred after the devastating floods of 1993 and 1995, prompting the introduction of the "Room for the River" program (Bogdan, Beckie, & Caine, 2022; Rijke et al., 2012). This transformative initiative brought about a heightened focus on integrating water management and spatial planning, with water becoming a central organizing principle within spatial planning strategies.

The management of primary flood defenses in the Netherlands can be described as a relatively closed arrangement, involving a limited number of stakeholders with homogeneous characteristics (Van der Brugge et al., 2005). Private actors, including insurance companies, are not directly involved, and citizens have a limited role in the decision-making process. This alignment of rules and resources with the actors and their discourse results in a high level of internal congruence. From a financial standpoint, this flood management approach is more secure compared to other countries. This is attributed to the presence of an autonomous taxation system for water management and the establishment of dedicated funds, such as the Delta fund, specifically allocated to main watercourses (van Rijswick & Havekes, 2012).

In the context of water management in the Netherlands, responsibility is distributed among four key public stakeholders, a system outlined in the Dutch Water Act (Ministerie van Infrastructuur en Waterstaat, 2010). These stakeholders have distinct roles and responsibilities, each contributing to the intricate tapestry of water governance:

National Government of the Netherlands
At the highest level, the national government takes the reins, steering the course of national water policy and enacting strategic measures to safeguard the nation's waterways. Their authority extends to establishing safety standards for primary water defenses (e.g., dikes and dunes).

Provinces
Beneath this overarching jurisdiction, the provinces have the responsibility to translate national water policies into regional measures. This role encompasses both operational tasks, such as groundwater extraction, and the diligent safekeeping of groundwater quality.

Water Authorities
Further down the hierarchy, water authorities are tasked with developing management plans for their respective region. They diligently oversee the maintenance of secondary water defenses (e.g., embankments around canals).

Municipalities
On the smallest scale, municipalities play a more concise role in water management. Within the urban tapestry, their responsibility centers on the management of groundwater in cities, including the disposal of wastewater and excess rainwater through the municipal sewage system.

The legal framework that orchestrates this ballet of responsibilities are documented within the Water Act (Ministerie van Infrastructuur en Waterstaat, 2010). Within this legal framework, numerous administrative agreements, such as the Water Administrative Agreement (Wijbenga, 2021), serve as the breeding grounds for innovation, birthing new commitments and measures that push the boundaries of water governance. In addition to these public controllers of water policy, there exists a dynamic sphere of private parties—ranging from water supply companies to urban planners and the dredging companies—are also engaged in the water management efforts in the Netherlands.'

Policy 'Water- and Soil-centric'

In 2022, the Dutch government announced the policy aimed at emphasizing the critical roles of water and soil in addressing the intricate challenges posed by spatial planning. The policy, aptly named "Water and Soil-centric (or "Water en Bodem Sturend") in Dutch), made its debut through a letter issued by the Ministry of Infrastructure and Water Management, as authored by Harbers and Heijnen (2022).

Within this letter, a set of profound principles was presented to guide the Dutch spatial development:

1. **The principle of "non-transfer"** emphasizes the avoidance of shifting problems (e.g., water storage in low polders) elsewhere.
2. **Acknowledging the nature of extreme events.** A prominent focus was placed on understanding the unpredictable nature of extreme events, urging a more vigilant approach.
3. **Embracing a comprehensive strategy** for flooding, drought, and soil.
4. **The Multi-Layered Safety Approach.** An elaborate composition highlighted the benefits of adopting the safety approach, ensuring resilience in the face of diverse risks.

The purpose of the Water and Soil-centric policy became evident and seeks to eliminate the burden of public costs for risk mitigation and the potential adverse secondary consequences. In essence, this policy can be distilled into the refrain from not shifting burdens onto others, echoing a message of shared responsibility and sustainable decision-making.

"Water and Soil-centric" in polder area's
The policy introduced by the Ministry of Infrastructure and Water has direct consequences for the area development in the context of the Dutch polders. The following paragraph highlights the measures and consequences of this policy, based on the letter of Harbers and Heijnen (2022).

The policy has consequences for developing in outer dike areas. New construction within riverbeds is prohibited, and the expansion of buildings in floodplain areas is now prohibited as well. These measures underscore the importance of preserving ample space for the construction of levees, water barriers, and the protection of our coastal regions.

Spatial planning of subsurface development is mandated, a joint responsibility of both the national government and local authorities at the municipal and provincial levels. These efforts aim to place greater emphasis on the evaluation of risks associated with flooding, water inundation, land subsidence, and the availability of drinking water in the determination of site selections and housing development planning. The primary objective is to prevent future construction decisions that may come to regret. Furthermore, the Government is actively directing efforts toward minimizing the coverage of soil in the Netherlands. By reducing soil coverage, we aim to preserve the natural landscapes in rural areas while also encouraging water infiltration within urbanized regions. This initiative supports the concept of "ontharding," or the reduction of ground coverage.

Thoughtful Site Selection for Construction
Construction in areas deemed less prudent and to be avoided, such as the outer dyke regions in the Ijsselmeer, the riverbed, adjacent to levees and barriers, and the deepest sections of the polders, is prohibited. However, it is noteworthy that, under certain conditions, residential development can be realized in most areas of the Netherlands. The Ministry of Infrastructure and Water Management (IenW) and the Ministry of the Interior and Kingdom Relations (BZK) are jointly developing a decision framework for assessing construction in (in)appropriate locations. This framework is to be applied to projects and regional developments where no zoning plan has been adopted by January 1, 2025. The application of the climate-resilient construction framework, known as the National Benchmark for Green and Climate adaptive Built Environment, is a useful framework. This system serves as a standard for assessing and promoting climate-resilient building practices. In the planning of regional developments, adequate provisions are made for water retention, with 5 to 10% of the deepest polders reserved for this purpose, preferably in the deepest sections. New construction is not permitted unless it does not compromise the region's water retention capacity.

Construction in Lowland Peat Areas
Lowland peat areas experience subsidence due to settling, compaction, and peat oxidation, primarily stemming from drainage activities. Such subsidence leads to increased maintenance costs for public spaces, sewer systems, and infrastructure. In the case of deep polders, there is an elevated risk of salinization and flooding due to land subsidence. To mitigate this, efforts are being made to raise groundwater levels by 20 to 40 cm, effectively minimizing land subsidence. The policy aims to strike a balance between growth and preservation, ensuring the long-term resilience of the built environment in the face of climate challenges. Although the policy is not yet part of the legal framework, it will increasingly influence both public and private entities.

Steering towards a climate adaptive built environment

The urgent and complex housing construction challenge of the Netherlands demands strategic location choices and sound decision frameworks for the spatial planning or residential areas, as addressed by van Kempen and Slootmaker (2021) in "Brief adviesaanvraag woningbouw en klimaatadaptatie" (Request for Advice on Housing and Climate Adaptation).

In response, the Delta Commissioner, Peter Glas, unveiled a national strategy for climate adaptative and resilient construction (Glas, 2021).Within the context of urban area development, this approach is translated into policies, such as the "Water and Soil-centric" policy, and standards for climate-adaptive urban area development.

In 2018, before the request for advice by van Kempen and Slootmaker (2021), the province of South-Holland has devised the covenant Climate-Adaptive Construction, with the aim of striving for climate-resilient construction in new development areas within the province. The objectives addressed in the covenant encompass reducing water-related issues, enhancing biodiversity, mitigating heat stress, addressing prolonged drought and tackling soil subsidence (Provincie Zuid-Holland, 2018). The covenant Climate-Adaptive Construction served as the cornerstone for establishing a standardized framework for climate adaptation, the National Benchmark for a Green and Climate-adaptive Built Environment (De Jonge, Harbers, & Van der Wal-Zeggelink, 2023). This initiative is a critical step towards effectively addressing the challenges posed by climate adaptation within the realm of housing construction. The latter mentioned benchmark comprises six fundamental themes that are integral to its implementation:

1. Heat
2. Flooding
3. Drought
4. Consequences of flooding
5. Biodiversity
6. Land subsidence

This benchmark serves as a comprehensive guideline for ensuring the resilience and adaptive capacity of built environments in the face of climate change. However, for the purpose of this research, the focus will be primarily directed toward the theme of water. Consequently, the focus lay in three themes of the benchmark for in-depth exploration within the case studies selected:

1. Flood risk, mitigation of flooding consequences.
2. Water overload risk, after extreme heavy rainfall.
3. Land subsidence, due to construction on weak soils.

In the National Benchmark, the standards are contingent on various factors, including the geographical location and the specific circumstances surrounding the urban area development. In particular, a national standard has been formulated when addressing the issue of water overload. Areas under development should remain resilient to extreme heavy rainfall occurring at a frequency of once in a century (1:100 years).

Furthermore, no water damage should be incurred when the water depth in public spaces reaches 0.2 meters (Rijksoverheid, 2023). In the quest for a comprehensive understanding of the National Benchmark, 4.1 Exploratory interviews delves into an exploratory interview with the Ministry of Infrastructure and Water Management, providing invaluable insights into the intricacies of the Benchmark and its application.

Carrot and Stick

Governments at the national, provincial, and regional levels can influence the initiation of appropriate decisions within the policy framework. In the literature, the possibilities for this influence are often divided into two variants: through regulations and frameworks (the stick) or through incentives such as subsidies (the carrot) (Nelson & Pritchard, 2016). In practice, the achievement of successful policy implementation is often a combination of both the carrot and the stick. The correct policy pathway is not preordained but varies depending on the goal, means, and context (van Alphen et al., 2022).

2.2. Urban Area Development in the Netherlands

In the Netherlands, urban area development occurs on a significant scale, aligning diverse land-use, actors and financial resources to harmonize various elements of the urban landscape (Edwin Buitelaar & Bregman, 2016). Urban area development (Dutch: Gebiedsontwikkeling) concerns defining, building and implementing a development vision or strategy for a certain district or neighborhood (Franzen, Hobma, de Jonge, & Wigmans, 2011). Daamen (2010) defines urban area development as:

> "A way of working in which government bodies, private parties, and other actors involved reach an integration of planning activities and spatial investment, eventually resulting in the implementation of spatial projects" (Daamen, 2010).

This paragraph focusses on the following sub-question: What does the investment decision-making process in urban area development entail? In summary, the following paragraph underscores the different PPP-governance frameworks, with a relation to the allocation of risk and responsibilities within the project. Within the governance of PPPs, the municipality has dual positioning, resulting in a 'double-hat' position.

Stakeholders in urban area development

The definition of Daamen (2010) shows the importance of the dynamics between public and private actors in urban area developments, influencing and steering outcomes of spatial projects. The complexity of urban area development reveals itself when describing the roles and systems of stakeholders involved. To begin with, there is a differentiation between public and private systems (*Figure 2.1*). The public system, the political process, can be described as an open system. Stakeholders influence the decision-making process. Choices made by the government body are determined by politicians, officials (Dutch: ambtenaren), and societal organizations. Politicians aim for voting maximization, while societal organizations strive to maximize the interests of their members. Officials seek budget maximization (Bult-Spiering, Blanken, & Dewulf, 2005).

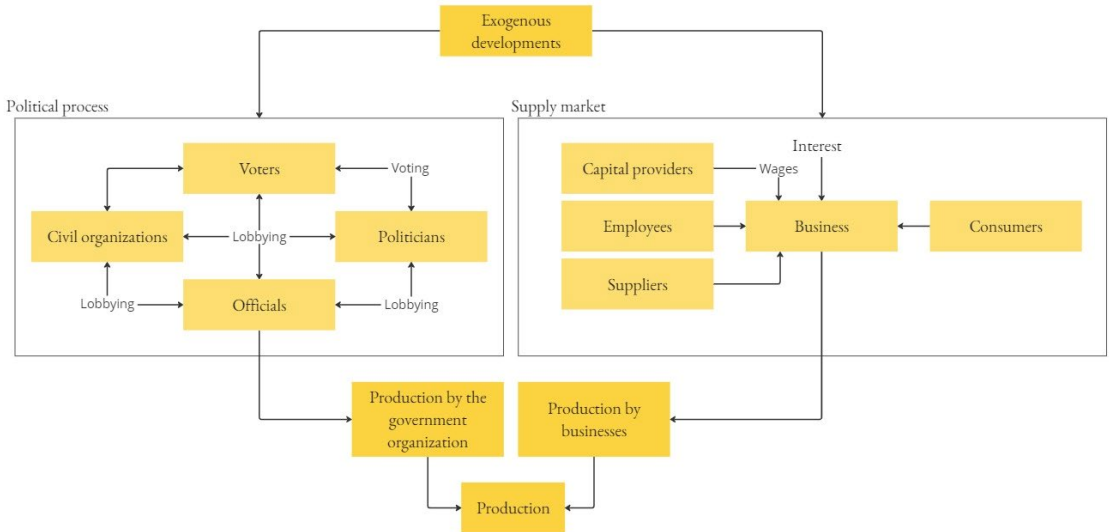


Figure 2.1. *Public and private systems (Bult-Spiering et al., 2005, p. 23)*

The private system, the supply market, operates differently from the political process. A business makes autonomous decisions within a relatively closed system (Bult-Spiering et al., 2005). The price offered by a business in the market is determined by competitive dynamics, involving trade-offs between costs and revenues. Business considers the needs of the consumers, and through the price mechanism, consumers express their preferences.

The diverse interest and roles held by public and private actors contribute to the complexity of urban area development. The way these parties interact to achieve successful urban area development as common goals have evolved over the years. This leads to close cooperation between the stakeholders involved. Public-private partnerships (PPPs), particularly in the context of area development, can be described as "a co-operation between public and private stakeholders with a durable character in which stakeholders develop mutual products and/or services and in which risk, costs and benefits are shared" (Klijn & Teisman, 2003). Urban area development is intricate, manifesting in various forms and involving various actors. In the Netherlands, actors align with the description provided in the following section.

Public stakeholders

The municipality plays different roles in urban area development. They play a role in granting building permits, creating land-use plans etc., but also have to opportunity to pursue own land development (Franzen et al., 2011). Within the land development role, municipalities can participate in urban area development as setting up development companies (mostly in PPP-structured urban area development). Within the organizational structure of the municipality (depending on its scale), various departments are involved in urban area development (e.g., real estate, transport and logistics, economic affairs etc.)

The province also has its stake in urban area development. Where municipalities can have a participative role in UAD, the role of the province is more focused on controlling and steering within the borders of policies (Zeeuw, 2018). Central government comes into play for large and/or complex urban area developments. The central government is mostly financially involved, e.g., granting subsidies.

Other authorities such as the water authority are limitedly involved in urban area development, within the borders of their knowledge and field of power. In general, water authorities have the responsibility of formulating management strategies for their specific geographic areas in the context of water management. They conscientiously supervise the upkeep of secondary water protective structures, such as embankments encircling canals, and main waterways.

Private stakeholders

The level of involvement of private stakeholders is contingent upon factors such as the project/context characteristics, the intended real estate product, and landownership arrangements. The private actors can be categorized based on their ownership status, dividing them into those with land and those without land (Wolting, Bregman, & Pool, 2006).

In nearly all instances of UAD, private developers assume a significant stakeholder role within the process, actively participating in PPPs. Their engagement is characterized by a notable commitment of resources and risk, extending beyond the scope of mere building

construction. Developers function as pivotal intermediaries among other stakeholders, translating the practical requirements and wishes of investors into the language of architects. In urban area developments, a clear distinction can be made between short-term developers, often referred to as 'hit-and-run developers,' and long-term developers. Long-term developers are typically engaged in Dutch UAD because of their perspective and ability to navigate the inherent complexity (Zeeuw, 2018).

Investors engage in the process of providing capital for urban area development. A distinction can be made between institutional investors and private investors. Their interest is focused on generating return on investments, investing money on a long-term basis (Franzen et al., 2011).

In the Dutch context, house associations occupy a pivotal role. Their primary responsibility revolves around ensuring affordable housing, particularly through social housing initiatives. However, they also harbor a keen interest in financial returns, thereby assuming the role of a private entity within the housing landscape (Franzen et al., 2011).

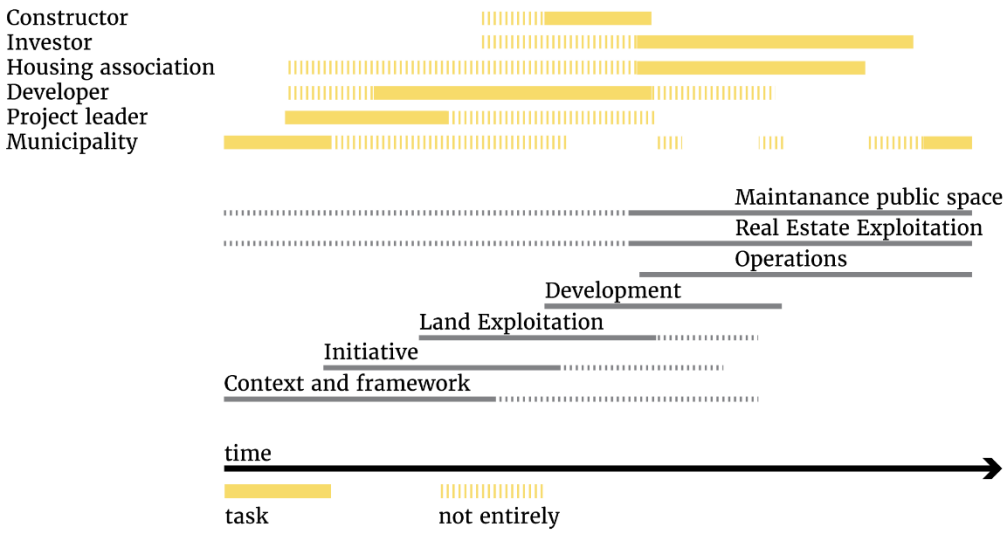


Figure 2.2. *Involvement of different stakeholders during the urban area development process* (Zeeuw, 2018, p. 102).

The involvement of both public and private actors in area development varies depending on the roles they play. In *Figure 2.2*, the role of each stakeholder is visualized. The developer, area coordinator, and municipality mainly take center stage at the beginning of the process, where the initiative and crucial decision points occur, shaping the project's trajectory. The municipality plays a multifaceted role that unfolds in distinct phases, encompassing its functions as a guiding, supervisory, and advisory body. After the completion of the UAD project, the municipality takes on the responsibility for overseeing the management and maintenance of public spaces.

Phases in urban area development

The involvement of stakeholders depends on the phase of urban area development. In literature, there is a distinction between four different phases: the initiation; planning; realization; and maintenance phase (Franzen et al., 2011).

An urban area development starts with an initiative. The initiative can be born as a response to local or national problems, e.g., housing shortage (Franzen et al., 2011). The characteristics and quantities can be drawn up by social and/or economic trends of the region and surrounding areas. Within this phase is the initiative and intention agreement.

In the realm of government land and water management policy (*Policy* '), the choices related to location, size, and requirements are of paramount importance. These choices are crucial in shaping the outcome of various development projects. In large-scale area developments, the initiative typically rests with public entities. However, there are three distinct approaches to this, as identified by Bult-Spiering et al. (2005):

1. ***Government-Led Planning:*** In this scenario, both the central government and other governmental bodies take the lead in formulating the development plans and specifying the desired outcomes. This is typically followed by a tendering process where private parties can participate.
2. ***Early Involvement of Private Parties***: Some projects involve early collaboration with private entities. This could be motivated by the expected added value of private involvement, risk-sharing considerations, or anticipated contributions from private parties.
3. ***Involvement Due to Project Characteristics:*** In certain cases, the government decides to engage private parties early due to specific project characteristics, such as the presence of private land holdings or other unique project attributes. Often, during the planning phase, a consortium of project sponsors is formed.

Private participants may still exercise some influence over local authorities even if it is usually the large-scale projects driven by public entities that lead to major development. This influence might be exercised directly in local governmental agencies such as city council and municipal authorities or could pervade into the provincial, region and even national level.

Conversely, small urban area developments and typical real estate projects mostly witness greater participation of the private entities for initiating such projects. The undertakings commonly use conventional avenues and involve limited cooperation among players from either side of the aisle. With regards to these small scale ventures, governments tend to be passive and assistive in most cases as opposed to being active as witnessed in case of those large enterprises noted first (Bult-Spiering et al., 2005).

The planning phase starts after the intention has been mutually formulated within the intention agreement and ends when construction works start. This phase includes agreement on the government structure used for urban area development. The different types of governance are elaborated in *Governance structures.*

The planning phase includes research, plan development, assessment and feasibility (A&F) and elaboration (Bult-Spiering et al., 2005). The realization phase involves the active participation of contractors. Within this phase, tasks encompass the execution of construction, the implementation of development plans, and the commencement of project exploitation (Bult-Spiering et al., 2005). After the realization phase, the urban area development is concluded, marking the initiation of the maintenance and operational phase.

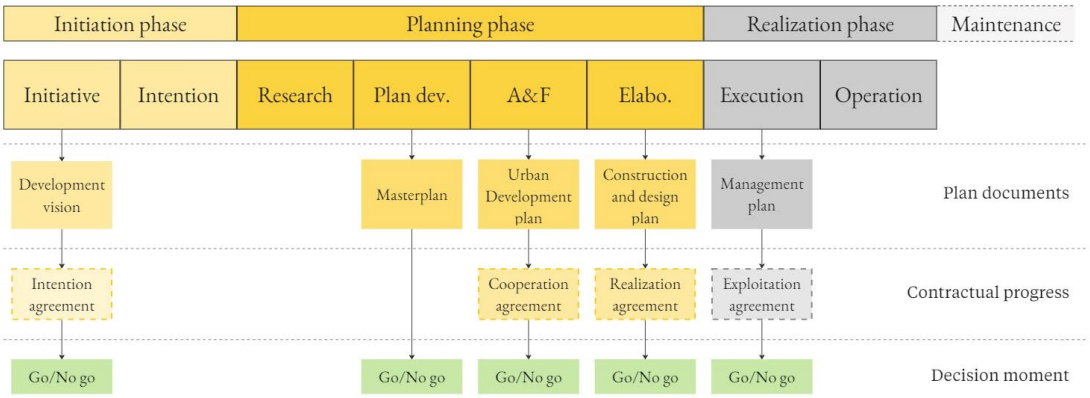


Figure 2.3. *Project phasing* (Bult-Spiering et al., 2005, p. 52; van der Linden, 2021).

This results in the following diagram *Figure 2.3*, visualizing the different phases with its corresponding plan documents, contractual progress, and decision moments. The duration of each phase is not represented in this visualization. The process is not linear and involves feedback loops and direction changes in the process. Therefore, the agreements are an example, and in practice, there is often a more extensive set of agreements among different parties.

Governance structures

When public and private stakeholders collaborate within urban area development, there are different governance structures for successful UAD. These structures play a fundamental role in facilitating and regulating the collaborative efforts between public and private entities, ensuring that urban development projects are not only successful but also sustainable in the long term. The following section will delve into an exploration of governance structures employed, providing insights into their characteristics (*Table 2.2*).

Table 2.2. Public-private partnerships frameworks, based on Zeeuw (2018, p. 111).

Phasing		Municipal development (traditional	Building rights	Joint-Venture	Developing Apart together	Concession	Private development (traditional)
Initiation	Initiative	Public	Public or private	Public or private	Public or private	Public	Public or private
Planning phase	Plan development	Public	Shared	Shared	Shared	Private	Private
	Land acquisition	Public	Private sells to public	Each for themselves; GEM	Each for themselves	Public sells to private	Private
	Land exploitation	Public	Public	Shared	Public or private	Private	Private
	Plan development	Public	Public, private input	Shared	Shared	Private, public input	Private
Execution	Project development	Private	Private	Private	Private	Private	Private
	Operation	Public	Public or private	Public or private	Public or private	Public or private	Public or private
Public → Private							

In the case studies employed for this research, the land exhibits fragmented ownership. This characteristic impacts the effectiveness of the various governance structures within the framework of PPPs. Two common collaboration models in the context of fragmented ownership are Joint-Venture and Developing Apart Together (Joint-Venture Light) (Hobma, Heurkens, & Van der Wal, 2019; Zeeuw, 2018).

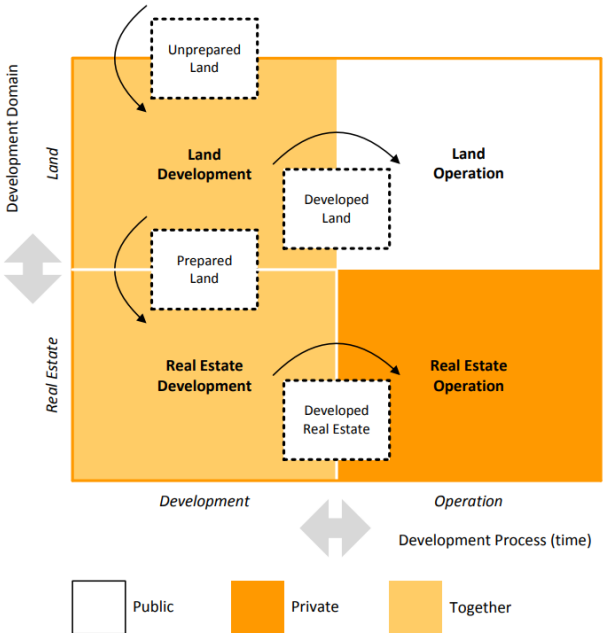


Figure 2.4. *Land and real estate development, public & private roles within a PPP (Heurkens, 2012, p. 153).*

Figure 2.4 illustrates the basic principle of both governance structures. The figure describes the public and private roles in transforming unprepared land into developed real estate. The figure delineates the distinctions in public and private responsibilities, wherein, in this example, land development and real estate development are developed together. In the later stage, the land operation resides within the public domain, and the real estate operation is assigned to the private domain.

Joint-Venture
Public and private parties establish a collaborative venture in the form of a Land Development Company (LDC), as outlined by Heurkens (2012). The parties involved, often the developer(s) and municipality, contribute lands and share ownership and decision-making authority within the LDC depending on the percentage of landownership. In practice, the distribution is often a 50-50 split between market parties and the municipality. The LDC assumes responsibility for land development and the preparation of the land for construction.

Significant is the role of the municipality, where it bears responsibility for the formulation of the land-use plan and concurrently assumes the role of a private shareholder. This dynamic gives rise to the 'double-hat' problem, as emphasized by Heurkens (2012).

'Double-hat' position of the municipality

The 'double-hat' position is introduced by Heurkens (2012) as "a Public organization under private law, but at the same time acting as the guardian of the common interest."

Within a PPP framework, the municipality is integrated into the PPP structure, assuming responsibility and risk. The municipality seeks control in the project and can serve as a catalyst for area development. However, the dual role results in a blurring of the municipality's interests (Heurkens, 2012). In broad terms, this leads to:
1. Conflict in the sphere of finance.
2. Shareholder vs. competent authority (authorizing grants, etc.)
3. Conflicting interests, policy vs. maximization of profits.

The primary danger of a double-hat problem is the entanglement of the municipality's interests within its own organization. The dual role impacts the control and implementation of policies, where non-financial considerations ideally prevail.

Developing Apart Together (DAT)
Developing Apart Together is a governance structure which is frequently employed in inner-city urban area developments characterized by fragmented ownership. Its emergence was in response to the inflexibility and increased financial risks associated with traditional Joint Ventures, wherein lands are contributed to a Land Development Company (Zeeuw, 2018). DAT is distinguished by its minimal land transactions (Hobma et al., 2019), primarily reserved for the equitable allocation of development plots or to facilitate the management of public spaces.
The allocation of plots unfolds as follows: The Land Development Company (LDC), comprising both public and private entities, collaboratively devises a comprehensive master plan for the area, transcending individual plot boundaries. This master plan

encompasses crucial aspects such as the program, densities, amenities, as well as phasing and scheduling. Following this, equitable distribution of plots takes place, contingent upon the stakeholder's ownership stake and the estimated revenue potential of the real estate program. The municipal authority, through a tendering process, commissions the development of their parcels to private developers. Within the project organization, private entities either oversee the development themselves or subcontract it to other developers.

As highlighted in *Table 2.2*, subtle distinctions exist between the two forms of Public-Private Partnership (PPP). The most significant discrepancy lies in whether or not lands are contributed to a dedicated Land Development Company (LDC), which has implications for the sharing of land exploitation revenues.

Financing urban area developments, Land Exploitation

The real estate finance process can be segmented into three distinct phases: the land exploitation phase, the real estate development phase, and the real estate exploitation phase. These phases collectively shape the financial dynamics of a project. The land exploitation is an integral part of the broader real estate financial planning process as outlined in *Figure 2.5* and plays a pivotal role in facilitating early-phase investments for public and private stakeholders involved. It represents a strategic approach to ensure that investments made in the early stages yield returns that align with the desired financial performance in the development and operation phase. The land exploitation encompasses various expenses, such as those related to the preparation of land for construction and residential development (Zeeuw, 2018).

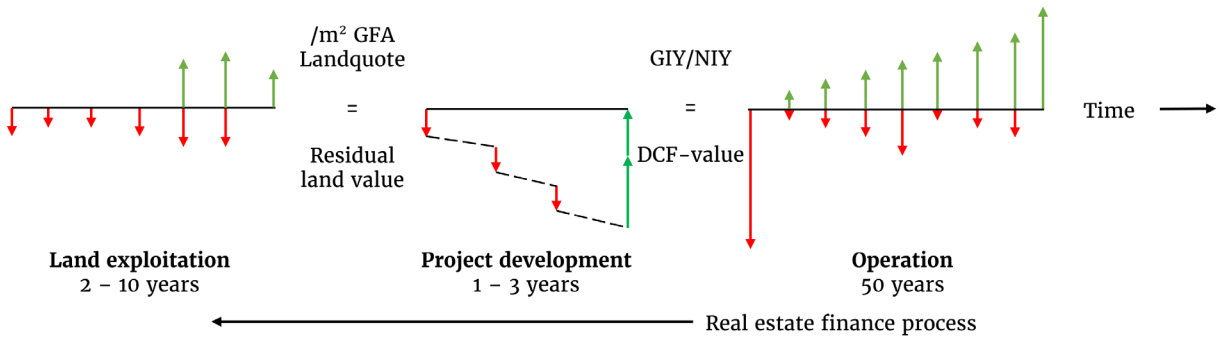


Figure 2.5. *The real estate finance process* (Vlek, Van Oosterhout, Rust, Van den Berg, & Chaulet, 2016, p. 4).

To gain a clearer understanding of the finance process, *Figure 2.5* offers a simplified representation of cash flows within the context of real estate development. The equal symbol denotes critical transactions, such as the sale of the plots, and the intersections highlight key financial junctures. The landowner or land exploiter actively manages the project to achieve profitability, aiming for self-sustaining land exploitation. This involves not only the expenses associated with the preparation of land and construction, but also includes allocable costs related to investments in infrastructure and public spaces. The capital expenditure (CAPEX) of climate adaptation measures is also part of land exploitation within this real estate finance process.

The figure illustrates that the real estate development process operates from left to right. However, the real estate financial modeling process operates from right to left, with the residual land value as the figure at the bottom. This financial modeling process incorporates the costs and revenues of real estate development and exploitation and highlights the balance between costs and returns in the real estate finance process (*Figure 2.6*).

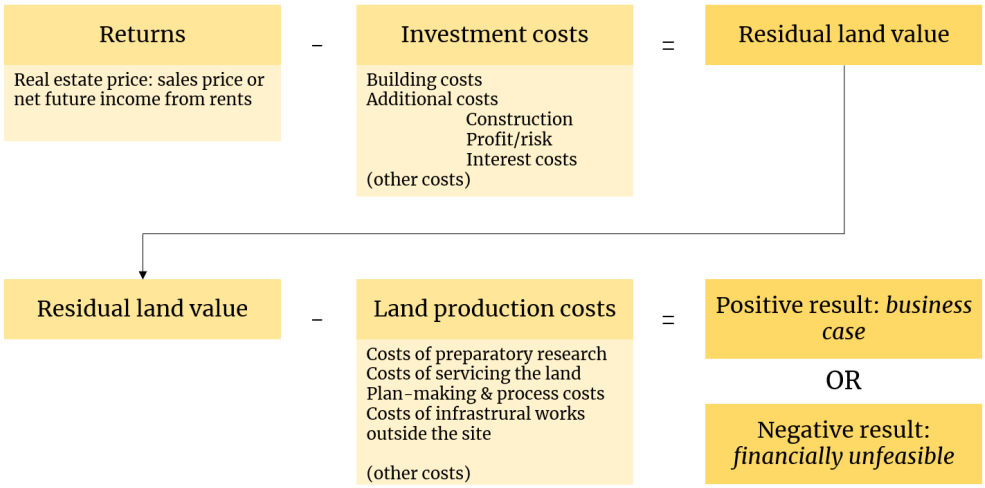


Figure 2.6. *The balance of costs and returns and its impact on the residual land value (E. Buitelaar, Witte, & Spit, 2014; Zeeuw, 2018).*

When a component incurs higher costs, as in the case of the residual land value, it directly impacts the outcome. The goal of the developing parties, those involved in the PPP structure in urban area development, is to achieve a positive return and thereby close the business case. For instance, the 'costs of preparatory research' within the land production costs may turn out to be higher. In such a scenario, the costs must be offset by a revenue component, such as the real estate price. Throughout the project, decision-makers have various levers to pull to steer towards a feasible plan, and investment decisions are made based on financial considerations.

2.3. Investment decision-making process

The investment decision-making process is part of the flood management policies of the Netherlands. This paragraph dives deeper into the investment decision-making process by defining the concept and framework for the process. Additionally, this paragraph explores two methods for investment decision-making processes with the relation to the context of climate adaptation and water management: Cost-Benefit Analysis (CBA) and Cost-Benefit Water (CBW).

In summary, the insights presented in this paragraph underscore the dynamics of the investment decision-making process, emphasizing the iterative nature of learning loops in risk management, the pervasive role of uncertainty – influenced by climate change as risk factor, and the application of cost-benefit analysis, particularly in the context of major infrastructural projects.

Defining investment decision-making and uncertainty

An investment decision is the decision to expenditure made now to achieve future gains (Avram et al., 2009). The outcome of these decisions is influenced by contextual factors that encompass both economic and financial considerations, thereby introducing a level of uncertainty into the equation. The process of investment decision-making is applicable across various scales and contexts. Factors that come into play when deciding whether to invest include the projected return on investment, the cost associated with acquiring the asset, the availability of funds for investment, and the chosen method of investment, as highlighted by Virlics (2013). The investment decision-making process is a combination of subjective factors (e.g., gut feeling, etc.) and objective factors (e.g., expected rate of return), as addressed by Virlics (2013). In his article, he describes investment decision-making as a process as visualized in *Figure 2.7.*

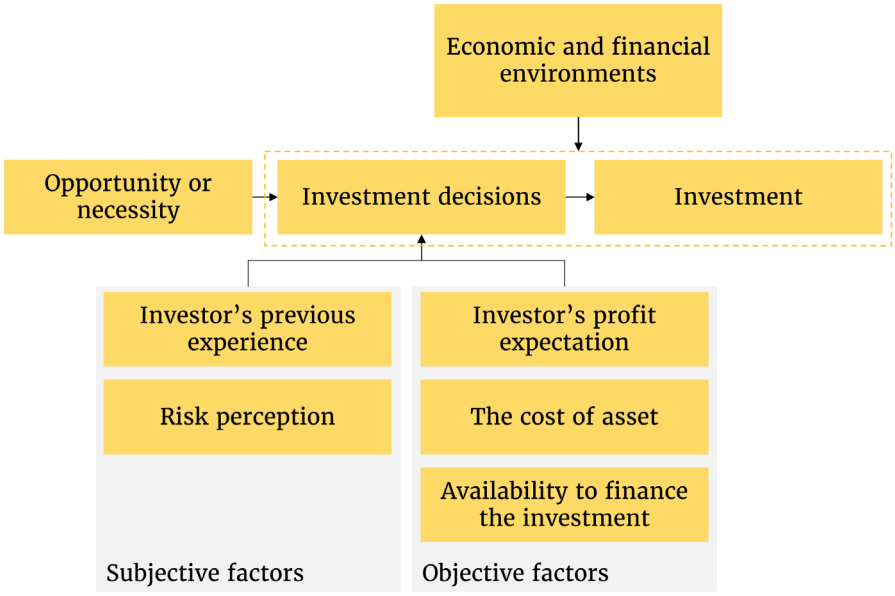


Figure 2.7. *The Investment Decision-making process, visualization based on Virlics (2013).*

Managing risks and uncertainties

In the context of area developments, a multitude of diverse risks and uncertainties come into play, influencing the investment decision-making process, with climate risks being a significant factor among them. A pivotal aspect of the investment decision-making process involves a comprehensive assessment of these risks and uncertainties.

Termeer and van den Brink (2013) have characterized the management of uncertainty related to climate change as the challenge of dealing with the "unknown unknowns." Uncertainty holds the potential to exert a profound influence on the outcomes of the decision-making process. When an analysis depicts deep uncertainty as well-defined, it can inadvertently foster excessive confidence among decision-makers, leading them to select strategies that may prove ineffective when the future unfolds in ways that deviate from their initial expectations and scenario projections (Popper, Lempert, & Bankes, 2005; Weaver et al., 2013).

Climate change itself can be perceived as a source of risk. Despite the wealth of available information, there remains considerable uncertainty regarding the precise nature of the future. In the context of urban area development, the potential repercussions of climate change manifest most notably in the preparatory stages of urban area developments.

Climate risk, especially in the context of polder development, is not an entirely novel concern. Developers and other stakeholders involved in area development have shared valuable insights and lessons gleaned from past projects. By disseminating coping mechanisms for managing risk, a learning and feedback loop (*Figure 2.8*) can be established, as exemplified in the research conducted by Delton (2007).

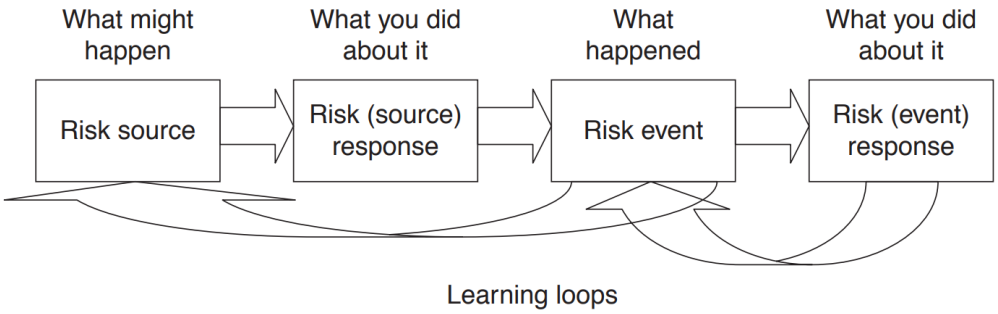


Figure 2.8. *Understanding 'risk' through time* (Delton, 2007; Winch, 2010, p. 315).

General risks for developing in polder areas have become known over the years. Still, various risks need to be addressed or are still unknown. The likelihood of a future climate event can be classified as definite, impossible, or falling within the spectrum in between. The available information and to what extent the risk response is known has a direct impact on how the decision maker act (Winch, 2010). The decision-maker needs to act per cognitive state of risk differently. In broad terms, the differentiation between the four cognitive states of risk and the designated act becomes clear in a probability/impact matrix *(Figure 2.9).*

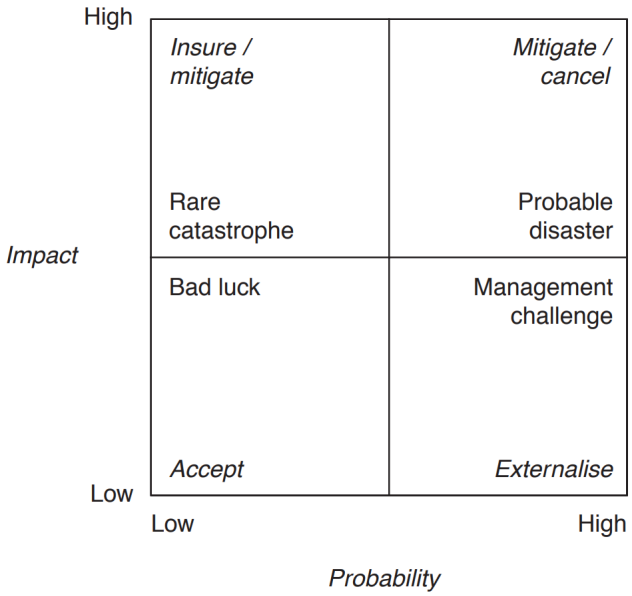


Figure 2.9. *Probability/impact matrix* (Winch, 2010, p. 319).

Although the probability/impact matrix can be seen as a backbone for risk management, it is up to the decision-maker to act to what extent they accept a certain risk. The decision maker makes the tradeoff whether or not the level of risk is worth the investment. The risk and uncertainty will always be present in an investment (Belli, Anderson, Barnum, Dixon, & Tan, 1998). The element of risk and uncertainty is a key consideration when making long-term investments. For example, in infrastructure projects, the lifespan of civil works can be up to 100 years. This requires decision makers to expect future challenges in the investment decision-making process, and uncertainties come into play (Bonfiglioli & Gancia, 2013).

One example of uncertainty for long-term investment decisions is the constant upcoming of new technical solutions during the lifespan of civil work. Additionally, climate change adds another layer of uncertainty, as it influences the effectiveness and resilience of infrastructure over time (Bonfiglioli & Gancia, 2013). Therefore, decision-makers may need to consider the far future in order to foresee issues and choose technical solutions that can handle extreme unpredictability (Nair and Howlett, 2014).

In literature, attention has been devoted to the exploration of frameworks designed to ease the investment decision-making process (Pot, Dewulf, Biesbroek, Van der Vlist, & Termeer, 2018; Teisman, 2000). Pot et al. (2018) argued that "Decision making evolves through more evolutionary and chaotic processes that are characterized by amongst others political conflicts, power struggles and framing contests". In this report, the research presented a framework that helps understand the process of forward-looking decision-making. Pot et al. (2018) divided the decision-making process into four distinct phases:

1. **Problem stream** – the problem definition that make up the problem stream in the decision-making process are dynamic and subject to change. Actors frame situations as problems based on their belief of the need for change.
2. **Solution stream** – This stream consists of the technical solutions drawn up by experts for the problems defined by decision-maker.

3. **Political stream** – The political stream includes political ideologies, coalition changes, and the pressure from outside authorities that support a certain issue.
4. **Choice opportunity stream** – When the decisionmaker is planning to produce and execute the decision. This stream includes regulation, procedures and norms that have influence on the decision.

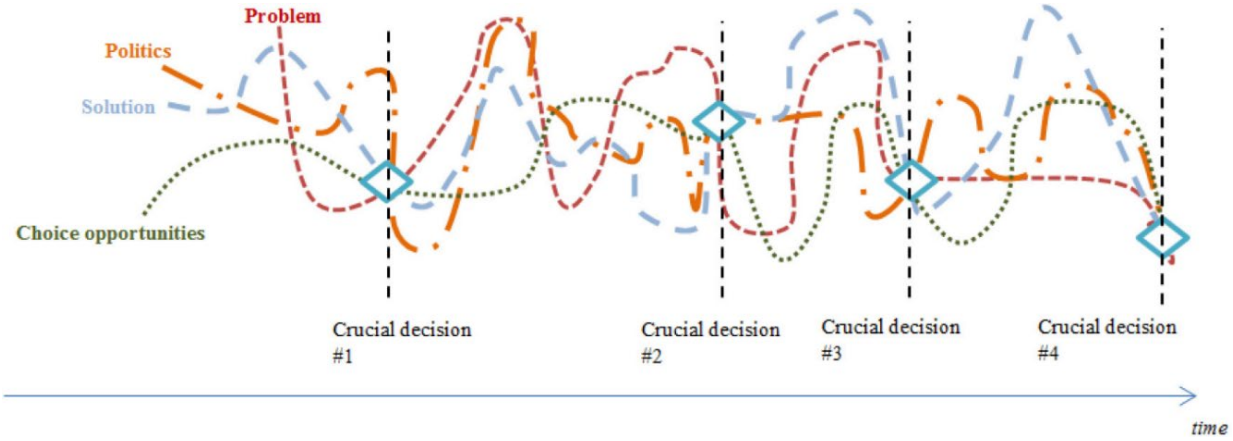


Figure 2.10. *Multiple stream model of decision-making (Pot et al., 2018).*

When the four streams line up with each other, decisions can be made (Howlett, McConnell, & Perl, 2016; Pot et al., 2018). As illustrated in *Figure 2.10*, the several streams begin to move separately until decision-makers link the four streams to make another decision for the same party. As described by Teisman (2000), it could take multiple decisions to invest in, following the example, new infrastructure. Therefore, the process uses rounds rather than phases. After a *crucial decision* (*Figure 2.10*), the decision changes the direction of the streams because it alters the conditions under which the decision will be made in the future.

The multiple stream model illustrates the decision-making process and the influence of a decision on the process and context itself. The multiple stream model is a framework for the process, not a tool for successful investment decision-making. The following paragraphs will focus on two tools, Cost-benefit analysis, and Cost-benefit Water, to support investment choices and decision processes.

Cost-benefit analysis

The Netherlands follows an evidence-based policy approach. To support investment choices due to policy change, the Cost-Benefit Analysis (CBA) is employed as a valuable tool (Romijn & Renes, 2015). Consequently, performing a CBA makes the (investment) trade-offs made by decision-makers traceable. The Dutch government has made it mandatory to incorporate Cost-Benefit Analysis (CBA) in major infrastructural projects that significantly influence the future of specific regions (Ministerie van Infrastructuur en Waterstaat, 2006). The purpose of conducting a CBA is to evaluate the potential positive and negative consequences of a policy or investment options on the long-term horizon (Spash & Hanley, 1995). By assigning a monetary value to all impacts, different alternatives can be easily compared, ultimately leading to a conclusive determination of the most advantageous choice.

What makes the link towards water management is the coping of uncertainty in Cost-Benefit analysis. CBA results have proven to be resilient, even in scenarios characterized by significant uncertainty (Asplund & Eliasson, 2016; Börjesson, Eliasson, & Lundberg, 2014). Decision-making is frequently required to be effectively supported from an economic standpoint by policy, legislation, and regulations (Ministerie van Infrastructuur en Waterstaat, 2006)

The process of the Cost-Benefit analyses divers, there is no single universally accepted method. The CBA approach of a large civil project is different than, for example, the CBA approach of a small start-up choosing between different packing methods. However, every process *(Figure 2.11)* usually consists of the five general steps (Hayes, 2023):

1. **Identify Project scope** – the first step involves comprehending the context, defining the objectives, and establishing a framework to shape the scope. The purpose of the cost-benefit analysis is to be formed through the project scope.
2. **Determine the costs** – The second steps lay the focus on the project costs. The costs may include direct costs, indirect costs, intangible costs (e.g., impact on customers), opportunity costs, cost of potential risks (e.g., regulatory risks).
3. **Determine the benefits** – the benefits of an investment opportunity might include the following: competitive advantages, intangible benefits (e.g., safety, customer satisfaction).
4. **Compute analysis calculations** – Once the input has been outlined, the later stage involves carrying out the analysis. This step includes the application of discount rates to determine the net present value (NPV) and performing a sensitivity analysis (risk assessment).
5. **Output, recommendation, and implementation** - This involves outlining the costs, advantages, net impact, and how the results finally support the analysis's initial objective.

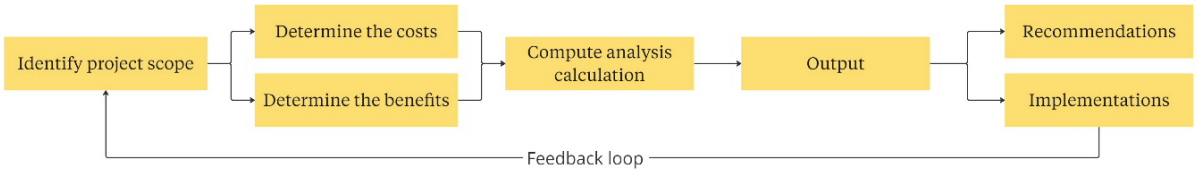


Figure 2.11. *Visualization of the cost-benefit analysis by Hayes (2023).*

Cost Benefit Water (CBW)
The government has devised a method for water management in the Netherlands that builds upon the fundamental principles of CBA, known as Cost-Benefits Water (Dutch: Kosten Baten Water). The objective of this method is to enhance the efficiency of (water) authorities by facilitating careful decision-making and policy formulation through the use of a standardized approach, adjusted for the context of water management ("Kosten Baten Water," n.d.). The CBW method is closely linked to national instruments used by the government. It encompasses three modules:1, the financial module; 2, the socio-economic module; 3, the social costs-benefits analysis. In practical terms, the KBW methodology closely resembles a standard CBA. The key difference lies in module 2 of CBW, which accounts for the contextual influences and indirect consequences ("Kosten Baten Water," n.d.).

Limitations in the Cost-Benefit Analysis
Although the CBA is a widely used, robust and resilient method (Asplund & Eliasson, 2016; Börjesson et al., 2014), the CBA has shortcomings for long-term investment tradeoffs for environmental issues (Ludwig, Brock, & Carpenter, 2005). Discounting the cashflow, a method that places more importance to the present than the future, is part of the CBA. The validity of using a discounted cashflow has been called into question when long-term effects are involved. Due to (extensive) discounting, long-term effects have the potential to become neglectable (Gollier & Weitzman, 2010; Ludwig et al., 2005).

In addition, the CBA consists of many assumptions. In the context of water management, the impact of climate change is addressed, but the weight and consequences of the impact are still an ongoing process of research. Nevertheless, the CBA approach still consists of various premises (Munda, 1996). This makes the CBA tangible for its changing context.

To conclude, the Cost-benefit analysis has its limitations, which hold significant weight when it comes to climate-related decisions. These limitations primarily stem from the substantial level of uncertainty involved and the imperative need for a long-term perspective. However, there is no need to outright dismiss the model. When it comes to complex issues, such as climate change, decision-making necessitates a strong foundation in quantitative and scientifically informed analysis within a well-organized framework, as embedded in the CBA approach, as Weaver et al. (2013) addressed. Utilizing the CBA approach for climate-related decisions can still pose challenges. These challenges encompass determining which factors should be included in the evaluation of benefits and costs, assigning value to intangible aspects that lack market prices, finding a proper balance between present and future costs/benefits, and addressing uncertainties surrounding the future (Weaver et al., 2013).

Lempert et al. (2013) advocates for the fact that the limitations of the CBA approach lie in the way of use, not in the approach itself. In his report, he describes that the CBA can be utilized as part of a process that includes a range of ethical viewpoints. This inclusive approach evaluates which combinations of viewpoints have the most significant impact on the ranking of proposed decision options. The information gathered is then utilized to identify and foster consensus on actions that exhibit robustness across a broad spectrum of these viewpoints (Lempert et al., 2013).

2.4. Conceptual framework

Based on the theoretical background, a conceptual framework can be drawn up. The relationship between the concepts of climate risks, climate adaptive measures, the investment decision-making process within Public-Private-Partnerships (PPP) on Polder area development is illustrated in *Figure 2.12.* The presence of climate risks leads to the necessity of adaptive measures in the built environment. Funding these measures has an impact on investment decision-making within the PPP's. The outcome of the investment decision-making process has an impact on the level of robustness of the polder area development (PAD), which may lead to future-proof area development. Within the process, the financial mechanisms present can stimulate the development or implementation of specific flood measures (e.g., climate adaptation measures). The presence of climate risks and the investment decision-making process have had, in turn, an impact on the urban area development of the Netherlands.

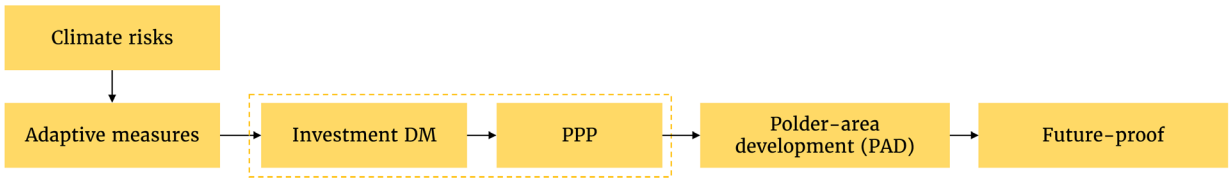


Figure 2.12. *Conceptual framework (author).*

Section III

Research design

Research design
Case study selection
Data collection and analysis
Data plan
Ethical considerations

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The research introduction has presented the main research question along with its sub-questions. The study aims to acquire a better understanding of the investment decision-making process for implementing climate adaptation, focusing on reducing flood risk in residential urban areas in the Netherlands. Therefore, it uses a qualitative research technique.

As stated in the introduction, this study aims to gain valuable insights into the challenges involved in investment decision-making through two intensive case studies and qualitative interviews. The findings will be compared to standard practice, with the use of validity interviews. This provides a robust assessment of the investment decision-making process and highlights potential gaps for further development.

3. Research design

This research seeks to investigate the impact of water risks on the investment decision-making process in polder-area development projects in the Netherlands. The research uses a variation of methods to answer the sub-questions and main research questions. A literature review, exploratory interviews, case studies (including in-depth interviews) and an expert panel is conducted to answer the main research question *(Figure 3.1)*. This chapter elaborates on research design, the data collection and analysis methods, data plan, and ethical considerations.

Figure 3.1. *Simplified research approach (author).*

In the following section, the research design is described. The research consists of theoretical research, presented in Section II – *Literature Review*, and empirical research, presented in Section IV – *Results*. The research methodology framework is presented in *Figure 3.2.*

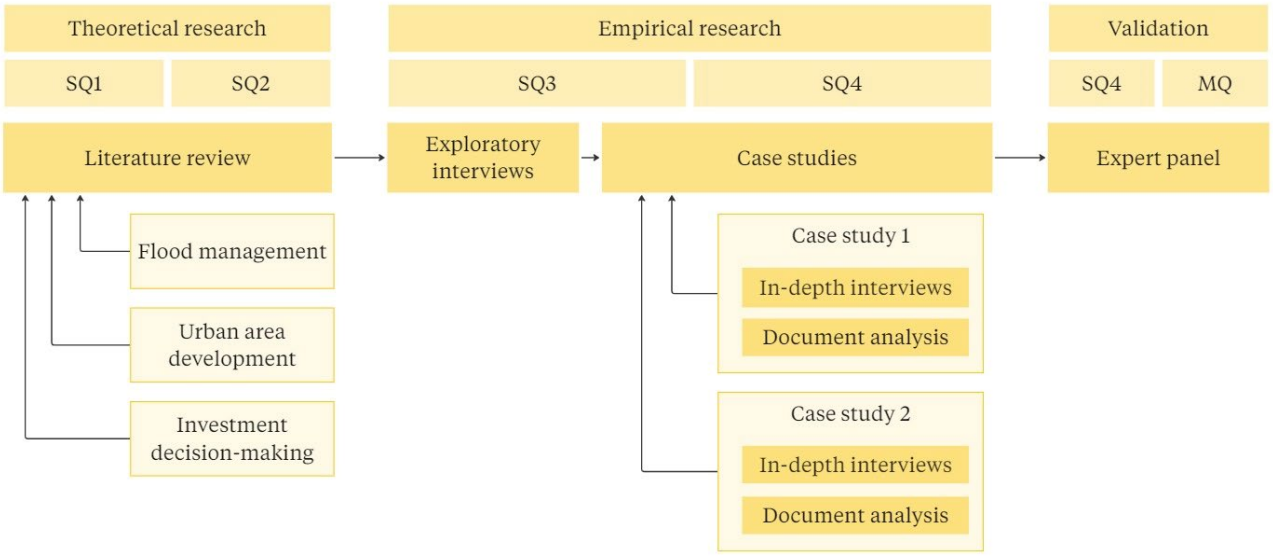


Figure 3.2. *Research methodology (author).*

Theoretical research designs

This study has first conducted theoretical research for the theoretical background, exploring the main concepts such as flood management in the Netherlands and the investment decision-making process. The objective of the literature study is to enhance a grasp on the water management policies and the 'standard' investment decision-making process in the context of urban area development. The theoretical research delved deeper into PPP-frameworks and how responsibility and risk are distributed during different project phases. These studies contributed to the analysis of the case studies.

After the framing of the theoretical background, the research strives to answer two sub-questions:

2. How do policy- and decisionmakers navigate the path toward reducing water-related risks in the Netherlands over time?
3. What does the investment decision-making process in urban area development entail?

The answers on these two sub-questions help get a better understanding before conducting exploratory interviews, the case studies (with in-depth interviews), and expert panel.

Empirical research designs

This research will comprise a multi-case study design that aims to provide profound insights into the subject matter. The case study method has been chosen to ensure a comprehensive and in-depth understanding of the subject matter being investigated. This paragraph aims to provide further details on the empirical research conducted in this study, which encompasses various approaches, including exploration interviews, case studies involving interviews, and an expert workshop. The empirical research concerns the following questions:

4. What are the standpoints of stakeholders involved in the Decision-Making Process regarding adaptation investments?
5. To what extent can the allocation of responsibility and risk be distributed between public and private stakeholders in polder-area development?

The empirical research consists of exploratory interviews with experts in the field of climate adaptation, in-depth interviews with stakeholders of two case studies, and an expert panel to validate the findings.

3.1. Case study selection

The case selection is performed based on project databases online and exploratory interviews. The exploratory interviews help with getting an understanding of the (complex) projects, their relevance to climate change and additional internal information. The project data is collected through academic resources (TU Library, Google Scholar etc.), non-academic online databases (e.g., Deltares, Kennisportaal Klimaatadaptatie), and information gained via Fakton Consultancy and exploratory interviews. *Figure 3.3* illustrates the case selection process employed in this research, providing a visual representation of the methodology followed.

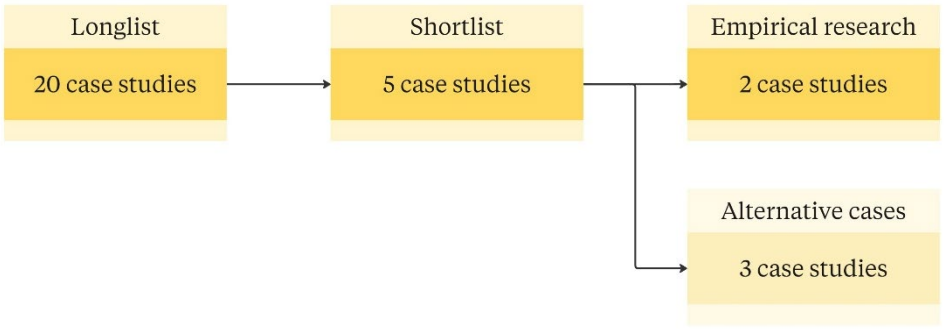


Figure 3.3. *Case study selection process (author).*

The shortlist is conducted based on the following predetermined selection criteria:

- **Location**: Relevance of climate change, flood hazard and flood management to the area.
- **Involved actors** (public/private): the structure of stakeholders within the project is important. The involvement of a public party is important.
- **Size**: +1000 dwellings. A representative urban area development project

- **Completion**: variety of new and in-function project.
- **Data available**: there is data available, and stakeholders have the will to cooperate.

With the use of the selection criteria, the following shortlist, containing five case studies in the context of polder-area development, is drawn up *Table 3.1*.

Table 3.1. Shortlist of case studies

Project name	Location	# dwellings	Phase
Westergouwe	Gouda, Zuid-Holland	4,500	Realization
Gnephoek	Alphen aan den Rijn, Zuid-Holland	3,800	Initiative
Reevedelta	Kampen, Overijssel	3,500	Realization
Het Vijfde Dorp	Zuidplas, Zuid-Holland	4,200	Initiative
Rijnenburg	Utrecht, Utrecht	20,000-40,000	Initiative

Based on the established selection criteria, Westergouwe and Gnephoek have been designated as the primary case studies. Especially the data availability and the willingness of stakeholders to participate were the most important decisive criteria. Furthermore, these particular cases hold considerable significance for Fakton Consultancy, the graduation company, thereby supporting the process of engaging the interviewees. The remaining three cases will serve as alternative options in case circumstances require a change in the selection.

3.2. Data collection and analysis

The various research methods demand different methods for data collection. Table 3.1 illustrates the relation between the data collection methods and the output, related to the sub-questions. The gathered data in the theoretical and empirical research is analyzed with the use of two methods: content analysis (Stemler, 2015) for the theoretical research and case study documents, thematic analysis (Clarke, Braun, & Hayfield, 2015) for the exploratory interviews, in-depth case studies and expert panel. The interviews are held in Dutch, the results (e.g., quotes) are translated to English and checked by the interviewee.

Table 3.2. Mixed-method approach: relation between data collection and output

Type of research	Data collection method	Amount	Output
Theoretical research	Literature study	Depending on availability and quality of resources	SQ-1 SQ-2
Empirical research	Exploratory interviews	Depending on quality and output	SQ-2 SQ-3
Empirical research	Analyzing internal and external documents	2 case studies	SQ-2 SQ-4
Empirical research	Interviews with actors	Per case, 3-4 interviews (6-8 in total)	RQ-2 RQ-3 RQ-4 MRQ
Empirical research	Expert panel	5 attendees	MRQ

To conduct a thorough theoretical study, both Google Scholar and Scopus databases were utilized to identify relevant sources. Publications specifically focused on the Netherlands were selected to ensure the manageability and applicability of the number of papers. The initial batch of papers underwent multiple filtering stages to arrive at a final list of literature that was deemed relevant. This filtering process involved eliminating duplicates, excluding papers written in languages other than English or Dutch, removing articles behind paywalls that were inaccessible, and screening for relevance by reading the abstracts. The combination of Google Scholar and Scopus proved beneficial in this regard, as Scopus's database primarily includes peer-reviewed literature, while Google Scholar supplemented this with technical reports and other pertinent content.

The empirical research consists of exploratory interviews, two case studies in the context of polder area development, and an expert panel. The case studies are supported by documentation analysis and in-depth interviews with stakeholders involved in the decision-making process. To strive for validity of the findings, data source triangulation is used in the empirical research (Carter, Bryant-Lukosius, Blythe, & Neville, 2014), which means that the collected data of interviews is supported by other statements or case documents. *Figure 3.4* illustrates an example of triangulation in this research.

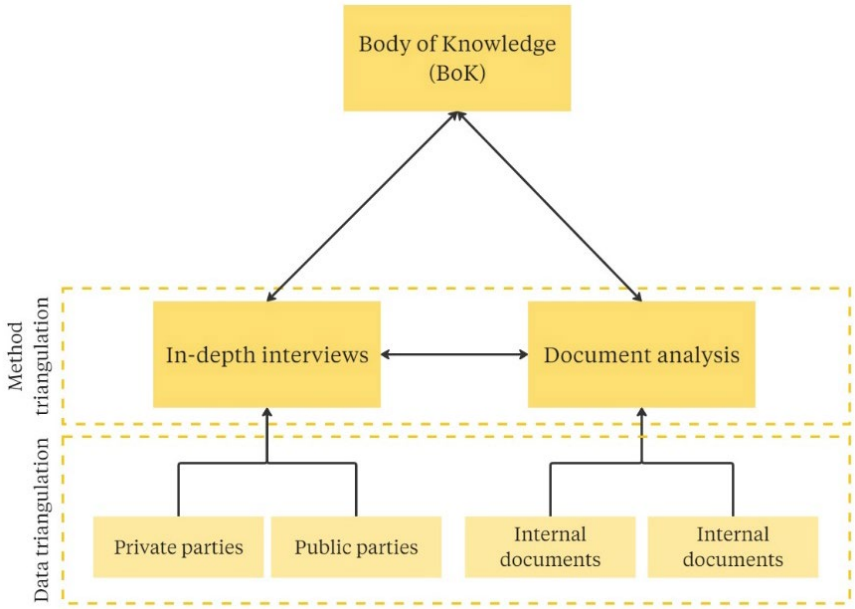


***Figure 3.4**. Method and data triangulation, based on Carter et al. (2014).*

Document analysis

The analysis of the two chosen cases, Westergouwe and Gnephoek, encompasses an examination of their contextual factors, dynamics, and the outcomes of the investment decision-making process. The central emphasis is on the mitigation of climate risks through the implementation of adaptation measures. The pertinent documents were acquired through online databases (e.g., Open Overheid and Bestuurlijke Informatie), and/or provided by interviewees. Predominantly, these documents consisted of decision-making and policy documents.

Exploratory interviews

The exploratory interviews serve as a starting point and valuable tool for gaining a deeper understanding of climate adaptation in the built environment. The exploratory interviews are open-ended, giving the interviewee room for their insights and expertise. The interviews are conducted based on three themes that was supported by the literature presented in Chapter II: *Literature Review*, as presented in *Appendix A: Interview protocol (Dutch).* Besides the gained information, this approach allows for a more comprehensive and nuanced analysis of the chosen cases. For the exploratory interviews, the transcripts are analyzed, based on themes and important quotes. The interviewees (n=5) are listed as displayed in *Table 3.3*.

Table 3.3. List of interviewees, exploratory interviews

Interviewee	Company	Function
I	Deltares	Expert Water- and Soilsystems
II	Fakton Consultancy	Expert-Market Director
III	Verbond van Verzekeraars	Policymaker
IV	Ministery of I&W	Senior Policymaker
V	ASR Real Estate	Researcher

In addition to the exploratory interviews, information was gained through informal conversations with experts met on the 'RED&BLUE Symposium' and the 'National Deltacongres'. The conversations resulted in a collection of small but significant pieces of information and getting a grasp of the interesting frames.

In-dept interviews

The in-dept interviews are conducted with decision-makers within the selected case studies. The interviews were semi-structured, whereby a few questions are pre-determined (Appendix A: Interview protocol (Dutch)). The objective of the in-dept interviews was to delve into the complexities and nuances of the challenges, stakeholder's roles, and decision-making process within the context of polder-area development. The semi-structured method leaves room for enabling a deeper exploration of the factors influencing the investment decision-making process, such as the role of the PPP-framework and climate risks.

The interviewees of the in-depth interviews were selected based on purposive (convenience) sampling. Each interview has two characteristics:

- Stakeholder in the PPP-framework of the selected urban area development. Part of a public or private party.
- The interviewee is an investment decision-maker.

The objective of the in-depth interviews was to gather many perspectives to identify important factors, top priories and potential prospects. An overview of the in-depth interviews conducted (n=8) is listed as displayed in *Table 3.4*.

Table 3.4. List of interviewees, in-depth interviews

Interviewee	Case	Party	Type
A	Westergouwe, Gouda	Public	Municipality
B	Westergouwe, Gouda	Public	Water authority
C	Westergouwe, Gouda	Private	Fakton Consultancy
D	Westergouwe, Gouda	Private	Developer
E	Gnephoek, Alphen aan den Rijn	Public	Municipality
F	Gnephoek, Alphen aan den Rijn	Public	Water authority
G	Gnephoek, Alphen aan den Rijn	Public	Province
H	Gnephoek, Alphen aan den Rijn	Private	Developer

This research uses cross-case and multi-stakeholder analysis to draw up findings. The results between public and private parties are within the case analyzed and compared. After that, the two case studies *Figure 3.5* illustrates the data analysis process.

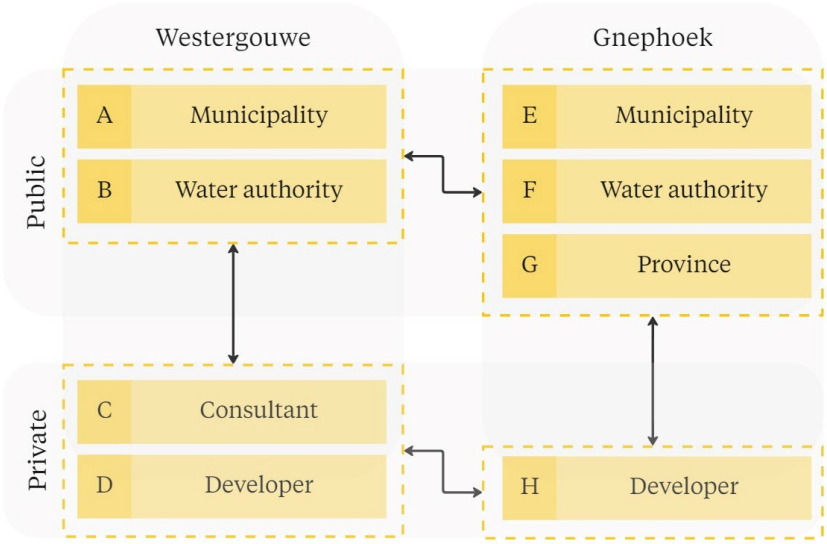


Figure 3.5. *Cross-case and multi-stakeholder analysis (author).*

The in-depth interviews are thematic analyzed with the use of Atlas.ti software, based on a mix-method approach, with the use of deductive codes from literature and inductive codes from the exploratory interviews. The codes are categorized in different code groups, as displayed in *Table 3.5*. To give an overview of the findings of the in-depth interviews per code, a codebook is drawn up in Appendix C: Codebook

Table 3.5. Codes of the in-depth interviews

Theme	Code group	Code
Water management	Physical risk	Flood hazard
		Water overload
		Soil subsidence
	Measure management	Climate adaptive measures
		Measures in public space
		Water levels
		Deflect
		Side effects
	Responsibility	Future responsibility
		Maintenance responsibility
Urban area development	Initiative	Context difficulties
		Role of public parties
		Role of private parties
	Governance	Control
		Dependency
		Long-term involvement
		Obligations
		Organization structure
		Ownership of land
	Responsibility	Governance responsibility
Investment decision-making process	Decision-making	Decision outcome
		Objective decisions
		Subjective decisions
		Lack of knowledge/expertise
	Non-physical risks	Policy risk
		Sales risk
		High ambition
		Public sentiment
		Project delay
	Costs/funding	Cutbacks
		Affordability
		Funding methodology
	Benefits	Private party
		End-user
		Municipality
	Responsibility	Allocation of responsibility
		Funding responsibility

Expert Panel

The findings of the in-depth interviews are presented in an expert panel. The objective of the panel was to align the case study findings with standard practice. The panel was internally composed (purposive sampling), with four experts with an expertise in urban area development, acquainted with PPP-frameworks and the implementation of climate adaptive measures. A noteworthy characteristic among these experts was their impartiality; none of them had any direct involvement in the two case studies.

The expert panel adopted a semi-structured format, as outlined in Appendix A: Interview protocol (Dutch). With the use of the findings from the exploratory interviews and case studies, provocative statements were formulated in alignment with the conclusions. The statements aimed to stimulate a discussion regarding notable observations in the findings and the experts' reflection on practical implementations. Moreover, the conclusions were refined or nuanced through the outcomes of the expert panel.

Table 3.6. List of attendees, expert panel

Attendees	**Company**	**Function**
P-A	Fakton Consultancy	Partner
P-B	Fakton Consultancy	Senior-Consultant
P-C	Fakton Consultancy	Consultant
P-D	Fakton Development	Director
P-F	Fakton Development	Associate Partner

3.3. Data plan

To ensure effective data management throughout this research process, a data management plan has been developed (Appendix D: Data management plan). The plan outlines the procedures for data analysis, aligning them with the research questions and objectives. The data management plan adheres to the FAIR data principles, which emphasize Findability, Accessibility, Interoperability and Reusability (FAIR). These principles guide the handling and documentation of the research data. By incorporating the FAIR principles, this research strives to enhance the overall quality and accessibility of the collected data.

In this research, attention has also been dedicated to safeguarding the data of the interviewees. The nature of the study allows interviewees to speak about their professional roles. For privacy considerations, all individuals involved in this research have been pseudonymized.

Upon completion of this research, the findings will be shared through the TU Delft Repository (www.repository.tudelft.nl). By making the research available through the TU Delft Repository, this study can reach a wide audience and can contribute to the advancement of knowledge in the field of flood management and residential urban area development.

3.4. Ethical considerations

In *ethical considerations in Qualitative study*, Arifin (2018) addresses ethical considerations in qualitative research. These considerations are in line with the four principles of ethical considerations by Diener and Crandall (1978). The four ethical considerations are as follows:

- Informed consent
- Voluntary participation
- Anonymity
- Avoiding exaggeration of objectives

All types of data collection throughout this research are voluntary. Participants have the option to remain anonymous, and their full consent is sought before involvement. Privacy protection measures are strictly adhered to, particularly when dealing with potentially confidential data. Safeguarding this privacy and confidentiality of participants is important throughout the research process. It is ensured that the objectives of the research are not exaggerated. Transparency and integrity are maintained in presenting the research goals, avoiding any misrepresentation of the objectives. This study aims to uphold the principles of ethical conduct.

Section IV

Results

Exploratory interviews
Case studies
Westergouwe, Gouda
Gnephoek, Alphen aan den Rijn
Expert Panel

4. Results

This chapter presents findings of the exploratory interviews, findings of the case studies, the document analysis and in-depth interviews, and validation with the use of an expert panel. This chapter is structured as follows: First, it presents the findings from exploratory interviews conducted with experts, researchers, and policymakers. The interviews served as support for the concepts of water management, decision-making and public-private partnerships in the context of climate adaptation. Second, empirical research delves deeper into two case studies: Westergouwe in Gouda and Gnephoek in Alphen aan den Rijn. Finally, an internal expert panel is enlisted to validate the primary findings.

4.1. Exploratory interviews

Open-structured exploratory interviews were conducted with the interviewees as presented in *Table 4.1*. The insights garnered from these exploratory interviews served as a foundation for the subsequent case studies, offering focal points for in-depth interviews and a deeper understanding of the three key concepts: water management, decision-making, and public-private partnerships.

Table 4.1. List of interviewees, exploratory interviews.

Interviewee	Company	Function
I	Deltares	Water Expert
II	Fakton Consultancy	Market Expert
III	Verbond van Verzekeraars	Policymaker
IV	Ministery of I&W	Policymaker
V	ASR Real Estate	Researcher

The interview consists of four themes throughout the conversation: Risk assessment, (stakeholder) responsibility, Real estate values, and laws and regulations.

Risk assessment

The interviewees unanimously agreed that there are climate risks in the built environment. The likelihood of the Netherlands experiencing flooding from primary defenses is very low, as mentioned by interviewee IV. In fact, the level of water risk is also influenced by the perspective of an individual, as per Interviewee I:

> *"If you're familiar with living in the polder and accustomed to the differences in elevation, you tend to be used to the situation. Your experience thus far, is that the water system is capable of handling extreme situations" – Interviewee I*

Risks such as the potential for secondary levee breaches or extreme rainfall events were mentioned by Interviewee I, II and V. Additionally, land subsidence is a significant risk associated with polder area development, as emphasized by interviewee IV and V. Related to these risks, water storage is a critical consideration for building in the polder. Interviewee I argue that the risk must be addressed within the borders of the polder, without shifting risks to surrounding areas or existing infrastructure. The extent of risks is determined by the location and specific characteristics of real estate. Nevertheless, (national) policy decisions have a significant impact on the level of risk within an area (Interviewee I; II). Interviewee I advocate that such crucial decisions should be based on scientific insights to assess risks effectively. Policy and location selection are intertwined, as illustrated by Interviewee IV, who stated:

> *"The question of 'where to build' is more controversial than the how, as there is now a greater consensus on the latter". – Interviewee IV*

Different stakeholders approach risk assessment in distinct ways. For instance, Interviewee II notes that investors must rely on qualitative evaluations for real estate investments in climate-risk-prone areas, because the financial impact cannot be sufficiently proven by comprehensive financial model. Investors primarily focus on assessing the degree of risk reduction. Meanwhile, Interviewee V sees the incorporation of climate adaptive measures into the gross initial yield as a crucial next step.

Both investors and developers currently adopt a wait-and-see approach regarding municipal decisions on construction permissions and closely observe market dynamics, product demand, and specific product requirements, as indicated by Interviewee II. Insurers, on the other hand, attempt to gauge risk profiles based on quantitative historical data and predictive analytics.

In addition, Interviewee I raises awareness of additional challenges arising from construction in low-lying polders, particularly concerning water quality issues. These secondary concerns often surface later, either during or after the project's completion. Water quality problems, including seepage, have also been substantiated in Interview A and B (Westergouwe)."

Real estate values

According to Interviewee I, a well-defined spatial plan can be instrumental in preserving property values. The key lies in delineating the areas that require protection against flooding. Once the location selection is made, the focus should shift towards achieving the most climate-adaptive development. Interviewee I articulates this perspective as follows:

> *"There is a need to build. But we should look carefully at which areas we designate for construction. And once a location has been chosen, we must design and construct in an effective way that suits this location and results in climate robust urban areas". – Interviewee I*

When an area is deemed high-risk, it is likely to have an impact on property values, as pointed out by Interviewee I and Interviewee II. However, Interviewee IV highlights that a climate-adaptive neighborhood can positively affect property values. These neighborhoods are often characterized by lush greenery, and residents have confidence in their protection against climate risks, resulting in less damage during water-related incidents. Notably, parties with sustainability ambitions, such as sustainable investors, are generally willing to incur additional costs to mitigate climate risks (Interviewee II). Nonetheless, this willingness is relatively lower compared to investments in technical climate mitigation measures, such as heat pumps, as the benefits or returns are more transparent, and there is a prevailing notion that "it has to happen at some point" (Interviewee II).

In the short term, it is likely that property values will remain stable despite climate risks, as emphasized by Interviewee II:

> *"It will take a long time before we see a difference in property values. The next few years there are probably investors who are willing to take on the risks." – Interviewee II*

Interviewee III notes that the extent of climate risks is not currently a decisive factor for investors when deciding whether to purchase a product (e.g., homes). Various parameters, including potential mitigation measures, are factored into a cash flow analysis, guiding decision-making. Climate risks do not seem to significantly influence the rental market either:

> *"Living in a climate-resilient manner does not necessarily translate into the ability to charge higher rent. The costs are not borne by the end user. Instead, the investor needs to accept a lower return on investment to implement these measures." – Interviewee V*

The stability of property values in the face of climate risks, according to experts, is primarily attributed to the short time horizon of stakeholders. Investors frequently rely on a 15-year model (Interviewee II; V), while insurers adopt a similar time frame. Interviewee III raises the point:

> *"It's possible that something that is currently insurable may become uninsurable in a few years due to the risks it poses." – Interviewee III*

Responsibilities

Among the interviews, a unanimous consensus emerged regarding the allocation of responsibility, with a significant burden placed on public entities, including government bodies, provinces, and municipalities. Interviewee I underlines this perspective:

> *"The government must ensure that a citizen is aware of climate risks and is able to determine if a home is in a location or area in which insurance against flooding is costly or even impossible." – Interviewee I*

It is the role of the government and municipalities to support market participants in making well-informed choices and safeguarding end-users from climate risks, as emphasized by Interviewee II. Market players, due to their limited involvement, may not be adequately equipped for this task. In addition, private buyers often lack the ability to fully comprehend the associated risks. Nonetheless, Interviewee III contends that market

participants are obliged to disseminate their expertise on the subject to government bodies, municipalities, and end-users. Insurers, for instance, can provide recommendations for risk mitigation to end-users residing in high-risk areas (Interviewee III). Interviewee IV underscores that the key to addressing these challenges lies in making prudent location decisions:

> *"When there's a requirement to build a certain number of homes, it's also the responsibility to carefully consider where and how these homes are constructed in relation to climate risks." – Interviewee IV*

Continuing the conversation, Interviewee IV further explains:

> *"I believe the most significant gains are to be made at the initiative. It involves including and truly integrating climate adaptation into planning and design. Thoughtful consideration of your choice of location can take you a long way. So, it essentially starts with policy and communication, and it's also a matter of taking responsibility." – Interviewee IV*

Laws and regulations

Almost all interviewees concur with the necessity of establishing guidelines for climate-adaptive construction. One approach involves allowing public entities to designate locations. The government decides if specific areas are suitable for housing development, and market players adhere to these determinations (Interviewee I; II). The municipality, in collaboration with the water authority, would then meticulously outline the conditions they provide to developers or builders (Interviewee I). Moreover, it is suggested:

> *"Legislation and regulations can be integrated into the building code quite easily, incorporating climate-adaptive construction standards into existing building regulations." – Interviewee I*

In cases of damage resulting from water-related incidents, insurers emphasize the importance of adaptive restoration (Interviewee III). This approach could mitigate future damage. According to Interviewee III, this should be enshrined in legislation, making it obligatory for everyone to adhere to.

These sentiments are echoed in discussions with Interviewee IV and V. For instance, Interviewee V mentions that investors will only embrace incorporating climate adaptation when other investors do the same. Additionally, climate-adaptive measures are often the first to be discarded when cost-cutting measures are necessary, as highlighted by Interviewee IV. This also facilitates long-term funding for climate-adaptive measures. As an example, Interviewee IV stated:

> *"If equal requirements are imposed, standardizing climate-adaptive measures becomes much more straightforward." – Interviewee IV*

However, there are risks associated with legislation and regulations. They could be misused by other parties, leading to the exclusion of climate-risk areas from investments, just when these areas need it (Interviewee IV).

To conclude, in the interviews, experts, policymakers and a researcher shared their perspectives on successful urban area development. With the results presented in the preceding paragraphs, a conclusion can be drawn based on four key takeaways: Risk assessment, need for national policy, different approaches among stakeholders, and public responsibilities for climate adaptation *Figure 4.1.*

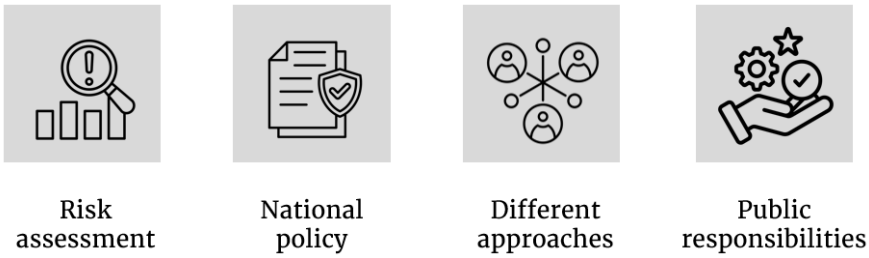


Figure 4.1. *Findings on the exploratory interviews (author).*

First, consensus on risk assessment is essential. A thorough risk assessment leads to the right location (INT-IV). Once there is agreement on the risks associated with different locations, a distinction arises between good, less favorable, and poor location choices. Currently, the degree of risk is determined differently by each stakeholder (INT-IV; INT-V), and therefore, the choices of location can contribute to the uniformity of risk assessment.

Subsequently, national policy can and does have a significant impact on the level of risk in an area (INT-I; INT-II). Water safety is nationally coordinated, inherently linked with the built environment. The public party (INT-II; INT-III; INT-IV), and specifically the national government (INT-I; INT-V) are responsibility for sound and clear policies regarding this subject. Government and municipalities play an important role in supporting private parties in making informed choices and protecting end-users from climate risks. On the other hand, it is the responsibility of private parties to provide public parties with the right knowledge and information (INT-III). Collaboration between public and private is crucial.

Examining investment decision-making, investors with high sustainability ambitions are willing to invest in climate-adaptive measures (INT-V). However, there is a lower willingness compared to climate-mitigating measures, such as installing a heat pump. This aligns with the challenges of financing climate-adaptive measures (INT-I; Khan, Robinson, Weikmans, Ciplet, & Roberts, 2020). This results in no observable price difference in property values, and it is unlikely to change in the coming years (INT-V). This is because climate risks are not yet part of the decision-making process for the purchase of new products (homes) (INT-II; INT-V).

Lastly, there is a need for legislation and regulations. Through standardization, financing would be less project-dependent (INT-IV). Two approaches can be distinguished in this regard. On the one hand, climate-adaptive requirements can be incorporated into the building code (INT-I). On the other hand, governments can regulate the location choice. Municipalities and water authorities can assess suitable locations. Developers/buildings only execute the development and are involved later in the process (INT-I; INT-IV).

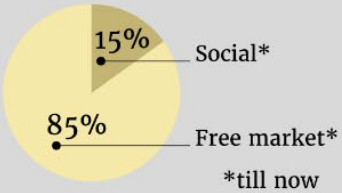
Size:	**200 ha**
Dwellings:	**4,500**
Phase:	**Realization phase**
PPP:	**Developing apart together (DAT)**
Level:	**NAP -6,30**

Characteristics

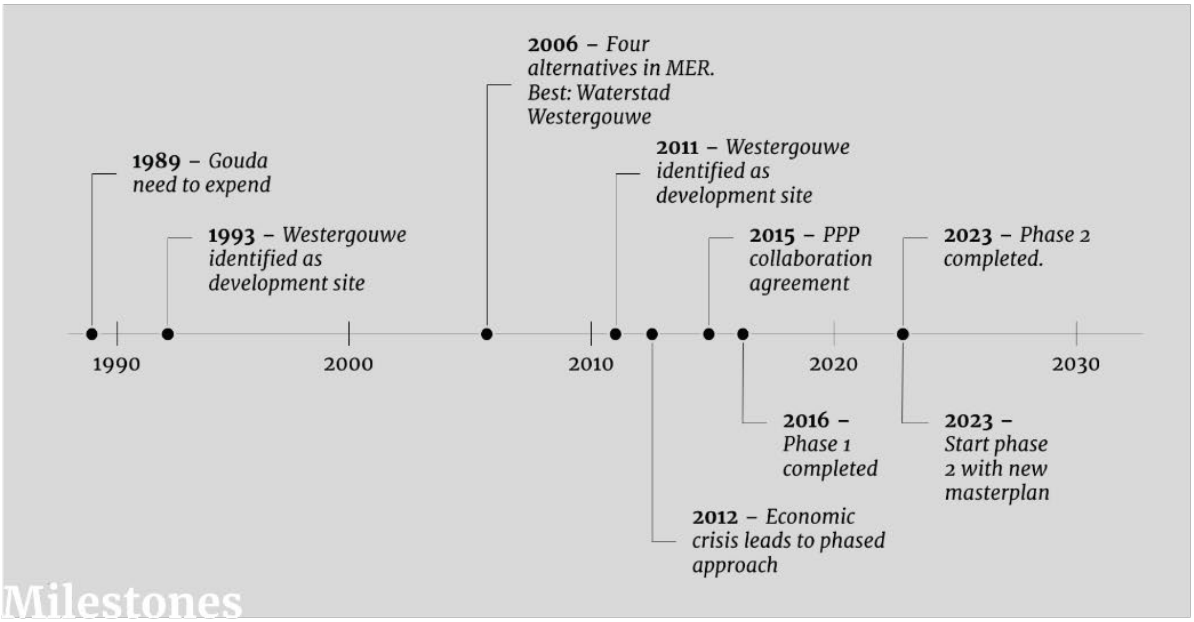
Soil subsidence

Floodrisk

Water drainage



Program



Milestones

***Figure 4.2**. Factsheet of Westergouwe, based on interviews and Gemeente Alphen aan den Rijn (2023b).*

The findings of Westergouwe are presented according to the benchmarked urban area development timeline. For the case of Westergouwe, the following stakeholders were interviewed, presented in *Table 4.2*.

Table 4.2. List of interviewees, in-depth interviews Westergouwe

Interviewee	Case	Party	Company
A	Westergouwe, Gouda	Public	Municipality
B	Westergouwe, Gouda	Public	Water authority
C	Westergouwe, Gouda	Private	Consultant
D	Westergouwe, Gouda	Private	Developer

The context of the UAD

Westergouwe, in the Zuidplaspolder located in West-Gouda, is a residential urban area development comprising approximately 4,500 dwellings. The low laying polder had a pre-construction water level between NAP -6.30 and -6.50 meters. The difference in elevation is still clearly visible. The ridge height is approximately equal to the height of the adjacent dike (INT-C; INT-D). The second phase of the area development was completed in 2023, bringing the total to 1,000 realized dwellings (INT-D). Due to the dating of the zoning plan, a new zoning was introduced: Westergouwe 2.0'. The changes resulted in a different program, focusing on more social and mid-priced housing (Gemeente Gouda, 2023; Projectbureau Westergouwe, 2020).

Throughout the establishment of Westergouwe, decisions were made by public and private parties to mitigate climate risks, such as implementing climate-adaptive measures to counteract flood hazards, waterlogging during heavy rainfall, and soil subsidence.

The factsheet (*Figure 4.2*) presents the project timeline, highlighting the key milestones:

1. In 1989, the necessity for the expansion of Gouda is acknowledged. Westergouwe is identified as a development location in the 1993 covenant. However, water risks and traffic issues play a significant role in the modification of the zoning plan (INT-A; INT-D).
2. In 2006, the Environmental Impact Assessment (MER) outlines four alternatives. Waterstad Westergouwe is deemed the most favorable alternative. Following the approval of the zoning plan, the development of the polder begins in 2011 (Gemeente Gouda, 2012b).
3. Due to the crisis in 2012, the municipality announces the decision to phase the project. This involves dividing the land development into stages, mitigating and spreading risks (INT-A; Gemeente Gouda, 2012a; Gemeente Gouda, 2012b).
4. In 2015, public and private parties sign a collaboration agreement. For the development, Heijmans and VolkerWessels formed a consortium under the name VOF Westergouwe. The municipality collaborates with VOF Westergouwe through the Westergouwe Project Bureau (INT-A; INT-D).

5. In 2016, phase 1 is completed. In the same year, phase 2 commences. By 2023, this phase is concluded and delivered, marking the beginning of the penultimate phase (Gemeente Gouda, 2015, 2016).

Initiation phase

In the 1970s, the land was acquired by the State with the initial intention of establishing a women's prison. However, when this initiative fell through, the land was subsequently offered to the municipality of Gouda (INT-D). The initiative for housing plans emerged in 1989, driven by the aspiration to expand the city outskirts and search for suitable building locations. The attention shifted to the Zuidplaspolder, where the municipality owned part of the land (Gemeente Gouda, 2012b). Simultaneously, private parties such as Heijmans and VolkerWessels held land. Early involvement of these parties in the initiative phase ensued, aligning with the third possibility outlined by Bult-Spiering et al. (2005): Involvement due to Project Characteristics. The municipality strategically deemed it necessary to involve these parties early in the planning process due to their speculative land acquisitions (INT-A).

Throughout the planning phase, commencing in 1993, the choice of location became politically sensitive (INT-D). The decision-making process concerning the initiative encountered obstacles and eventually resulted in a pronouncement by Minister Dekker of the Ministry of VROM (INT-D; Gemeente Gouda, 2012b). Additionally, the water authority opposed the housing plans, advising against construction in the low laying polder (INT-C).

> *"It's the softest ground, softer than any we have. So, how could you even entertain the idea that it's a good plan to build here?" - INT-B*

Following the decision of the Ministry of VROM, the water authority was requested to reconsider its stance and shift focus towards determining how climate-adaptive construction could be implemented (INT-C). The housing development was permitted to proceed on the condition that the floor level of the homes was not lower than the inundation level of the polder (INT-C; INT-D). The involvement of the former Ministry of VROM is noteworthy, as a typical area development is not typically assessed in the parliament or by a minister (INT-C; Gemeente Gouda, 2012b). As discussed in *chapter 2.2*, each involved stakeholder has the capacity to adequately weigh choices themselves, including whether or not to build (Franzen et al., 2011; Zeeuw, 2018). With the approval from the ministry, subsequent steps were taken in the planning of Westergouwe.

Governance

Due to the characteristics of the project, with land ownership divided equally between the market parties and the municipality, a public-private partnership (PPP) was established. The municipality opted for active control over the development of urban areas (INT-A).

> *"The municipality considered it crucial to be able to make its own choices in real estate development. The political leadership wanted to be closely involved, steering the course. Gouda is a small city, and the political sphere is deeply engaged in the matters at hand." - INT-A*

Given this premise, three governance structures were possible: Building rights, Joint-venture, and Developing Apart Together (DAT) (Hobma et al., 2019; Zeeuw, 2018). In the decision-making process for the governance structure, the municipality explicitly ruled out the execution of urban area development using a Land Development Company (LDC), due to investment risks (INT-A). These risks are also mentioned by Hobma et al. (2019), with the majority of the risks being place on the public party. DAT was chosen as a governance structure, allowing the municipality to maintain sufficient control while avoiding risks, such as making significant upfront investments in the project. This is facilitated by the structure of DAT and the existing land positions held by the municipality.

Firstly, regarding the structure of DAT, all stakeholders utilize their own financial land exploitation instrument (Dutch: GREX). Costs for large area investments are shared, such as land preparation, based on land share. *Figure 4.3* illustrates the governance structure of Westergouwe.

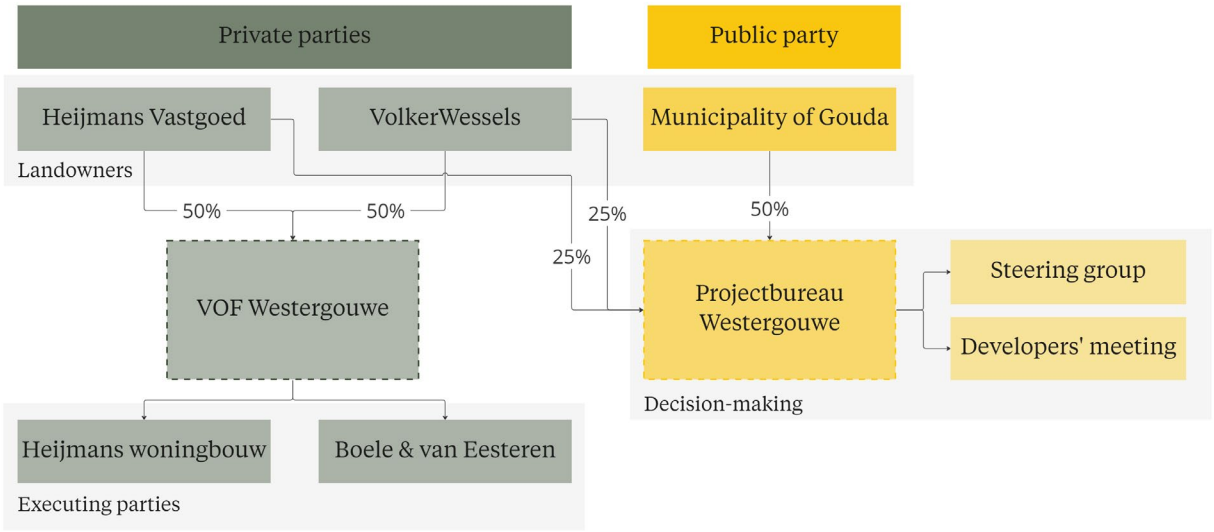


Figure 4.3. *Governance structure Westergouwe, based on INT-A; INT-D.*

In the depicted figure, the market parties Heijmans en VolkerWessels jointly form a consortium known as VOF Westergouwe. This consortium serves as an executing entity, concentrating on the planning and construction phases of residential developments. Notably, for specific sub-areas, external market parties, including Boule & van Eesteren, underwent a tendering process (INT-D). the municipality, Heijmans, and VolkerWessels are also part of 'Westergouwe Project Bureau'. The project bureau serves as a decision-making unit of the project, featuring a steering group and developers' meeting (INT-A; INT-D). This bureau plays a role in determining aspects such as public infrastructure, housing allocations, and the implementation of climate-adaptive measures (INT-A; INT-C; INT-D).

In adherence to the DAT characteristics, the lands are not collectively contributed. Instead, they remain under the ownership of either the public or private party until a specific plot is due for development (INT-A; Hobma et al., 2019). Based on the revenue potential, the land is equitably distributed among the parties after the land is prepared for construction and habitation.

Additionally, the municipality's early position merits attention. Within the context of a Developing Apart Together (DAT)-model, the influence within the decision-making unit- embodied in the Westergouwe Project Bureau- often hinges on the ratio of land positions within the project scope (Franzen et al., 2011). Leveraging its early land position, the municipality exercised significant control, acting as a pivotal force propelling the area's development forward. However, the municipality operated with a dual role, assuming the responsibilities of both developer as public executor and overseer of regional policy (Heurkens, 2012).

Integral to the development process was the formulation of an environmental Impact Assessment (EIA) (Gemeente Gouda, 2012a, 2014). Within the EIA, four potential scenarios were outlined, with 'Waterstad Westergouwe' emerging as the most favorable option (INT-A; Gemeente Gouda, 2012a). A crucial aspect of this variant was the commitment to avoiding externalization of impact on neighboring areas. This stipulation is currently recognized as an integral component of the 'Water and Soil-centric'-policy (Harbers & Heijnen, 2022). It is noteworthy that this condition was articulated at an early stage by the Water Authority (INT-B).

> *The area had to stand on its own two feet. During heavy rainfall, the water level in the waterways within the area should be able to be managed internally. This led to a substantial set of requirements that was then presented". – INT-B*

Hence, the water authority opted to employ a cascading model, facilitating the establishment of water buffers within the area that can be utilized during intense rainfall events (INT-B; INT-D).

Planning phase

With the issuance of the letter of intent in 2008 (INT-A), the initiation of the planning phase ensued. Paramount conditions were imposed by the Ministry of VROM and the water authority, underscoring the necessity for the floor level to surpass the inundation level of the polder. This stipulation culminated in establishing a floor level set at NAP -4.20 meters (INT-B; Gemeente Gouda, 2008). The requirement laid the groundwork for the climate-adaptive measures undertaken. To achieve this floor level, the PPP chose to conduct a uniform elevation, meaning that the entire terrain, irrespective of whether the ground would serve as foundation, streets, or public spaces. This method obviated the need to navigate the complexities associated with varying soil types (INT-A; INT-D). The adaptation of this measure aimed at proactively averting soil subsidence in the forthcoming years (INT-D).

Within the framework of the zoning plan, the entire region was bound by a cap of 30 centimeters on residual settlement over a span of 30 years. The decision to embrace a comprehensive elevation strategy empowered the project bureau to administer the situation conventionally. This approach mitigated the potential risk of recurrent adjustments in elevation for public spaces, gardens, and side roads (INT-D). The choice of a comprehensive elevation strategy facilitated a standard management situation, wherein the financial provisions for maintenance and upkeep could be sourced from customary municipal funds (e.g., property tax) (INT-A).

However, the costs associated with this measure imposed financial strain on the feasibility of the business case (INT-D). Achieving a residual settlement of no more than 30 centimeters in 30 years necessitated the consolidation of the peat soil (INT-C). The measures taken to counteract soil subsidence led to substantial upfront investments, all before a single dwelling had been constructed.

Figure 4.4. *Bulwark dwellings, designed on a dike (Bureau 070, n.d.).*

Figure 4.5. *Location of Bulwark dwellings (Bureau 070, n.d.).*

In response to these financial considerations, the project bureau made the strategic decision to prioritize the development of high-quality housing in the initial phase. This approach involved enhancing the quality of public spaces, resulting in a higher market value per square meter (INT-D). The yield of the first phase contributed to covering the upfront investments already incurred, such as the uniform ground elevation required for subsequent phases (INT-A; INT-C).

Moreover, the Ringdijk, situated on the periphery of the area, did not meet the required standards to safeguard the future residents. During the planning phase, while shaping the contours of the Room for the Rivers-program, it remained uncertain whether the Ringdijk would be part of the reinforcement and fortification initiative (INT-A; INT-B). To ensure protection against flood hazard, the residences needed safeguarding, as mandated by the water assessment conducted by the water authority. Fearing potential project delays and subsequent cost escalations, the project bureau chose to design the houses on a dike, as illustrated in *Figure 4.4. and Figure 4.5.* The dike was conceived as a defense mechanism in case of a breach in the Ringdijk (INT-C; Projectbureau Westergouwe, 2012). Its purpose was to impede the inflow of water into the area by mitigating its force and velocity (INT-A; INT-C). The higher yield from the first phase also facilitated the financing of this costly climate-adaptive measure (INT-A; INT-B).

In hindsight, the water authority reinforced and fortified the Ringdijk as part of the Room for the River-program. Consequently, the climate-adaptive measure became an unnecessary investment, and its implementation was not extended to other parts of the project (INT-A; INT-C). The costs for the dike wall were evenly split (50-50) among the stakeholders of the project bureau.

Figure 4.6. *Spatial plan of phase 2 (Gemeente Gouda, 2016).*

In the planning phase of phase 2 (*Figure 4.6*), consideration was given to affordability. However, the same relatively expensive measures had to be implemented for the development and preparation of land, such as the previously mentioned ground elevation. To keep the costs of the residences low, the project bureau opted to achieve a higher housing density (INT-B; INT-D; Gemeente Gouda, 2016). Interviewee A commented on this aspect:

> *"In phase two, as a municipality, we focused on affordability. I must honestly say that it wasn't entirely successful"* – Interviewee A

Simultaneously, the increase in the number of housings served as a risk buffer, which, as stated by interviewee D, is held as a financing measure. To prevent the need for cuts in climate-adaptive measures, a risk buffer was established (INT-D).

Realization phase

In 2013/2014, the Dutch real estate market faced a downturn (INT-A). Building in one of the lowest-lying polders, where no houses stood, presented a considerable market risk. This risk was duly recognized by the project bureau. In 2013, a decision was made to decelerate the pace of housing construction. Instead of the initial plan of 400 houses per year, only 100 to 150 houses were realized annually (INT-C). The lands were subdivided into smaller plots to make the area development less susceptible to economic fluctuations (Gemeente Gouda, 2012b). Moreover, the municipality found it challenging to predict the demand for residences in Westergouwe (INT-A). This phased approach played a role in mitigating the market risk associated with Westergouwe. This "Learning Loop", as described by (Winch, 2010), continues to be applied. During challenging market conditions or with high-risk products, smaller plots are introduced into the market (INT-A; INT-D).

Operatation phase

During the establishment of the collaboration agreement in 2008, criteria were set for the public space in line with 'Waterstad Westergouwe'. Although the initiative phase already considered flood hazard and the risk of soft soil, climate-adaptive measures did not find their way into the guidelines for public space (INT-D). Working with an outdated handbook raises questions about the assessment framework whenever the public space is transferred to the municipality (INT-D). The unclear agreements and changing context bring potential procedural risks and unnecessary debates.

After phase 1 was realized, it became evident that the uniformly ground elevation exerts significant pressure on the subsurface, causing seepage in the pond and along the edges of the project area. This nutrient and iron-rich water contribute to a significant decline in water quality in the area (INT-B). To mitigate the deterioration of water quality, seepage barriers must be installed at the edges of the Ringdijk. Strictly speaking, the municipality is responsible for the water quality in an area (2.1 Water management in the Netherlands), given that phase 1 is already in the operation phase. However, the costs for the measure are covered within the land development of the project bureau (INT-D). In Westergouwe, climate-adaptive measures have also been implemented per plot, encouraging residents to apply greening (INT-D). It is noteworthy that in hindsight, it would have been better to focus on collective measures that would apply to the entire planning area (INT-A; INT-D).

Gnephoek *Alphen aan den Rijn*

Soil subsidence

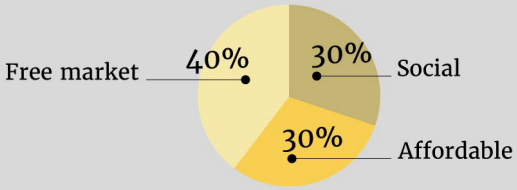
Floodrisk

Water drainage

Characteristics

Size:	**210 ha**
Dwellings:	**5,500**
Phase:	**Initiative phase**
PPP:	**Joint-Venture**
Level:	**NAP -4,00**

Program



Milestones

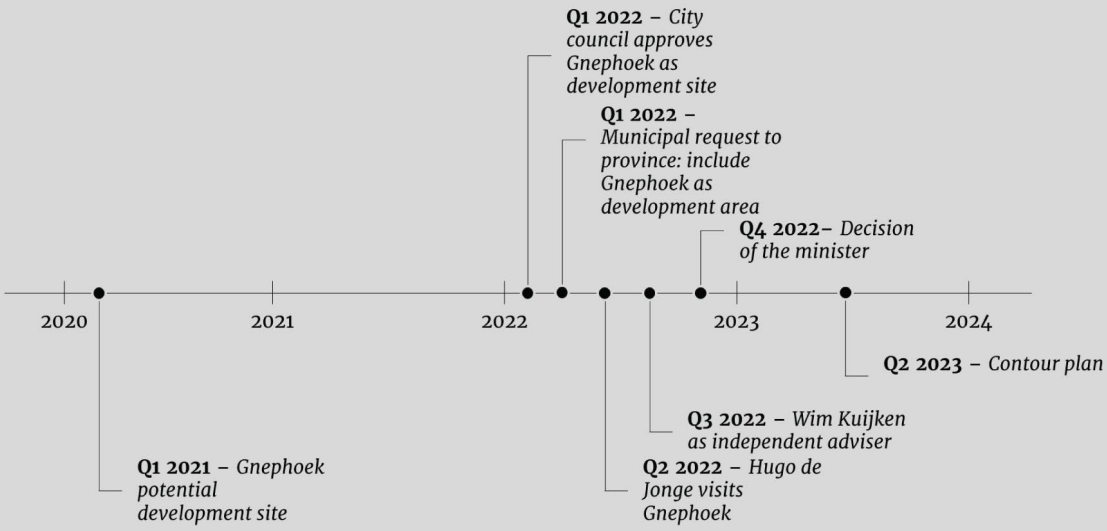


Figure 4.7. *Factsheet Gnephoek, based on Gemeente Alphen aan den Rijn (2023b), INT-E, INT-F, INT-G, INT-H.*

The findings of the urban area development in Gnephoek are presented based on the benchmark of the project phases outlined in *chapter 2.2.* The investment decision-making process will be delineated in the following paragraphs. The realization and operation phases will also be addressed. Despite the plan being in its early stages, the components discussed are planned and not yet implemented. However, this structure is maintained to draw a clear comparison between the cases. For the initiative in the Gnephoek, stakeholders involved were interviewed, as shown in Table 4.3.

Table 4.3. List of interviewees, in-depth interviews Gnephoek

Interviewee	Case	Party	Company
E	Gnephoek, Alphen aan den Rijn	Public	Municipality
F	Gnephoek, Alphen aan den Rijn	Public	Water authority
G	Gnephoek, Alphen aan den Rijn	Public	Province
H	Gnephoek, Alphen aan den Rijn	Private	Developer

The context of the UAD

Figure 4.8. *Masterplan Gnephoek (Gemeente Alphen aan den Rijn, 2023b).*

The polder is situated on the north side of the city Alphen aan den Rijn, covering a total area of 212.5 ha (*Figure 4.8*). Currently, the area is predominantly agricultural land, with a few businesses and farmers established there (Gemeente Alphen aan den Rijn, 2023b). The urban area development in Gnephoek involves the construction of 5,500 dwellings. The polder is located at NAP -1.0 meters, near the city's edge, descending to NAP -4.0 meters deeper into the polder (*Figure 4.9*). The envisioned area development in the Gnephoek polder is still in the initiation phase, but has a history associated with the initiative of the plan.

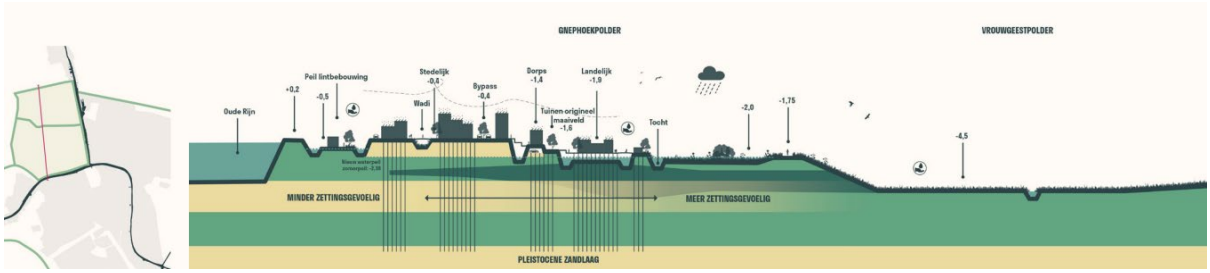


Figure 4.9. *Cross section of the planned development in the Gnephoek-Polder (Gemeente Alphen aan den Rijn, 2023b).*

The key milestones of the Gnephoek are:

1. The municipality of Alphen aan den Rijn aimed to alleviate the housing shortage in the region. In 2021, the Gnephoek polder is identified as a potential development location, with the municipality envision 8,000 to 10,000 dwellings (Gemeente Alphen aan den Rijn, 2021).
2. The plans face disapproval from the province of South-Holland, due to uncertainties within the plan. Minister Hugo de Jonge decides to further investigate the possibilities for housing development and appoints Wim Kuijken as an independent advisor (Kuijken, 2022a). Wim Kuijken presents four different future perspectives for the Gnephoek, with variant 3 (5,500 dwellings, hockey-stick) deemed realistic (Kuijken, 2022b)
3. Public and private parties collaborate to develop 'Countourenplan Gnephoek', aiming to reach a conclusive decision. Suggested is a Joint-Venture approach for the area development (Fakton Consultancy, 2023).
4. The costs for land preparation, including climate-adaptive measures, and the above-plan costs turn out to be high, resulting in a deficit of € 50 million (Gemeente Alphen aan den Rijn, 2020; Provincie Zuid-Holland, 2022)

Initiation phase

The initiative of the Gnephoek originates from the inquiry of the municipality, into the prospective locations for future residential developments within its borders (INT-E; Noordermeer, van Gool, Zevenbergen, Blom, & Bontekoe, 2021). Recognizing that development in the polder addresses the qualitative demand for housing, the municipal designated the Gnephoek as suitable location (INT-E: Gemeente Alphen aan den Rijn, 2021), a designation endorsed by the water authority as well (INT-F). Gnephoek was once part of a list of Vinex locations, where private parties speculatively acquired and retained land (INT-H). *Figure 4.10* presents the landownership and shares between the municipality and private parties within the Gnephoek poler.

Figure 4.10. *Landownership of the Gnephoek-polder (Gemeente Alphen aan den Rijn, 2023a).*

The largest landowner is BPD, represented in green. Other private parties include ASR, VolkerWessels, and Beagle Vastgoed. Additionally, the municipality holds approximately a share of 12% (INT-E). BPD owns most of the land (71%), leading the municipality to designate them as the spokesperson on behalf of the private parties (INT-H). This decision significantly influenced the project's organizational structure for the initiative phase, granting the developer considerable influence and steering opportunities. Due to their land positions, private parties were involved early in the initiative phase.

The municipality aimed to realize 8,000-10,000 dwellings in the Gnephoek polder (INT-E: Gemeente Alphen aan den Rijn, 2021). To facilitate the housing plans, changes to the provincial environmental policy (Dutch: omgevingsbeleid) and the inclusion of the plans in the 3-hectare map were required (INT-E; INT-G). However, this request was rejected by the province, leading to a dispute between the two public parties.

> *"If we allow plans that do not align with the legally binding parts of the provincial policy, any individual, including third parties, can go to the Council of State, which leads to the annulment of the zoning plan" – INT-G*

The province deemed the polder unsuitable for large-scale housing development for various reasons, including problematic soil conditions, costly mobility measures, and the presence of available alternative building locations in the area. Moreover, the plans contradicted the current environmental policy of the province of South-Holland (INT-G; Provincie Zuid-Holland, 2022)

> *"We can only make a decision when there is a well-elaborated plan in place. Up until that moment, there had always been a discussion about the number of dwellings and the (precise) location of those dwellings" – INT-G*

A criticism from the province was the lack of clarity in the (financial) plans, where there was a lack of substantiation regarding the realization of affordable and climate-adaptive housing (INT-G; Provincie Zuid-Holland, 2022).

The municipality disagreed with the response of the province and decided to proceed with the planning phase, expecting that the province would reconsider (INT-E). The ussue seemed to revolve around the 'Dogma of the Green Heart':

> *"The Green Heart has been sanctified; nothing is allowed there. Yet, that's precisely where many opportunities lie". – INT-E*

The decision-making process regarding the initiative in the Gnephoek polder faced difficulties. In the tension between the province and the municipality, the water authority found itself in a challenging position (INT-F). Despite the difficulties, the water authority decided to actively participate in the planning process form the initiation phase. They preferred proactive involvement over retrospective evaluation, considering their theoretical controlling role (INT-F; Provincie Zuid-Holland, 2021). The 'Water and Soil-centric'-policy were notable absent in their perception of the response (INT-F).

> *"We'd rather contribute to a plan that ultimately doesn't proceed than not having been involved in a plan that does go through". – INT-F*

The initiative of the Gnephoek encountered challenges, leading to a request for intervention from the national government. Following a site visit, the Minister of VRO concluded that his intervention was necessary to make a decision about the future of the Gnephoek polder (de Jonge, 2023a), partly influenced by a motion concerning the Gnephoek in the Second Chamber (Dutch: Tweede Kamer).

The Minister appointed an independent advisor to explore potential development directions (Kuijken, 2022a), with a focus on geomorphological integration, assisted by the water authority (INT-F). The advice encompassed the presentation of four scenarios *Table 4.4*.

Table 4.4. Development scenarios Gnephoek (Kuijken, 2022b)

Scenarios	Housing	Public space
Scenario 1	No housing	Management and development task for nature.
Scenario 2	2,000 dwellings located south of the Gnephoek.	50 ha of nature on lower-laying grounds.
Scenario 3	5,500 dwellings in the southern and eastern part of the Gnephoek (hockey-stick).	50 ha of nature, and 30 ha of green/water.
Scenario 4	8,000-9,000 dwellings covering the entire area.	130 ha of nature required.

In the advice, preference is given to scenario 3, where the number of dwellings is nearly halved (Kuijken, 2022b). The province did not express a preference for the scenarios in *Table 4.4* and relies on the letter (INT-G). To achieve a well-functioning plan, the province provides conditions for adaptation to the environmental policy (INT-G). These conditions are partly based on the 'Climate-Adaptive Building Covenant' (Zuid-Holland, 2018). The province responded that they want the issues raised in the letter to be resolved. According

to the province, based on the conditions, it can be inferred which scenario is the most promising (INT-G).

Two additional conditions were introduced in the new coalition agreement (INT-G; Provincie Zuid-Holland, 2023), where consensus within the municipal council on the proposed plans is essential. The province argued that this consensus had not been fully reached while a motion about the Gnephoek was discussed in the Second Chamber (INT-G; De Jonge, 2023b). Moreover, the pans must comply with established minimum areas for nature and maximum areas for housing, as specified in the coalition agreement (INT-G; Provincie Zuid-Holland, 2023).

After the introduction of these conditions, even a discussion arose between the municipality and the province regarding the ratio of gross/net greenery in the area (INT-G). A green strip is integrated into the built environment, leading to the question of whether it should be included in the square meters of nature (INT-G).

Within the initiation phase, the province had a high level of steering on the content of the revised plan for Gnephoek, the contour plan (INT-E; INT-G). This role is notable given their controlling function based on established polices (Bult-Spiering et al., 2005).The province states that the process has only been clarified thanks to their guidance (INT-G). Private parties were not involved in the discussion between the province and the municipality (INT-H). In the organizational structure for this phase, the responsibility for communication with other public parties is assigned to the municipality (INT-H; Gemeente Alphen aan den Rijn, 2023c).

In early 2023, the municipality presented the revised plan, the contour plan (INT-E; Gemeente Alphen aan den Rijn, 2023b). The plan faces a deficit of € 50 million in above-plan costs, which are not attributable to the area development (Gemeente Alphen aan den Rijn, 2020; Provincie Zuid-Holland, 2022). Due to the deficit, the plan does not yet meet the conditions set by the province (INT-E; INT-G; INT-H). The municipality has requested a contribution from the national government to address the deficit (INT-E).

Partnership during the Initiative

For the initiative phase, an organizational schema was drawn up (*Figure 4.11*). The four private parties with land ownership (*Figure 4.10*) form a consortium with an intention agreement with the municipality (INT-H). Control is distributed based on land ownership (INT-H). Due to significant land ownership, developer BPD takes a leading role in area development and facilitates communication between the municipality and other landowners (INT-H). Despite having limited landownership, the municipality also holds a significant position in the decision-making process, with a 50% share (INT-E).

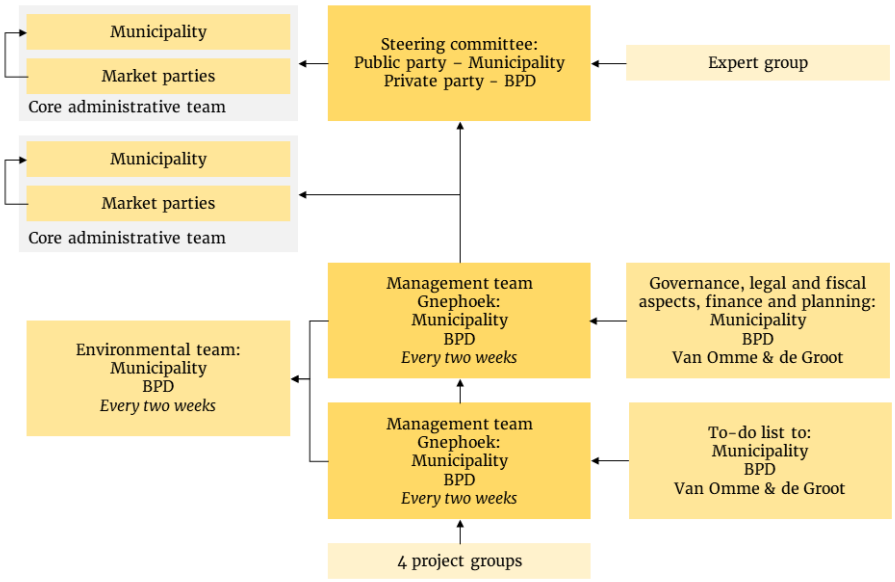


Figure 4.11. *Governance structure of the initiative phase (Gemeente Alphen aan den Rijn, 2023c).*

Governance

A governance structure involved multiple developers and the municipality is complex, likely resulting in a limited PPP with the municipality and two private parties (INT-F; INT-H). It remains unclear which landowners will participate in the urban area development. According to the municipality, it is not obvious for a landowner with a 5% share to have prolonged and meaningful involvement during the project (INT-E). The municipality also argues that such a situation introduces unnecessary risk for the private party and adds complexity to the governance structure.

The province is not directly involved in the urban area development (INT-G; Provincie Zuid-Holland, 2023). They explicitly state that conditions and agreements are directed to the municipality, which, in turn, incorporates them into the PPP. The province's only risks area primarily related to reputational damage, if the Gnephoek project fails. In such a scenario, the province would have approved an unsuccessful plan (INT-G).

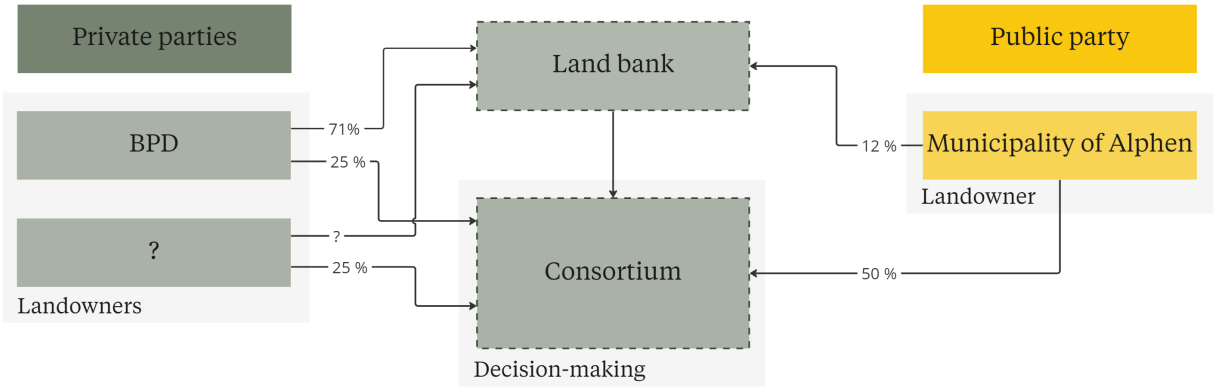


Figure 4.12. *Governance structure Gnephoek, based on INT-E; INT-H; Fakton Consultancy (2023).*

Figure 4.12 illustrates the proposed PPP framework. Both the private parties and the municipality hold a 50% share, accompanied by an identical risk profile (INT-E; Fakton Consultancy, 2023). The municipality has deliberately chosen this collaborative model due to the level of control it affords (INT-E). Despite possessing a low share of land within the polder, this approach enables the municipality to exert sufficient steering (Hobma et al., 2019). The municipality seeks such control to ensure the realization of its ambitions (INT-E).

In the joint venture, a variation of the Land Development Company (LDC) is used. Lands earmarked for development are placed into a Land Bank, divided per phase (INT-E; INT-H). A predefined allocation key is agreed upon in advance. The municipality, in conjunction with the collaborative entity, bears responsibility for preparing the land for construction. Due to the complexity of the development, the private parties opted against placing the lands in a LDC to prevent burdening the area development with a large upfront investment (INT-H), in other words, reducing capital commitment (Zeeuw, 2018).

In the context of urban area development, the developer, and in this case, the municipality as well, aim to avoid making substantial investments without seeing an immediate return. This is referred to as reducing capital commitment, and it is explained in detail in textbox: from bathtub to sink.

From bathtub to sink: Reducing capital commitment.

In urban area development, significant upfront investments are required to serve as a catalyst for the entire area (Zeeuw, 2018). These large investments typically involve the acquisition and preparation of land. To reduce the financial burden, the financial sector emphasizes shortening the balance sheet and improving cash flow. This can be achieved through proper phasing, ensuring sufficient income is generated in proportion to each expenditure (Zeeuw, 2018).

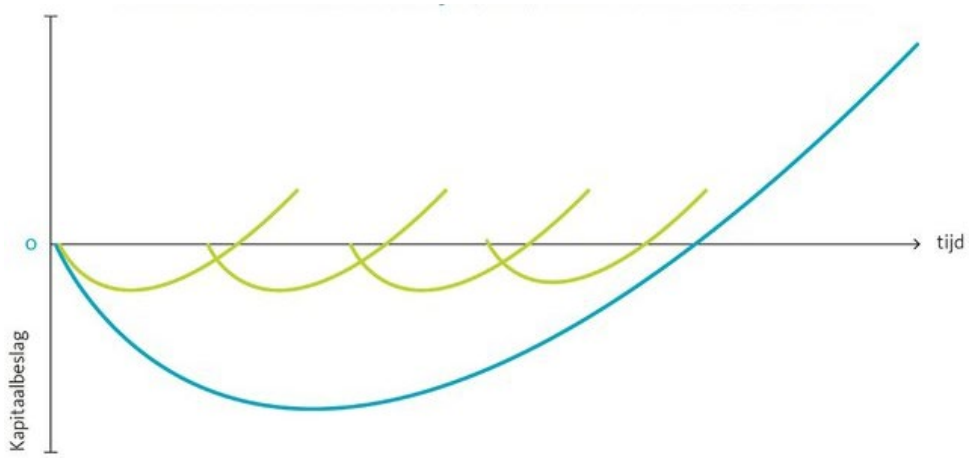


Figure 4.13. *From bathtub to sink: Reducing capital commitment* (Zeeuw, 2018, p. 73).

Within the framework of the PPP, several risks have been identified (Fakton Consultancy, 2023). To begin with, the most significant risk is financial feasibility. Therefore, the municipality has decided to assess the impact of urban area development on the municipal budget (INT-E). Early involvement of private parties allows them to scrutinize the

feasibility. Furthermore, a project risk arises due to the upcoming change in the council after four years. The inability to establish agreements and contracts spanning a 20-year period poses a challenge. However, by incorporating the plots per phase into the land bank, they transform into more manageable and smaller-scale investments (INT-H). Lastly, the municipality recognizes ambition risk. The plan entails a high level of ambition, with specified housing numbers and climate-adaptive measures. The role of the municipality within the PPP-frameworks allows the safeguarding of these ambitions (INT-E; Franzen et al., 2011).

Planning phase

The climate-adaptive measures required in the area have been advised by the water authority INT-G). The water authority primarily plays an assessing reactive role (INT-G), within the framework of the water test required for urban area development. The standard set by the water authority is to manage a minimum rainfall of 90 mm. In the Gnephoek, the baseline is set at 120 mm (INT-E; Int-F; INT-H). According to the water authority, they guided the process towards this higher standard (Gemeente Alphen aan den Rijn, 2023b).The decision was consciously made not to adhere to the legal minimum when financial considerations had to be met (INT-F).

The requirement is set at 120 mm because of the flow rate for the essential waterways, falling within their responsibility (INT-F). The water authority finds it challenging to continue guiding this throughout the project, due to their limited role and influence (INT-F). They do not want more responsibility; only essential waterways will fall under their management.

> *"It is the responsibility of the municipality to prevent waterlogging in homes" – INT-F*

Risk

The polder has various safety risks: subsidence risk, settlement risk, and risks for water safety (INT-F). The water authority would like to better integrate safety into regulations, with direct involvement in the planning process (INT-F). While the design cannot be dictated, the standards and objectives can be outlined (INT-F).

Among the risks, the most significant concern is potential waterlogging due to heavy rainfall (INT-E). Due to the small size of the polder, waterlogging can occur quickly, which should not be shifted onto surrounding areas (INT-E; INT-F). Subsidence and residual settlement also pose risks (Gemeente Alphen aan den Rijn, 2023d), with differing opinions on the significance. The municipality does not consider residual settlement a major risk (INT-E). With proper construction techniques, the risk seems manageable, and potential issues are more significant in adjacent areas (INT-E). The water authority sees subsidence and residual settlement as a rather serious challenge (INT-F). Maintaining the soil's stability requires considerable attention during the operation phase. Moreover, the dike along the Heijmanswetering had to be strengthened due to the planned housing development, moving from IPO class 3 to IPO class 4. According to the developer this was deferred maintenance, and developers must ensure they do not suddenly bear the costs (INT-H). Simultaneously, according to the water authority, the dike was not yet due for renewal, so the costs still had to be imposed on the planned development (INT-F). The flood risk is not seen as greater than in the rest of the Randstad region (INT-E). The old

Rhine has experienced flooding in the past, mainly impacting on the composition of the soil (INT-H).

The water authority actively contributed ideas on how to mitigate risks within the polder, but due to their controlling role, they cannot participate in the design. However, they have provided standards based on the Water Board Regulation and the Climate Adaptive Building Covenant (INT-E; Zuid-Holland, 2018).

The implementation of climate-adaptive measures for the collective area must be done collectively, according to public parties. The focus is on a large scale rather than giving choices to end-users (INT-E; INT-F). Contributions are made collectively, and taxes (water board tax, property tax) cannot be differentiated (INT-F).

Realization phase

The Gnephoek is still in the initiation phase, awaiting approval from the Council of State for further planning (INT-E). Consideration has already been given to the structure of the realization phase, outlining key factors that can be adjusted to achieve a positive financial outcome. These factors include density, construction speed, contribution value, and parking standards.

Firstly, regarding density, the area exhibits a relatively high density of 40 homes per hectare, leading to a larger yield per hectare (INT-E). However, the municipality identifies the placement of high-end homes on relatively small plots as a risk (INT-E). The municipality notes that these upscale residences are built on relatively small plots, although ample greenery and space surround the water buffers within the area. The developer contends that this is not a lever to pull for a positive financial outcome but rather a response to market demand for this type of housing (INT-H). Despite political aspirations for a higher affordability percentage, achieving this comes at the expense of financial feasibility (INT-E), introducing a risk element. The municipality aims to build at a rapid pace (INT-E), yet the developer provides a more realistic estimate, suggesting a slower pace of up to 500 homes per year (INT-H).

> *"One should always be somewhat uncensored naïve, I always say. But it must still be realistic". – INT-H*

Additionally, the contribution value (Dutch: inbrengwaarde) is set relatively low based on discussions with private parties (INT-E). Market participants perceive this value as considerably lower than usual, but they can absorb this loss due to their long-term ownership of the lands (INT-H).

Lastly, the municipality influences the development by establishing a lower parking standard for the area, adjusted to the current car ownership situation in Alphen aan den Rijn (INT-E). Parking hubs for visitors are planned to reduce operational costs (OPEX) in public spaces. Stakeholders anticipate that these levers are the key elements to be adjusted during the realization of the area development. To safeguard a financial buffer, the plan includes a relatively high-risk reserve (INT-E). Furthermore, risks need to be further allocated within the framework of the public-private partnership, and much remains unclear (INT-E).

The mentioned levers are intended to achieve a positive outcome in land and real estate development. While it may seem that the municipality and developer are covering certain costs, the municipality acknowledges that the expenses are primarily borne by those purchasing a home (INT-E).

Operational phase

The final phase of real estate development is still distant, but an integral part of the planning process includes the operational phase. The management and operation of the future area development in Gnephoek can be divided into two parts: the residential zone and the nature zone. For the residential zone, it is logical for the municipality to assume responsibility for management and maintenance (INT-E; INT-H). The municipality naturally undertakes this task, including the management of climate-adaptive measures, and receives financial resources to cover the associated costs (INT-H). From a spatial planning perspective, the municipality is the entity capable of overseeing and controlling this aspect (INT-F).

The management and operation of the nature zone are still under discussion. This responsibility is less aligned with the role of the municipality (INT-F; INT-H). The developer considers the creation of nature as a concession for the citizens of Alphen aan den Rijn (INT-H). While the investments come with associated costs, they enhance the livability of the area. Nature represents one of the municipal assets, making the municipality accountable for the expenses (INT-H). Simultaneously, the municipality acknowledges the risks involved, particularly in terms of societal costs related to management and maintenance (INT-F).

4.4. Expert Panel

The findings of the exploratory interviews and the two case studies, including the in-depth interviews, are validated through an expert panel. The expert panel is hosted at the graduation company, and therefore an internal validation with employees of Fakton Consultancy and Fakton Development. As stated in Chapter III: *Research design*, the objective of the expert panel was to invalidate or confirm the findings with the use of statements.

Table 4.5. List of attendees, expert panel.

Attendees	Company	Function
P-A	Fakton Consultancy	Partner
P-B	Fakton Consultancy	Senior-Consultant
P-C	Fakton Development	Director
P-D	Fakton Development	Associate Partner

Attendees of the internal session were two consultants of Fakton consultancy and two developers of Fakton Development. Due to the common language, this expert panel was hosted in Dutch. The session started with an introduction of the research. To create common ground among the attendees, the problem statement and research method were

presented. Thereafter, the statements were presented to the attendees, divided between two categories: responsibility and risk (*Table 4.6*).

Table 4.6. Discussed statements, expert panel.

Theme	Statement
Responsibility	**Statement 1** – *The national government is tasked with identifying suitable construction sites, taking climate risks into account.*
	Statement 2 – *Within the complexity of urban area development in public-private partnerships, the responsibility for implementing climate-adaptive measures lies with the municipality.*
	Statement 3 – *The private sector bears the responsibility of disseminating knowledge about climate risks.*
Risk	**Statement 4** – *Physical risks are sufficiently understood and can be effectively mitigated.*
	Statement 5 – *Non-physical risks are the most influential factors in climate-adaptive decision-making.*
	Statement 6 – *The municipality benefits from climate-adaptive urban area developments and should therefore contribute/invest more.*
	Statement 7 – *Area development should focus on implementing collective measures, limiting end-user choices regarding adaptive measures.*
Concluding	**Concluding** – *Climate-adaptive measures are inadequately integrated into the investment decision-making process, and both public and private entities lack the requisite tools for climate-adaptive polder-area development.*

Responsibility

Statement 1 – *The national government is tasked with identifying suitable construction sites, taking climate risks into account.*

The interviewees largely agree that the national government (the state/ministry) is responsible for locating suitable construction sites, taking climate risks into account. It is emphasized that the province currently plays a significant role, but there are different opinions regarding the extent of control from the national government. A solution may be to exclude specific areas from suitability for new construction. Simultaneously, the influence and lobbying power of the private parties, the developers, are deemed too significant.

> *"At present, private interests often take precedence over climate adaptation issues and (water)safety concerns. Lobbying for construction in areas with known climate risks is driven by previously acquired land position".*

There is a call for discussion on the role of the national government in spatial planning and controlling land speculation, with land exchange and expropriation suggested as possible solutions. The withdrawal of the national government from spatial planning is seen as a problem that has contributed to the current challenges.

Statement 2 – *Within the complexity of urban area development in public-private partnerships, the responsibility for implementing climate-adaptive measures lies with the municipality.*

Within the discussion, it is emphasized that the municipality should play a regulatory role in collaboration with both water authorities and the guidelines set forth by the national government. The municipality is a pivotal figure in establishing the general direction and framework. Additionally, it is underscored that ensuring a clear separation between the involved stakeholders of the municipality within the PPP-structure and those external to it, is of great importance. The responsibility of municipal personnel external to the PPP framework is to assess climate adaptive measures, emphasizing its public-law function and the essential need to avoid a conflict of interest.

Private parties are not expected to bear responsibility for such measures, as financial interest would play a leading role. This underscores the importance of making clear agreements in advance about the assessment to prevent potential disputes. Deviations from the foundational agreements stated in the collaboration agreement have financial consequences in PPP frameworks. Therefore, the attendees agree that the government, including the municipality, must always prevent. This accentuated the need to establish clear agreements upfront.

Statement 3 - *The private sector bears the responsibility of disseminating knowledge about climate risks.*

In a general sense, the attendees concluded that both public and private parties stand to gain from the exchange of knowledge regarding techniques and methodologies for the successful implementation of climate adaptive measures. An illustrative instance is the 'Climate Adaptive Building' covenant initiated by the province of South-Holland (Zuid-Holland, 2018). Nonetheless, a note of skepticism is interjected, contending that such covenants lack enforceability. Additionally, the discourse acknowledges that knowledge dissemination, particularly knowledge acquisition, is contingent upon government funding.

The discussion encompasses considerations regarding the roles of various stakeholders, including educational institutions and insurers, in sharing information about climate risks. Transparency on the part of insurers is asserted as an inherent necessity, albeit with potential repercussions on real estate valuation. The consensus suggests that knowledge regarding climate risks should emanate from governmental sources, and in its absence, insurers will inevitably assume this role.

Risk

Statement 4 - *Physical risks are sufficiently understood and can be effectively mitigated.*

Consensus surrounds the assertion that there exists ample attention to the given proposition, yet the pursuit of knowledge must persist. Caution is advised against adopting a comprehensive understanding of well-known risks. While the physical risks are largely recognized in isolation, considerable uncertainty surrounds the timing of climate events, potentially constraining mitigation efforts. Expectations are contradictory, with occurrences deemed improbable five years ago now manifesting as reality. Furthermore, it is noted that forthcoming challenges may shift from water-related issues to concerns pertaining to drought.

Statement 5 - *Non-physical risks are the most influential factors in climate-adaptive decision-making.*

The non-physical risks indeed exert the most significant influence on the climate adaptive decision-making process. The discussion reveals that current practices are steered by financial considerations of developers, with yield serving as a guiding factor. There exists a perception that certain parties primarily focus on labeling developments as climate-adaptive without extending beyond the minimal requirements.

> *"In practice, the business case is leading for the investment decision. The risk is the most influential factor".*

Investors exhibit a greater interest in a climate-adaptive approach compared to individual buyers, who are seemingly less preoccupied with such considerations. The emphasis appears to be on immediate needs, such as the necessity for housing. Buyers do not have access to reports on climate risks and have trust that the government takes responsibility. Therefore, there is consensus that the impetus for climate adaptive measures does not primarily emanate from buyers, but rather from governmental policy measures.

Statement 6 - *The municipality benefits from climate-adaptive urban area developments and should therefore contribute/invest more.*

On the one hand, the discussion emphasized that the municipality, as primary landowner and responsible for public spaces, bears a duty of care and, therefore, should contribute more. The municipality plays a facilitating role in the development and establishment of new residential areas, with benefits accruing to the residents of the municipality. Nevertheless, at a broader level, the government stands to gain more from the climate-adaptive nature of spatial development than the regional municipality.

On the other hand, a debate ensues regarding ultimate responsibility for the costs: the municipality, the citizens, or the end-user. When these costs become part of the land development, ultimately, it is the end-user who bears the expenses of the measures. When frameworks and boundaries are established in advance, this results in reduced land development revenue for the municipality. Once again, the reference is made to the importance of clear governmental frameworks. The notion that ambiguity on this matter can lead to burdens and additional costs for the municipality. Additionally, it is the responsibility of the municipality to provide clarity on expectations and costs during the initiative phase, before the start of the project.

Lastly, it is underscored that the municipality must be explicit about the ambitions it sets. If climate risks are a focal point, a trade-off may be necessary in terms of affordability or other ambitions.

> *"Municipalities must carefully consider the balance between the costs of adaptive measures and the affordability of the (housing)program. In areas where extensive climate adaptive measures are necessary, it may be more prudent to compromise on affordability to ensure the feasibility of the urban area development".*

Statement 7 - *Area development should focus on implementing collective measures, limiting end-user choices regarding adaptive measures.*

The attendees largely concur with the statement. It is crucial that the focus shifts towards the implementation of collective measures. The emphasis is placed on the notion that individual solutions, at plot level, are often unfeasible in spatial developments. Urban area development necessitates large-scale upfront investments, with a strong emphasis on cost-effectiveness. Steering through purchase contracts may be a potential alternative. It is also important to move away from working on a per-phase or per-plot basis and to be willing to make upfront investments.

Concluding - *Climate-adaptive measures are inadequately integrated into the investment decision-making process, and both public and private parties lack the requisite tools for climate-adaptive polder-area development.*

The attendees present divergent perspectives on the concluding statement. On the one hand, it is noted that there are parties already equipped with the appropriate set of tools for climate adaptive measures. According to the attendees, the water authority possesses tools for proper water management. Simultaneously, it is highlighted that the national government lacks tools to successfully integrate climate adaptive measures into investment decisions. On the other hand, the ongoing discussion about the implementation of measures is centered around the financing of climate adaptive investments.

Debate ensues regarding the extent to which climate adaptive measures are incorporated into the investment decision-making process. The integration of water-related measures aligns with Dutch thinking, but the imperative is highlighted through the “Water and Soil-centric” policy. Nonetheless, it remains a persistent challenge that while climate adaptive measures may be considered, they often lack sufficient financial coverage.

The allocation of responsibilities and risks associated with the implementation of climate adaptive measures impacts the investment climate. This is coupled with other ambitions set for the area, such as affordability of housing. The accumulation of ambitions could compromise the assurance of safety for residents in the area. Additionally, land speculation significantly affects the business case of spatial development, leaving fewer financial resources available for climate adaptive investments. It is worth highlighting that residential construction plans in burgeoning areas are currently characterized by an unexpected financial shortfall, referred to in Dutch as the "Onrendabele Top." Conventionally, expansion locations have been recognized for their ease of financial viability, particularly in the context of area developments.

4.5. Findings and implementation

This empirical study focused on the core question: "Who pays for what, when?" This question was central in discussions with experts during the exploratory interviews, the stakeholders involved in both cases, and the participants in the expert panel. In the exploratory interviews, it is frequently mentioned that end-users generally bear the costs of implemented measures or water risks within a specific area (INT-I; INT-II; INT-V). The case study of Westergouwe also revealed who ultimately bears the costs. Interviewee D articulates this as follows:

> *And who should foot the bill for this? Well, in the end, I could say, "We cover the land development costs," but, of course, we don't do that. It's simply embedded within the pricing of the homes – INT-D*

The Expert Panel emphasizes the importance of establishing clear agreements at the onset of a project. Experts highlight that clear frameworks help prevent costs from ultimately falling on end-users.

Role of public and private parties within Westergouwe

The interviews conducted in Westergouwe reveal that the climate adaptation-frameworks for the developer were already clearly established by the former Ministry of VROM (INT-D). While the solution was not directly prescribed, the goal was determined. Discussions regarding climate-adaptive measures and the associated costs remained limited (INT-A; INT-D).

Despite the clear frameworks at the project's inception, numerous decisions were made throughout its development to steer towards a positive financial outcome, despite the costly measures required. Particularly during the planning phase, decisions significantly influenced the results of the area development. In the subsequent realization phase, adjustments were primarily made by decision-makers in the project bureau to achieve the intended ambitions and frameworks. Throughout the project, some levers were pulled, including:

- The housing density per phase.
- The speed of construction.
- The quality of public infrastructure.

In hindsight, it is mentioned that it might have been better to place even more emphasis on collective adaptive measures, rather than individual plot- or parcel-specific measures (INT-A; INT-D).

Role of public and private parties within Gnephoek

During the planning phase of Gnephoek, discussions arose from the outset regarding the construction plans, with no agreement between two public entities, namely the province and the municipality. The municipality had a different vision regarding the possibilities within the polder than the province. The involved developers, after years of waiting, were eager to commence construction (INT-F; INT-H). Under pressure from the national government, the Provincial Executive (Province of South Holland) formulated conditions to

deem the construction in Gnephoek justifiable. In this context, the province assumed a more directive than controlling role (INT-G) to ensure that a plan in the Gnephoek polder could still be realized.

The requirement for climate-adaptive measures had an impact on the feasibility of the plan (INT-E). During the planning phase, both the municipality and developers pulled various levers to achieve an intended positive land exploitation (INT-E; INT-F; INT-H), including:

- High residential density with small plots.
- Reduced input value.
- Low parking standards with a focus on OPEX.

Additionally, a substantial financial buffer was incorporated. These levers were also presented in the expert panel, where developers emphasized that such adjustments are customary in area development and not novel (P-D; P-F).

The two case studies generally share the same objective, namely the development of housing, and face similar physical and non-physical risks. The following section draws a comparison between the public and private parties involved in both area developments.

Role of Public Parties in Westergouwe and Gnephoek

During the initiation phase of both projects, the (former) ministries played a significant role in the decision-making process. Remarkably, the minister was personally involved in the initiative, despite the usual responsibility lying with the province and municipality. In the case of Gnephoek, the plans were rejected, but the minister overruled the decision. It can be argued that something went wrong in the decision-making process regarding the frameworks that were established and communicated. Normally, the frameworks set by the ministry permeate the province and the municipality (Expert Panel). Both in the exploratory interviews and the expert panel, it became evident that the responsibility for frameworks should be nationally directed. The top-down approach ensures clarity in the process and prevents high costs due to alterations or delays (Expert Panel).

Regarding the municipality: both municipalities had substantial ambitions at the project's inception and aimed to participate through a PPP. Due to prior land ownership in the Zuidplaspolder, the municipality of Gouda could effectively guide private parties. In Gnephoek, where the municipality has a more limited share, the municipality nevertheless took on more responsibility and risks within the PPP structure.

In both developments, the water authority played a crucial controlling role. In Westergouwe, they were involved from the beginning, provided advice on climate-adaptive design, and monitored their own responsibilities. However, the water authority could not actively contribute to designing necessary measures. This approach served as an example for the Gnephoek polder. The water authority advised early on, despite a dispute between the municipality and the province. They aimed to monitor and provide advice throughout the process.

Role of Private Parties in Westergouwe and Gnephoek

Bult-Spiering et al. (2005) discussed three possible initiatives within PPP-frameworks. In the cases of both Westergouwe and Gnephoek, developers were involved early in the planning process due to the land positions they had acquired. In both Westergouwe and Gnephoek, land ownership played a significant role in the collaboration structure and the investment decision-making process. The danger of prolonged land speculation was highlighted in the Expert Panel. Land speculation can inflate land prices, leaving less money available for necessary adjustments to the area. Additionally, the question arises whether development starts because it is a sensible place to build or due to land ownership (Expert Panel).

Implementation of empirical research

This chapter highlighted the dynamics between public and private stakeholders, resulting in four key findings; steering with levers to pull, stakeholder involvement, critical oversight, and influence of landownership *(Figure 4.14).*

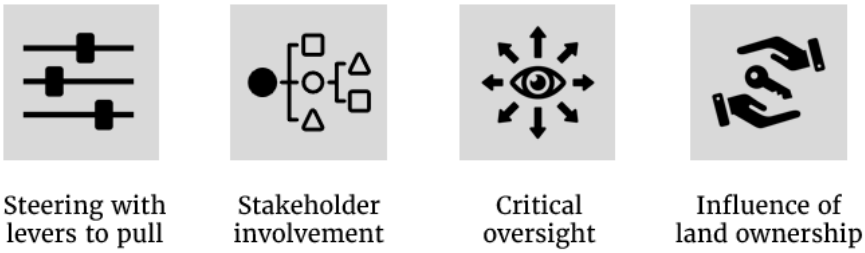


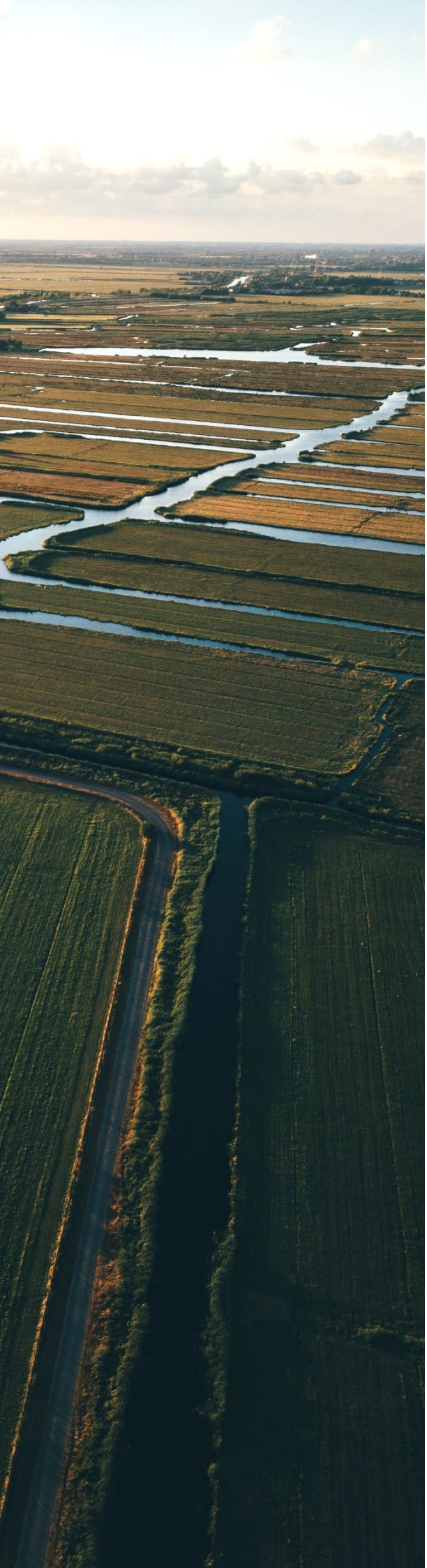
Figure 4.14*. Key findings of the empirical research (author).*

Firstly, decision-makers within the PPPs had an active steering role. Both the municipality and private parties steered on the feasibility during the process. To maintain a financially feasible urban area development, the decisionmakers had levers to pull such as: housing density, construction speed, and public space quality. These levers were novel in the context of urban area development.

Secondly, in the case of Westergouwe and Gnephoek, the Ministries exhibited an unusual level of personal involvement in the case. This direct engagement in decision-making hints at departure from their typical responsibilities. Moreover, both municipalities actively participated in PPPs, assuming significant levels of responsibility and associated risks. During both processes, the perception of climate change has been integrated into the risk assessment process, leading to varied evaluations from different stakeholders.

Thirdly, the water authorities maintained crucial oversight of the implementation of climate-adaptive measures during the process of both case studies. The level of climate adaptation within Westergouwe was an example for the water authority in the case of the Gnephoek.

Lastly, land ownership influenced in both cases the governance structure and investment decisions. Private parties had early involvement. This raised the question of whether development starts because it is a sensible place to build or due to prior land ownership and the lobbying forces of the private parties.



Section V

Discussion & Conclusion

Reflection
Literature
Appendix

5. Discussion

The findings can be divided into responsibility and risk. Responsibility pertains to which party is accountable for the development, as well as the management and maintenance, and who ensures that specific objectives and/or ambitions are achieved. Risk can be categorized into physical (e.g., flood hazard) and non-physical (e.g., market demand risk) risks. Risks in area developments often manifest themselves in terms of costs and benefits.

5.1. Responsibility

In the context of water management, policy has predominantly been reactive. The urgency for effective measures, such as primary and secondary barriers, has particularly manifested itself after climate events (Bogdan et al., 2022). At the national level, water management is coordinated, with responsibilities divided among Rijkswaterstaat, provinces, and water authorities (Ministerie van Infrastructuur en Waterstaat, 2010). Water authorities are specifically tasked with controlling major waterways in a designated area, while municipalities are responsible for preventing high water levels in public spaces.

However, a certain ambiguity is evident in practice. While responsibilities are clearly defined in the water management of the Netherlands, they become less clear in the context of urban area developments. Municipalities and private parties collaborate to implement climate-adaptive measures, subject to assessment by the water authorities through the water test. As described in the literature, the municipality can assume an active (steering) role within a PPP framework, a situation evident in both case studies. Here, the municipality plays a dual role as a private party in urban area development (Heurkens, 2012), aiming for financial returns in partnership with developers. In the case of Westergouwe, the responsibility for implementing climate-adaptive measures primarily rested with the project bureau, comprising private parties and the municipality. Financial considerations significantly influenced the decision-making process of the project bureau. In the development of Gnephoek, it is currently challenging to assess as the project is still in the initiation phase.

Therefore, the dual role of the municipality was clearly visible in both case studies. The municipality took on an active steering role in the PPP, steering on feasibility of the project. The levers to pull were mostly focused on this financial feasibility, as the most important motive for these considerations. A question that arises is whether ambitions for climate adaptation will consistently outweigh financial incentives throughout the process, placing pressure on the primary role of the municipality, functioning as a public organization which steers on implementing societal ambitions. Consequently, the Expert Panel (4.4) emphasizes the crucial need to maintain a clear separation within the municipality between stakeholders in the PPP, and those tasked with assessing area development for climate-adaptive measures.

Bult-Spiering et al. (2005) delineate the dynamics between public and private parties, wherein their analysis dissects these dynamics, seemingly with little overlap. However, in practice, it is notable that significant interaction occurred between developers and the municipality, as observed in both projects. Private parties, specifically developers, exert pressure on the municipality and the government to permit construction activities at specific locations, as highlighted by the Expert Panel (4.4). This situation unveils the potent influence of private lobbying forces on the public domain, deviating from the theoretical frameworks outlined by Bult-Spiering et al. (2005). This influence becomes particularly pronounced within the dynamics of a PPP. Notably, the municipality, ensconced in such collaborative frameworks, becomes inherently vulnerable to the lobbying forces by private stakeholders. Under the contextual backdrop of the dual role positioning of the municipality, the specter of lobbying forces emerges as a potent factor in the successful implementation of climate-adaptive measures. This risk, if left unmitigated, has the potential to impede the seamless integration of crucial climate resilience initiatives.

On the other hand, it becomes apparent that the developer is often reliant on the municipality in area development, given the scale of the project. This interplay between public and private parties illustrates the complexity of practice, where dynamics cannot be neatly categorized into separate compartments, as suggested in the theoretical considerations of Bult-Spiering et al. (2005)

Carrot & Stick

Various options exist for the government to encourage and steer developers, end-users, or regional authorities on specific issues such as climate adaptation (Bogdan et al., 2022). In the literature, a distinction is made between two approaches: 'the Carrot' and 'the Stick' (Nelson & Pritchard, 2016). From the exploratory interviews, in-depth interviews, and the expert panel, it is evident that opinions on how the Netherlands should build climate-adaptively are divided. Some advocate for clear regulations, designating specific areas as unsuitable for construction (the Stick). Others suggest steering by incentivizing stakeholders towards climate-adaptive measures through financial incentives (the Carrot). The minister's intervention highlights the balance between the two approaches. When an urban area development project, specifically one focused on climate adaptation, faces challenges in getting started, there seems to be a need to present a positive incentive to catalyze the development.

5.2. Risk

In the literature, the decision-making process is often depicted as a linear progression from left to right, occasionally incorporating a single feedback loop (Hayes, 2023; Virlics, 2013; Winch, 2010). Especially during the initial phases of the project, however, the investment decision-making process was more intricate, involving multiple feedback loops. In practice, one party would establish frameworks, eliciting a response from the other party, and the frameworks might then be adjusted. This process bears a strong resemblance to the Stream model proposed by Pot et al. (2018), where numerous factors influence the decision-making moment.

Another noteworthy aspect was the limited use of tools in the investment decision-making process. Although tools like Cost-Benefit Analysis are often applied in major infrastructure projects (Ministerie van Infrastructuur en Waterstaat, 2006), they were not extensively utilized in area development practices. In the Gnephoek polder initiative, occasional reference was made to assessing measures against Life-Cycle Costing (LCC). Here, capital costs (CAPEX) are compared with operational costs (OPEX) to make a financial evaluation. In contrast, in the two case studies, the Land Exploitation (Dutch: GREX) served as the primary tool for investment decision-making.

The Land Exploitation is based on a residual value, meaning that future costs and revenues are not considered in the Land Exploitation. This stands in stark contrast to a societal cost-benefit analysis (Börjesson et al., 2014). The primary objective of Land Exploitation is to achieve financial balance, allowing adjustments to certain parameters to steer the feasibility of the development. However, this introduces risks for investments in climate-adaptive measures. The added value of these investments gets overshadowed by the discount rate applied in the land development plan. The focus is placed on the project's costs and revenues rather than the broader public costs and benefits, neglecting the additional gains from investments in climate-adaptive measures within the area's framework. Focusing on the case studies, a discernible pattern emerges. At each expenditure point, an evaluation was conducted to ensure the Land Exploitation still yielded a positive return. If not, decision-makers had levers to pull, or the measures were not implemented at all.

On the one hand, there has been a comprehensive identification of the physical risks. Both public and private entities are familiar with the corresponding measures, as observed in the literature (Singh et al., 2020). Nevertheless, it is evident in both the literature and exploratory interviews that financing for climate-adaptive measures poses a challenge (INT-I; INT-II). The prospect of standardization might potentially trigger financial mechanisms for climate-adaptive measures (INT-IV).

On the other hand, non-physical risks prove more challenging to prevent and entail significant costs in projects. As areas are designated as climate-risky, non-physical risks such as market risks and the potential for reputational damage play a substantial role in projects. Both the case studies and the expert panel highlighted that these risks are still considerably underemphasized, a finding also affirmed in the literature where non-physical risks are categorized under Management Challenge (Winch, 2010), with low impact and high likelihood of occurrence. Nevertheless, collectively, these risks contribute significantly to the overall impact.

Lastly, it was concluded from the case studies that future emphasis should be placed on collective adaptive measures. However, this contradicts the goals of both the developer and the municipality within the PPP, which aim to limit capital expenditure (Zeeuw, 2018). Collective measures require substantial investments at the beginning of the process. The question arises whether financial mechanisms can provide a fitting solution for this.

5.3. Limitations

While this research provides many new insights, it also has limitations that should be considered. Firstly, the topic of climate-adaptive area development is dynamic and complex. The literature used is a sampling, and there are numerous tools and approaches to assess climate risks and their effects on the built environment. Moreover, numerous resources exist to obtain comparable results beyond those introduced here. The literature was acquired until September 2023, and any publications that came out afterward were only partially included in the study.

The case studies were a part of a developmental process. Decision-making and discussions were snapshots in time. The events described reflect individual experiences and may differ from reality. Triangulation was used to mitigate any potential inaccuracies. The intended development in the Gnephoek-polder is in its initiation phase, and the outcomes of the discussed decisions are largely unknown.

The aim of this research is to focus on the investment decision-making process. The research delves into details through in-depth interviews with stakeholders from two cases, due to research boundaries and the willingness of stakeholders from other projects. It could be worthwhile conducting further research with additional case studies from improved credibility. Nonetheless, the validation is done by the expert panel, which compares findings with daily practices.

Conducting research at a graduation company may pose a risk, creating a bias towards the company's goals. To avoid this, the graduation company's involvement in interviews was non-existent, and they had no access to case-sensitive information. Additionally, the expert panel involved practitioners who were not connected to the case studies and spoke from their practical experience. The primary objective of this approach was to limit bias as much as possible.

6. Conclusion

The research's objective was to investigate the impact of climate risk in the investment decision-making process on polder-area development projects. This research focuses on water risks within climate risks. The convergence of climate change, low-laying polders in the Netherlands and the housing demand results in a challenge for effective implementation of climate adaptive measures. Societal relevance lies in informing policymakers, developers, and municipalities about insights on the impact of water risks on the investment decision-making process. Scientific relevance lies in assessing the investment decision-making process in the context of climate adaptation, creating a bridge towards the real estate domain. The combination may lead to successful climate adaptation in urban development, contributing to a comprehensive understanding of the complex interplay between theory, policy, and practice. This research strived for creating a better understanding of the question "Who pays what, when?". Therefore, the research concludes with answering the following main research question:

> *"In which way do water risks impact the investment decision-making process in polder-area development projects in the Netherlands?"*

The water risks have an impact on the investment decision-making process in four ways. Firstly, the implementation of climate-adaptive measures into the investment decision-making process is currently insufficient. The water risks places pressure on the successful implementation of climate adaptive and the Dutch government has limited tools for effective guidance during urban area development. The approach for water management in the Netherlands has changed over time. Initially, management approach exhibited a reactive character in the early years. Notwithstanding, policy is beginning to take shape within the water management world. A recent shift transitioned the water management approach from merely mitigating water to actively adapting to it. The policy 'Water and Soil-driven', serves as an emerging bridge between the water and the building environment. It also formulates principles regarding spatial planning to make the Dutch built environment climate-adaptive. The initial tools for implementing climate adaptation are starting to emerge in response to these advancements. However, these tools are currently confined to a limited awareness and have not been incorporated into laws and regulations yet. Unlike other public parties, empirical research indicates that the water authorities in both case studies have the knowledge and required resources for successful implementation. Their responsibility in overseeing control functions and their understanding of water-related risks underscore their effectiveness in ensuring climate resilience.

Secondly, financial considerations have a strong impact on the investment decision-making process and therefore on investments in climate adaptation. At present, the Land Exploitation (Dutch: GREX) serves as the primary and foremost evaluative tool for assessing investment decisions, e.g., climate-adaptive investments. The Land Exploitation serves as a shared reference framework between the municipality and developer, both integral parts of the PPP. Land exploitation relies on a residual value approach, where possible future costs and revenues are excluded. Its objective is financial equilibrium. However, this approach poses risks for climate-adaptive investments, as their value is

diminished by the discount rate in the land development plan. Its focus is primarily on the considerations between various investments, along with associated costs. Societal impact and risks are not taken into account in this assessment. The emphasis on project-specific costs and revenues overlooks broader public costs and benefits, neglecting the additional advantages of climate-adaptive measures in the area's framework. Therefore, the use of this evaluation tool leads to a scenario where financial considerations influence the extent of water-related risks, rather than the water-related risks being the decisive factor in climate adaptation investments.

Thirdly, the dual positioning of the municipality complicates the investment decision-making process regarding the implementation of climate-adaptive measures and steers on financially driven decisions. In the context of PPPs, the municipality assumes a dual role, functioning both as a public and private party, referred to as the *'double hat' position*. This dual role introduces complexities, notably placing pressure on the control of climate-adaptive measures due to financial feasibility considerations. It is crucial to acknowledge the division between the part of the municipality involved in the PPP and the part outside of it. This division is essential to prevent climate adaptation strategy from becoming compromised by financially driven decisions. The responsibility for steering the implementation of climate-adaptive measures rests primarily with regional authorities. The influence wielded by municipalities is predominantly embedded in their participation in PPPs, entailing the acceptance of responsibilities and associated risks.

Lastly, non-physical risks within polder-area developments have a large impact on the feasibility of the project, which hinders climate adaptive investments. The risks within polder-area development can be divided into physical and non-physical risks. Physical risks and climate adaptive measures to mitigate these risks are well-known in the realm of urban area development. However, non-physical risks have a major impact on the outcomes of climate adaptive investment decisions. A dominant non-physical risk is introduced due to land speculation, placing pressure on the financial feasibility of polder-area development. Due to numerous speculations in the past, a specific plot has undergone various transactions over the years. This phenomenon influences the residual value of the plot within land exploitation. This market dynamic results in a higher price per square meter for the plot without incorporating value capturing. The dominance of the business case and land speculation significantly hinders the successful implementation of climate-adaptive measures. The prioritization of financial considerations over water safety in decision-making regarding construction locations is detrimental to both government and end-users, enlarging water risks in residential urban areas.

By navigating the impacts of water risks towards adaptation, driven by collaborative efforts, a holistic approach becomes imperative to forge a path toward a more resilient built environment.

6.1. Recommendations

Recommendations for implementation

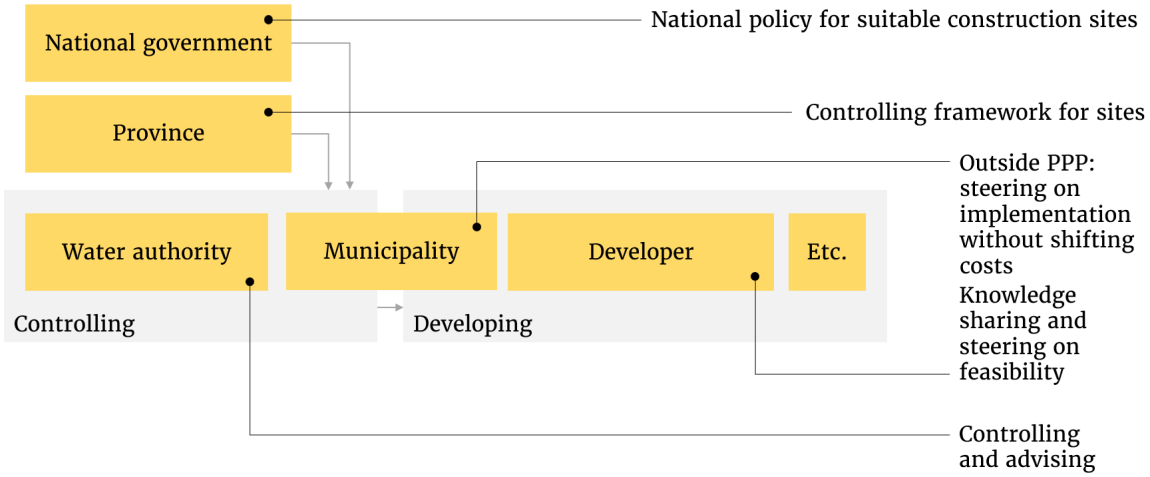


Figure 6.1. *Allocation of responsibility and risk of public and private stakeholders in polder-area development (author).*

Consistent with the findings of this research, a recommendation can be put forth for those involved in climate-adaptive area development. The objective of this research was to address the question "who pays what, when?". The research strived to unravel the complexity of the risks and responsibilities among decision-makers within polder-area development that comes in hand with water risks in the low-laying areas of the Netherlands. On that note, *Figure 6.1* presents a proposal regarding the allocation of responsibilities and risks among the public and private stakeholders engaged in polder-area development.

The involved parties primarily look to the frameworks set by the national government. Norms and oversight are expected to flow from the national government to the province and then to the municipality. The national government is entrusted with identifying suitable construction sites while considering climate risks. Specific areas may be excluded due to these risks. Tools, such as land sharing, are deemed necessary for the government's exclusionary processes. Monitoring the implementation should be a municipal responsibility.

To reduce non-physical risks, it is the municipality's responsibility, as the initiator, to clearly define the frameworks and goals at the outset of the project. The stacking of ambitions also contributes to the emergence of non-physical risks during area development. In situations with numerous climate risks, it might be more prudent to prioritize the ambition of creating a climate-adaptive neighborhood over adhering strictly to other goals, such as affordability. The municipality assumes a facilitating role and bears the responsibility of preventing the shifting of costs to end-users. If the municipality is part of the PPP, there must be vigilance to ensure a clear separation between those involved within and outside the PPP. Municipal personnel external to the PPP are tasked with the responsibility for control.

The role of the private party leans more towards knowledge sharing and facilitating the feasibility of area development. Knowledge sharing is, to a certain extent, a mutual interest of both public and private parties, necessitating contribution from both sides. By establishing clear ambitions, norms, and rules at the outset, costs are more equitably distributed among the municipality, developer, government, and end-user, ensuring each party contributes their fair share. Private parties can play a role in implementing climate-adaptive measures by focusing on steering the project towards feasibility, taking into account the measures in place. In this way, private parties can facilitate the financing of these measures by strategically leveraging the available opportunities. With this outlined distribution, the path from identifying risks to establishing resilience becomes visible, shedding light on a strategic pathway toward a more climate-resilient future.

Recommendations for further research

This study provides a piece of the climatological puzzle, highlighting that the Netherlands can be kept high and dry if the sufficient attention continues to be devoted to climate adaptation. The research gap concerning the investment decision-making process regarding climate change and urban area development has received significant attention. However, to establish a scope, boundaries had to be set. Filling the research gap created other intriguing questions. To further explore these questions, *Figure 6.2* presents recommendations for further research in line with the conceptual framework of this research.

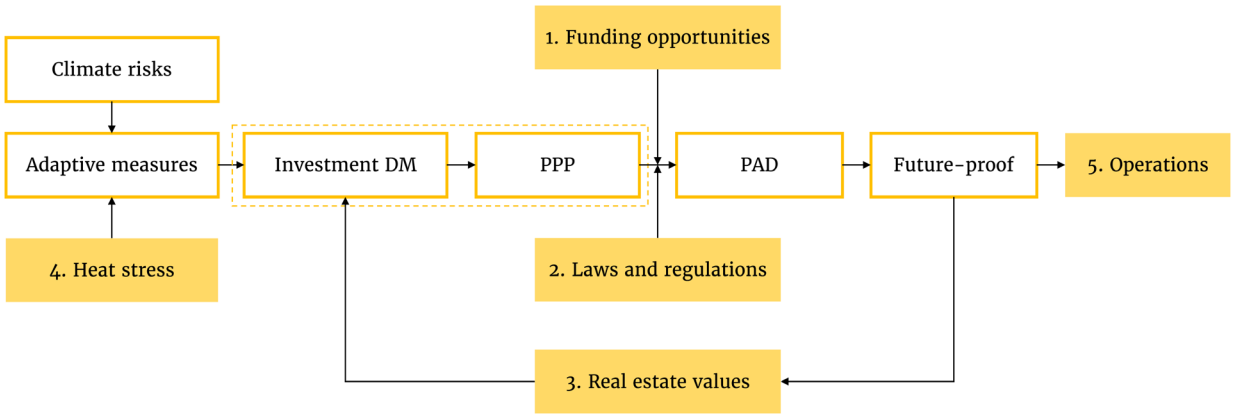


Figure 6.2. *Recommendations based on the conceptual framework (author).*

1. ***Funding opportunities***

As stated in the conclusion, climate-adaptive measures are financed through the Land Exploitation (Dutch: GREX) of a project, potentially impacting the project's financial feasibility. One solution for financing the implementation of adaptation measures is the use of standardized funding methods (e.g., Green Bonds). The standardization of regulations and improved possibilities for standardized financing go hand in hand, as discussed by interviewee IV. Additionally, the appropriate governance structure can play a role in this matter. In this context, the involvement of municipalities, provinces, and the government is relevant due to their financial capacity.

The significance of this financial capacity became evident during the initiative of the Gnephoek, where a shortfall of over € 50 million prompted the search for a contribution from the national government.

Currently, the solution for the right tools is not yet provided, but funding opportunities are beginning to take shape in broad strokes. Further research on funding methods may streamline and improve the implementation of climate-adaptive measures.

2. *Laws and regulations*

This study initiated a discussion regarding legal and regulatory aspects, using the Carrot and Stick approach. It reveals a call from stakeholders for regulatory frameworks. Moreover, in the exploratory interviews, special attention was devoted to the need for laws and regulation. Interviewee IV mentioned: "If equal requirements are imposed, standardizing climate-adaptive measures becomes much more straightforward". While there has been an initial attempt to standardize measures with the National Benchmark for a Green and Climate-adaptive Built Environment, the benchmark is not embedded in regulation. Therefore, an examination could delve deeper into the pathways towards laws and regulations in the sphere of climate adaptive urban area development.

3. *Real estate values*

Further study could delve deeper into the relationship between water risks, climate-adaptive measures, and real estate values. It would be particularly interesting to examine the potential negative impact of climate events, or the positive impact associated with the implementation of adaptive measures on real estate values. In both case studies, it was observed that both public and private stakeholders paid less attention to the potential impact of a climate-adaptive environment on the rise or fall of real estate values. Conversely, the positive influence of green quality was more significant and manifested more rapidly. However, during the exploratory interviews, particularly with experts from the investment and insurance sectors (INT-II, INT-V), it was discussed that there is a connection between real estate values and climate adaptation. Nevertheless, water-related risks remain less visible and may be indirectly linked to real estate values. Hence, further research into the correlation between real estate values and climate adaptation could provide valuable insights.

4. *Heat stress*

The study focuses solely on water-related risks and excludes any mentions of heat stress. However, it is worth noting that heat stress may become a significant concern in the future, especially in the G4-cities of the Netherlands, as seen in frameworks like "Maatlat Klimaat Adaptief Bouwen" (Rijksoverheid, 2023), which introduce initial standards for mitigating the issue in densely built areas. The expert panel highlighted that in the coming years, the Netherlands will continue to face water risks, but in the longer term, water scarcity, drought and heat will play a more significant role (*4.4 Expert Panel*). Research into the impact of heat, utilizing a similar framework could be effectively conducted to assess its impact on the investment decision-making process.

5. Operations

This study primarily focused on the development phase, incorporating only a segment of the operational phase immediately following completion. The nature of Land Exploitation limits the scope for considering lifecycle costs in climate-adaptive measures.

In the Gnephoek development, the municipality indicated that while there is some attention to lifecycle costs, practical application remains limited. This research also proposes an implementation plan for climate-adaptive area development. A thorough evaluation of investment flows from the municipal perspective is essential. It is possible that the Maintenance & Operations department of a municipality can finance the costs for maintaining climate-adaptive measures in a traditional manner. Furthermore, the operational phase of such measures is closely linked to potentially standardized financial mechanisms. Further research into the operational phase, particularly how to manage and finance measures throughout the life cycle while ensuring quality, would be intriguing to explore. Climate-adaptive measures are a novel addition to the portfolios of those in charge, usually the municipality, and thus further investigation in this area is desirable.

7. Reflection

The following chapter provides a reflection on the research method and relation with the MSc Management in the Built Environment. Thereafter, the personal reflection highlights the process towards P2 and P4.

7.1. Design and context

Choice of method

This is a qualitative research in which interviews play a pivotal role. The research strived to create a bridge between theory and practice. Opting for interviews precisely fosters interaction with practical facets. The dialogues yield insights into the investment decision-making process, elucidating the rationale behind certain choices and retrospective reflections on the decisions made. The qualitative methodology introduces complexities in comparison as data assumes a secondary position. Consequently, discerning connections becomes intricate. Simultaneously, the research design is exploratory. Embracing this methodology affords the requisite latitude to derive the presented results in the preceding chapter.

The chosen method contributes to the sharpness of the study. The exploratory interviews delineate the contours of the conclusion, highlighting intriguing aspects and eliciting pertinent queries. The in-depth interviews reveal the importance of Public-Private Partnerships (PPPs) in the allocation of responsibilities and risks, forming the foundation of this investigation. Lastly, the expert panel plays a pivotal role in validating the results, introducing nuanced perspectives and refinement.

Context

From the perspective of the researcher, in the daily routine, the water and construction sectors may appear unrelated. However, the policy of 'Water and Soil Governance' has successfully forged a connection between these seemingly distinct realms. Climate-adaptive construction stands as a link demanding a connection between these two ostensibly disparate worlds. As a researcher with a background in architecture, delving deeper into the realm of water was fascinating, revealing its relevance to the built environment. Gaining insights into water management not only provides a broader perspective on the built environment but also sheds new light on the challenges of climate adaptation.

It is essential that these two domains engage in more dialogue in the future. In the master's program in Architecture, Urbanism, and Building Sciences, students are equipped to innovate smart solutions for today with an eye on tomorrow, particularly in the context of climate change. Designing, constructing, and contributing to the climate-adaptive built environment of the future constitute integral aspects of this education.

7.2. Personal reflection

Process towards P2: Graduation Laboratory

I found the Graduation Laboratory course insightful but challenging. I quickly had a clear direction for my research. My interest lies in urban developments, with a particular focus on the financial perspective and feasibility. At the beginning of this course, I felt that the choices of themes were limited and not directly supportive. That's why I decided to set up my own research and explored which theme aligned best with it. I wanted to choose a research direction that is at this moment highly relevant, with expectations of significant innovation and changes (e.g., in regulations).

Considering my interests, I find the impact of climate adaptive measures fitting and intriguing. The process of developing a main question, sub-questions, and research methodology was challenging for me. Fortunately, I received support throughout this process from informative theme sessions, my mentors, and colleagues at Fakton. Between P1 and P2, I experienced a brief yet intensive period of work. Submitting my P2 report in week 6 and presenting it in week 7 feels quite early in the quarter, putting significant time pressure on me. However, this timeframe also provides me with the advantage of having ample time and flexibility to properly set up my case studies and arrange interviews.

Process towards P4

In September, I started the case study selection process. As I navigated through the selection criteria and analyzed the case study documents, the question arose: where am I looking for? Throughout September, I dedicated time to clarifying the purpose of my research. Extensive reading, discussions with my advisors, peers, and colleagues from Fakton were instrumental in shaping my research goal. I aimed to have a clear objective before delving into the in-depth interviews, aiming to prevent the need for potential redo. After much contemplation, writing, and revision, I refined my focus towards the dynamics within the investment decision-making process in relation to Public-Private Partnerships (PPP).

Conducting the interviews proved to be an enjoyable experience. I had the opportunity to engage with numerous individuals about their experiences in the process, striving to conduct as many interviews in person as possible (which was largely successful). It was interesting to observe that some were hesitant to participate in interviews, while others enthusiastically embraced my request. There seemed to be little middle ground. Additionally, the relevance of my topic provided a significant source of motivation. Attending various events and conferences, engaging in conversations about climate adaptation, fueled my belief in the future of climate adaptation in the built environment, energizing my efforts.

Navigating towards the results posed a challenge, as the light at the end of the tunnel was not immediately visible. Processing transcripts without immediate connections and conclusions was demanding. Despite the difficulty of not seeing immediate results, it was

necessary to continue. On a Sunday evening before my P3, something clicked, and the puzzle pieces fell into place, giving shape to a developing conclusion.

Reflecting on the process, I found it to be a valuable learning experience, with time swiftly passing by. The early scheduling of my P4 brought about significant time pressure. While this pressure led to challenging moments, it also helped me stay focused and productive, allowing me to manage my tasks effectively. The process was at times isolating, with few others engaging in similar work, and the need to independently structure my schedule. Ultimately, it was a rewarding learning experience, particularly in advancing my academic writing skills, which I anticipate carrying forward throughout my career.

8. Literature

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9. Appendix

Appendix A: Interview protocol (Dutch)

Interview Protocol | Experts

Afstudeerder (student): Daniël Zantinge

Begeleiding vanuit:

Technische Universiteit Delft: Ir. E.H.M. (Ellen) Geurts & Dr. Z.J. (Zac) Taylor

Fakton Consultancy, ir. T. (Tim) van der Zaan.

Het onderzoek

Nederland staat voor klimaatuitdagingen, met als doel tegen 2030 bijna een miljoen woningen te bouwen, waarvan 600.000 in klimaatgevoelige gebieden. Hoewel de verscheidenheid aan instrumenten voor klimaatadaptatie wellicht helder lijkt, vormt de effectieve implementatie en goede kosten- en risicoverdeling van deze maatregelen een grote uitdaging. Mijn onderzoek vergelijkt twee cases, Gnephoek (Alphen aan den Rijn) en Westergouwe (Gouda), om een herzien investeringsmodel voor klimaatadaptatie te ontwikkelen. Als onderdeel van mijn onderzoek ga ik in gesprek met experts die betrokken zijn geweest bij de kennisontwikkeling, (investerings)besluitvorming en/of realisatie van klimaat adaptieve maatregelen.

De onderzoeksvraag van dit onderzoek luidt: *Wat is de invloed van overstromings- en waterrisico's op het investerings-besluitvormingsproces in gebiedsontwikkelingen in het Nederlandse polderlandschap?*

Het interview is open-gestructureerd aan de hand van vier thema's: inschatten van risico's; verantwoordelijkheden; vastgoedwaarden; en wet- en regelgeving. Er is voldoende ruimte voor eigen inbreng.

Agenda	**Categorie**	**Vraag**
Introductie (10 min)	Kennismaking	• Doel van het onderzoek. • De structuur van het interview. • Informed Consent Form. • Vragen voorafgaand het interview
Onderzoek (45 min)	**Thema 1: Inschatten van risico's**	
	Thema 2: Verantwoordelijkheden	
	Thema 3: Vastgoedwaarden	
	Thema 4: Wet- en regelgeving	
Afsluiting (5 min)	Afronding	• Toelichting vervolg van het onderzoek • Ruimte voor vragen achteraf

Interview Protocol | Westergouwe

Afstudeerder (student): Daniël Zantinge

Begeleiding vanuit:

Technische Universiteit Delft: Ir. E.H.M. (Ellen) Geurts & Dr. Z.J. (Zac) Taylor

Fakton Consultancy, ir. T. (Tim) van der Zaan.

Het onderzoek

Nederland staat voor klimaatuitdagingen, met als doel tegen 2030 bijna een miljoen woningen te bouwen, waarvan 600.000 in klimaatgevoelige gebieden. Hoewel de verscheidenheid aan instrumenten voor klimaatadaptatie wellicht helder lijkt, vormt de effectieve implementatie en goede kosten- en risicoverdeling van deze maatregelen een grote uitdaging. Mijn onderzoek vergelijkt twee cases, Gnephoek (Alphen aan den Rijn) en Westergouwe (Gouda), om een herzien investeringsmodel voor klimaatadaptatie te ontwikkelen. Als onderdeel van mijn onderzoek ga ik in gesprek met betrokkenen van de gebiedsontwikkeling.

De onderzoeksvraag van dit onderzoek luidt: *Wat is de invloed van overstromings- en waterrisico's op het investerings-besluitvormingsproces in gebiedsontwikkelingen in het Nederlandse polderlandschap?*

Het interview zal allereerst ingaan op de totstandkoming van de plannen voor de gebiedsontwikkeling. De rol hierin van jullie organisatie, en belangrijke besluitvormingen. In het tweede deel van het interview gaan we verder in op de klimaatrisico's, de kosten en de baten van adaptieve maatregelen in Westergouwe.

De volgende momenten waren belangrijk voor het project:

1. In 1989 wordt de noodzaak tot uitbreiding van Gouda benoemt. In het convenant (1993) wordt Westergouwe als ontwikkellocatie genoemd. Echter, de waterrisico's en de verkeersproblematiek spelen een dusdanige grote rol voor de wijziging van het bestemmingsplan.
2. In 2006 worden er in de MER 4 alternatieven genoemd. Waterstad Westergouwe wordt als beste alternatief beschouwd. Na goedkeuring van het bestemmingsplan, wordt in 2011 gestart met het bouwrijp maken van de polder.
3. Door de crisis in 2012 kondigt de gemeente aan het project te gaan faseren. Hiermee wordt de grondexploitatie in fases opgesplitst, zodat risico's worden verkleind en verspreid.
4. In 2015 tekenen de publiek en private partijen een samenwerkingsovereenkomst. Voor de ontwikkeling bouwen Heijmans en VolkerWessels in consortium, onder

naam VOF Westergouwe. De gemeente werkt samen met VOF Westergouwe in het projectbureau Westergouwe.

5. In 2016 wordt fase 1 opgeleverd. In hetzelfde jaar gaat fase 2 van start. In 2023 is deze fase afgerond en opgeleverd. Dit betekende de start van de een-na-laatste fase.

Agenda	**Categorie**	**Vraag**
Introductie (10 min)	Kennismaking	• Doel van het onderzoek. • De structuur van het interview. • Informed Consent Form. • Vragen voorafgaand het interview
Onderzoek (45 min)	**Fase 1: Rollen en verantwoordelijkheden gebiedsontwikkeling**	
	Totstandkoming van de plannen in Westergouwe	• Kunt u een toelichting geven op de totstandkoming van het project en belangrijke momenten in het proces? • Kunt u iets vertellen over jullie betrokkenheid in het project?
	Publiek-private samenwerking	• Hoe ziet de projectorganisatie eruit? • Hoe zijn de verantwoordelijkheden en risico's van het project verdeeld?
	Uw rol in de gebiedsontwikkeling	• Hoe heeft uw betrokkenheid invloed gehad op de besluitvorming in dit project? • Op welke manier heeft u sturing kunnen geven aan de ontwikkeling van dit gebied?
	Fase 2: Klimaatadaptieve maatregelen in het gebied	
	Klimaatrisico's in het gebied	• Zou u kunnen toelichten welke klimaatrisico's er worden gezien vanuit uw perspectief? • Kunt u iets toelichten over uw perspectief op de klimaatrisico's van dit project?
	Verantwoordelijkheden	• Welke maatregelen zijn hierin jullie verantwoordelijkheid? • Bunt u het eens met die verantwoordelijkheid?
	Bekostiging	• Hoe zijn de investeringskosten voor de maatregelen betaald? • Hoe worden de onderhoud- en beheerkosten voor de maatregelen betaald?
	Baten	• Hoe is de baten-verdeling geregeld? • Ligt dit in lijn met de kostendrager?
Afsluiting (5 min)	Afronding	• Toelichting vervolg van het onderzoek • Ruimte voor vragen achteraf

Interview Protocol | Gnephoek

Afstudeerder (student): Daniël Zantinge

Begeleiding vanuit:

Technische Universiteit Delft: Ir. E.H.M. (Ellen) Geurts & Dr. Z.J. (Zac) Taylor

Fakton Consultancy, ir. T. (Tim) van der Zaan.

Het onderzoek

Nederland staat voor klimaatuitdagingen, met als doel tegen 2030 bijna een miljoen woningen te bouwen, waarvan 600.000 in klimaatgevoelige gebieden. Hoewel de verscheidenheid aan instrumenten voor klimaatadaptatie wellicht helder lijkt, vormt de effectieve implementatie en goede kosten- en risicoverdeling van deze maatregelen een grote uitdaging. Mijn onderzoek vergelijkt twee cases, Gnephoek (Alphen aan den Rijn) en Westergouwe (Gouda), om een herzien investeringsmodel voor klimaatadaptatie te ontwikkelen. Als onderdeel van mijn onderzoek ga ik in gesprek met betrokkenen van de Gebiedsontwikkeling.

De onderzoeksvraag van dit onderzoek luidt: *Wat is de invloed van overstromings- en waterrisico's op het investerings-besluitvormingsproces in gebiedsontwikkelingen in het Nederlandse polderlandschap?*

Het interview zal allereerst ingaan op de totstandkoming van de plannen voor de gebiedsontwikkeling. De rol hierin van jullie organisatie, en belangrijke besluitvormingen. In het tweede deel van het interview gaan we verder in op de klimaatrisico's, de kosten en de baten van adaptieve maatregelen in de Gnephoek.

1. Gemeente Alphen aan den Rijn breidt graag uit om het woningtekort in de regio terug te dringen. In 2021 wordt de polder Gnephoek als mogelijke ontwikkellocatie gekenmerkt. De gemeente beoogd 8.000 tot 10.000 woningen.
2. Provincie Zuid-Holland houdt de plannen tegen. Minister Hugo de Jonge besluit de mogelijkheden tot woningbouw verder te onderzoeken en stelt Wim Kuijken als onafhankelijk adviseur. Wim Kuijken biedt 4 verschillende toekomstperspectieven voor de Gnephoek, waarvan variant 3 (5.500 woningen, hockey-stick) realistisch wordt geschat.
3. De publiek en private partijen ontwikkelen Masterplan Gnephoek om zo tot een eindconclusie te komen. Het voorstel is om in Joint-Venture het gebied te ontwikkelen.
4. De bouwrijpmaak-kosten voor het gebied, inclusief klimaatadaptieve maatregelen, en de bovenplanse kosten (voor infrastructuur) vallen hoog uit, er is een tekort van € 50 miljoen.

Agenda	Categorie	Vraag
Introductie (10 min)	Kennismaking	• Doel van het onderzoek. • De structuur van het interview. • Informed Consent Form. • Vragen voorafgaand het interview
Onderzoek (45 min)	**Fase 1: Rollen en verantwoordelijkheden gebiedsontwikkeling**	
	Totstandkoming van de planning in de Gnephoek	• Kunt u een toelichting geven op de totstandkoming van het project en belangrijke momenten in het proces? • Kunt u iets vertellen over jullie betrokkenheid in het project?
	Publiek-private samenwerking	• Hoe ziet de projectorganisatie eruit? • Hoe zijn de verantwoordelijkheden en risico's van het project verdeeld?
	Uw rol in de gebiedsontwikkeling	• De hockeystick werd door Wim Kuijken onderschreven. Wat was jullie rol in dit besluit? • In hoeverre kunt u sturing geven in de besluitvorming van het project?
	Fase 2: Klimaatadaptieve maatregelen in het gebied	
	Klimaatrisico's in het gebied	• Zou u kunnen toelichten welke klimaatrisico's er worden gezien vanuit uw perspectief? • Kunt u iets toelichten over uw perspectief op de klimaatrisico's van dit project?
	Verantwoordelijkheden	• Welke maatregelen zijn hierin jullie verantwoordelijkheid? • Bunt u het eens met die verantwoordelijkheid?
	Bekostiging	• Hoe worden de investeringskosten voor de maatregelen betaald? • Hoe worden de onderhoud- en beheerkosten voor de maatregelen betaald?
	Baten	• Hoe is de baten-verdeling geregeld? • Ligt dit in lijn met de kostendrager?
Afsluiting (5 min)	Afronding	• Toelichting vervolg van het onderzoek • Ruimte voor vragen achteraf

Appendix B: Informed Consent Form (Dutch)

Informed Consent Form

Afstudeerder (student): Daniël Zantinge

Begeleiding vanuit:

Technische Universiteit Delft: Ir. E.H.M. (Ellen) Geurts & Dr. Z.J. (Zac) Taylor

Fakton Consultancy, ir. T. (Tim) van der Zaan.

Beste deelnemer,

Mijn naam is Daniël Zantinge, en voor de afronding van mijn MSc Management in the Built Environment doe ik momenteel een academisch onderzoek naar klimaatadaptieve gebiedsontwikkeling.

Het onderzoek

Nederland staat voor klimaatuitdagingen, met als doel tegen 2030 bijna een miljoen woningen te bouwen, waarvan 600.000 in klimaatgevoelige gebieden. Hoewel de verscheidenheid aan instrumenten voor klimaatadaptatie wellicht helder lijkt, vormt de effectieve implementatie en goede kosten- en risicoverdeling van deze maatregelen een grote uitdaging. Mijn onderzoek vergelijkt twee cases, Gnephoek (Alphen aan den Rijn) en Westergouwe (Gouda), om een herzien investeringsmodel voor klimaatadaptatie te ontwikkelen. Als onderdeel van mijn onderzoek ga ik in gesprek met experts die betrokken zijn geweest bij de kennisontwikkeling, (investerings)besluitvorming en/of realisatie van klimaat adaptieve maatregelen. Als expert nodig ik u uit om deel te nemen aan dit interview.

Het interview

Het interview zal naar verwachting ongeveer 60 minuten duren en zal bij voorkeur worden opgenomen. Uw persoonlijke gegevens, afgezien van uw naam, organisatie en functie, worden niet gedeeld. Uw deelname is geheel vrijwillig, en u kunt op elk moment besluiten om het interview te beëindigen. De transcriptie van het interview zal met u gedeeld worden om u de ruimte te geven eventuele aanpassingen te doen.

Door uw deelname kunnen zowel publieke als private belanghebbenden dieper inzicht verwerven in het besluitvormingsproces voor investeringen in klimaatadaptieve maatregelen binnen gebiedsontwikkelingen in Nederland. Bovendien wordt er gestreefd naar bredere kennisdeling met praktische inzichten die nuttig zullen zijn voor toekomstig onderzoek over dit actuele onderwerp.

Bedankt voor uw deelname aan mijn afstudeeronderzoek.

Met vriendelijke groet,

Daniël Zantinge

Toestemmingsformulier - Klimaatadaptieve gebiedsontwikkeling

Dit toestemmingsformulier heeft betrekking op een onderzoek dat wordt uitgevoerd als onderdeel van de afronding van MSc Management in the Built Environment aan de Faculteit Bouwkunde van de TU Delft. Door middel van het ondertekenen van dit document bevestigt u geïnformeerd te zijn over dit onderzoek, de methodiek die wordt gebruikt waarop de onderzoeksgegevens worden verzameld en gebruikt (kruis aan wat van toepassing is):

☐ Hierbij verklaar ik dat ik grondig ben geïnformeerd over het onderzoek en de gelegenheid heb gehad om eventuele vragen te stellen. Ik heb dit formulier zorgvuldig gelezen en stem hierbij in met mijn deelname aan het onderzoek.

☐ Mijn deelname aan dit onderzoek is geheel vrijwillig. Ik ben me ervan bewust dat ik het recht heb om vragen te weigeren te beantwoorden en dat ik op elk gewenst moment tijdens het onderzoek mijn deelname mag beëindigen.

☐ Ik verleen toestemming voor een audio-opname van het interview. Deze opname zal uitsluitend worden gebruikt voor dit onderzoek en zal na afronding van het onderzoek worden verwijderd.

☐ Ik begrijp dat mijn titel en de naam van het bedrijf waar ik werkzaam ben, genoemd kunnen worden in mijn scriptie. Buiten deze informatie zullen er geen persoonlijke gegevens worden gedeeld. De onderzoeker zal ervoor zorgen dat ik niet te identificeren ben in de gegevens, rapporten of artikelen die uit het onderzoek worden gepubliceerd. Mijn privacy als deelnemer aan dit onderzoek is gewaarborgd

☐ Ik stem ermee in dat de informatie die ik tijdens het interview verstrek, geciteerd kan worden in de output, nadat er communicatie heeft plaatsgevonden en overeenstemming is bereikt over het citaat.

Deelnemer

_____	_____	_____
Naam	Handtekening	Datum

Onderzoeker

Ik, Daniël Zantinge, verklaar dat ik de informatie en het toestemmingsformulier volledig en duidelijk aan de deelnemer heb gepresenteerd en alle opkomende vragen over het onderzoek bereid ben te beantwoorden.

_____	_____
Handtekening	Datum

Informed Consent Form

Afstudeerder (student): Daniël Zantinge

Begeleiding vanuit:

Technische Universiteit Delft: Ir. E.H.M. (Ellen) Geurts & Dr. Z.J. (Zac) Taylor

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De onderzoeksvraag van dit onderzoek luidt: *Wat is de invloed van overstromings- en waterrisico's op het investerings-besluitvormingsproces in gebiedsontwikkelingen in het Nederlandse polderlandschap?*

Het interview

Het interview zal naar verwachting ongeveer 60 minuten duren, de vragen zullen semi-gestructureerd zijn en het interview zal bij voorkeur worden opgenomen. Uw persoonlijke gegevens, afgezien van uw naam, organisatie en functie, worden niet gedeeld. Uw deelname is geheel vrijwillig, en u kunt op elk moment besluiten om het interview te beëindigen. De transcriptie van het interview zal met u gedeeld worden om u de ruimte te geven eventuele aanpassingen te doen.

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Bedankt voor uw deelname aan mijn afstudeeronderzoek.

Met vriendelijke groet,
Daniël Zantinge

Toestemmingsformulier - Klimaatadaptieve gebiedsontwikkeling

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☐ Hierbij verklaar ik dat ik grondig ben geïnformeerd over het onderzoek en de gelegenheid heb gehad om eventuele vragen te stellen. Ik heb dit formulier zorgvuldig gelezen en stem hierbij in met mijn deelname aan het onderzoek.

☐ Mijn deelname aan dit onderzoek is geheel vrijwillig. Ik ben me ervan bewust dat ik het recht heb om vragen te weigeren te beantwoorden en dat ik op elk gewenst moment tijdens het onderzoek mijn deelname mag beëindigen.

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☐ Ik stem ermee in dat de informatie die ik tijdens het interview verstrek, geciteerd kan worden in de output, nadat er communicatie heeft plaatsgevonden en overeenstemming is bereikt over het citaat.

Deelnemer

_____	_____	_____
Naam	Handtekening	Datum

Onderzoeker

Ik, Daniël Zantinge, verklaar dat ik de informatie en het toestemmingsformulier volledig en duidelijk aan de deelnemer heb gepresenteerd en alle opkomende vragen over het onderzoek bereid ben te beantwoorden.

_____	_____
Handtekening	Datum

Appendix C: Codebook

In the literature review, three themes are presented: Water management, Urban area development and the investment decision-making process. These three themes were handled during the semi-structured in-depth interviews, which resulted in a coding structure. The themes linked to the codes are presented with the figure. An example of a quotation per code is presented in the table.

Each code is linked to a specific theme, with an exception for 'responsibility'. The concept of responsibility is cross-thematic. For each theme, a definition is given per code, with special attention on how responsibility is defined within each theme.

Codes linked to theme '**Water Management**':

- *Physical risk:* the potential adverse impacts on the built environment due to climate change.
    - *Flood hazard*
    - *Water overload*
    - *Soil subsidence*
- *Measure management:* The way measures are incorporated within the built environment. The management refers to the 'how' and these measures are managed.
    - *Climate adaptive measures*
    - *Measures in public space*
    - *Water levels*
    - *Deflect*
    - *Side effects*
- *Responsibility*: reflects on the allocation of responsibilities within the context of water management. The responsibility refers to the 'by whom' these measures are managed.
    - *Future responsibility*
    - *Maintenance responsibility*

Codes linked to theme '**Urban Area Development**':

- *Initiative:* the process of kickstarting the project, highlighting the decisions made by the initiator and the actions of other stakeholders engaged in the initiative.
    - *Context difficulties*
    - *Role of private parties*
    - *Role of public parties*
- *Governance*: the structures and processes that facilitate decision-making, coordination, and regulation, ensuring effective management and collaboration among stakeholders.
    - *Control*
    - *Dependency*
    - *Long-term involvement*
    - *Obligations*
    - *Organization structure*

    - *Ownership of land*
- *Responsibility*: the accountable behavior expected from all involved parties, which depends on the type of governance, arrangements and letters of intent.

Codes linked to theme '**Investment Decision-making process**':

- *Decision-making:* The process of decision formation, encompassing the actions of stakeholders who wield control.
    - *Decision outcome*
    - Objective decisions
    - Subjective decisions
    - Lack of knowledge/expertise
- *Benefits:* the outcomes accrued by a party due to a decision made. These positive results may encompass various gains, advantages, or improvements directly attributable to the chosen course of action.
    - *Private party*
    - *End-user*
    - *Municipality*
- *Non-physical risk:* Risks associated with factors such as regulatory changes, market fluctuation, and management issues. These risks primarily translate into financial challenges.
    - *Policy risk*
    - *Sales risk*
    - *High ambition*
    - *Public sentiment*
    - *Project delay*
- *Responsibility:* The obligation or accountability one holds for the outcomes of the decision-making process.
    - *Allocation of responsibility*
    - *Funding responsibility*

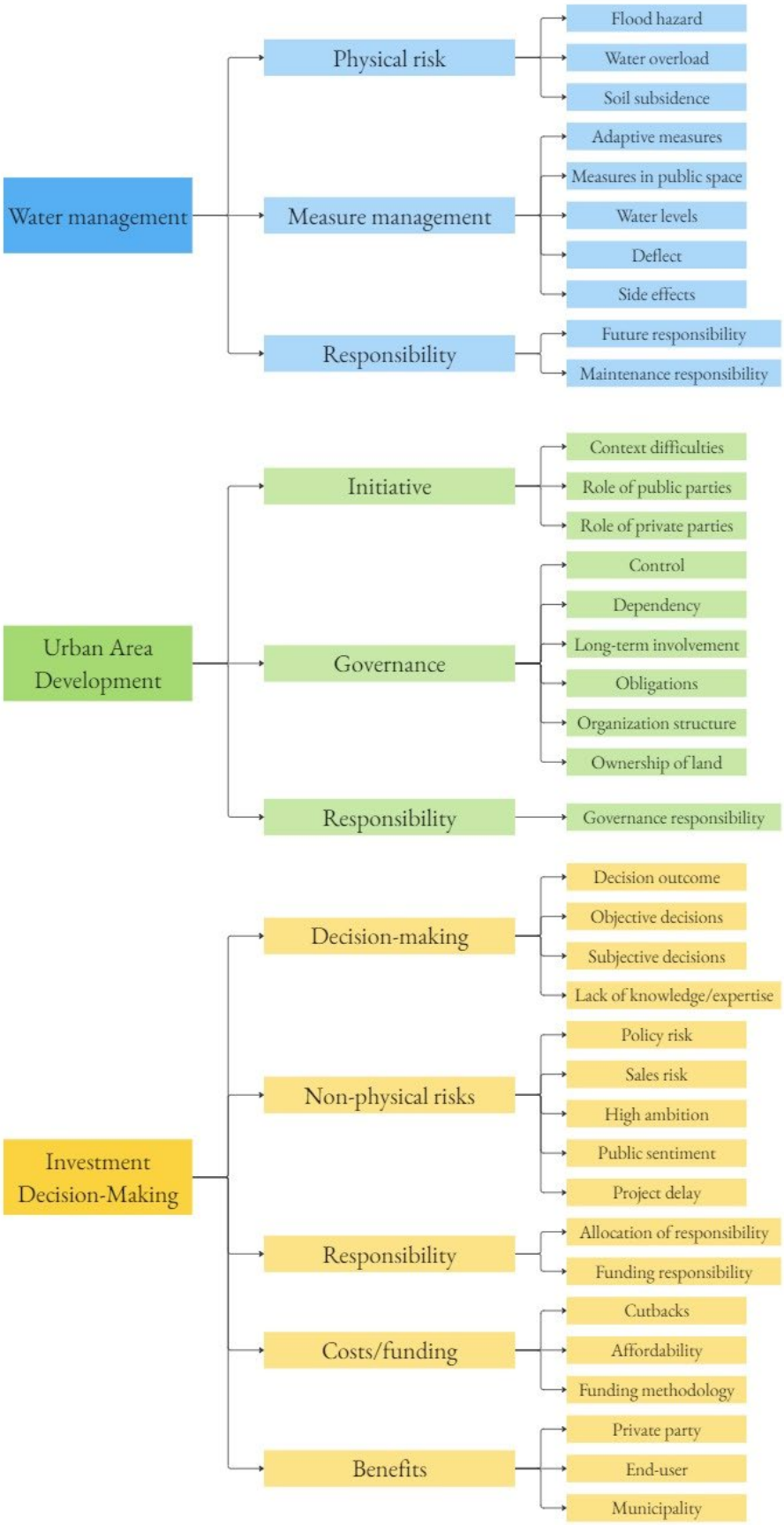


Figure: *Link between themes (concepts) and codes.*

Table: Example quotes of interviewees per code

Theme	Code group	Code	Quotation
Water management	Physical risk	Flood hazard	"Yes, if such a heavy rainfall from Limburg were to occur here, it would pose significant problems too".
		Water overload	"Fortunately, we still have an abundance of space to absorb extreme rainfall and other related events. There is a lot of water storage in the area".
		Soil subsidence	"In a figurative sense, this is arguable the least advisable location for construction, considering the softness of the soil and the depth of the polder".
	Measure management	Climate adaptive measures	"The second measure involves the construction of a large concrete wall on this island. In the event of a dike breach, this wall is designed to stand firm like a barrier".
		Measures in public space	"The use of semi-pervious surfaces in public areas improves water drainage, contributing to overall flood mitigation".
		Water levels	"When necessary, the water level is allowed to rise by 50-60 centimeters. This adjustment ensures that the area can retain rainfall for as long as possible".
		Deflect	"We do not deflect excess water onto other areas or lower-lying regions. We have the capability to retain and gradually allow the absorption of extreme rainfall"
		Side effects	"An often overlooked aspect is the contemporary issue of peat oxidation and the resulting CO2 emissions. What we are doing here proves to be an effective method to counter this phenomenon -we are halting the oxidation process by encapsulating the peat".
	Responsibility	Future responsibility	"It is not inherently the responsibility of a municipality to manage such initiatives. The determination of the ultimate caretaker for the area remains a point of discussion for us".
		Maintenance responsibility	"The same principle applies to the main waterways and the upcoming weirs. Ultimately, we assume responsibility for their management and maintenance, but only once they are constructed in accordance with our specifications".
Urban area development	Initiative	Context difficulties	"The complexity of this situation stemmed from longstanding debates regarding residential construction in the polder".
		Role of public parties	"The municipality assumed this role because we deemed it crucial to have the control to make decisions in the real estate development".
		Role of private parties	"The challenge lies in the fact that a significant portion of the land is privately owned. Spatial planning has become somewhat intricate in this context".
	Governance	Control	"Deciding which levers to pull-whether aiming for maximum return, emphasizing architectural quality, or considering various other factors- is a multifaceted decision".
		Dependency	"Our fate was contingent on obtaining that approval. What would have happened if that consent had not been granted is big question mark".
		Long-term involvement	"Participating in such a long-term urban area development poses a significant challenge and prompts exploration of the most effective modes of engagement".
		Obligations	"Our agreements with the municipality form the basis for their inclusion in the public-private partnership".

		Organization structure	"The project-company does not have a legal personality. It is simply a practical collaborative structure based on a mutual agreement".
		Ownership of land	"The land was sold to the municipality at the time, resulting in a 50% ownership stake in the land".
	Responsibility	Governance responsibility	"There was a deliberate decision to allow parties to retain responsibility for their own real estate development in this context".
Investment decision-making process	Decision-making	Decision outcome	"In the second phase, our focus shifted towards affordability. I must honestly admit that this goal was not entirely achieved".
		Objective decisions	"The initial plan to reroute the pipeline, which was obstructing the area, had to be reconsidered due to the exorbitant costs involved".
		Subjective decisions	"We opted to provide the area with high-quality public infrastructure, and we bear the additional costs ourselves".
		Lack of knowledge/expertise	"In the future, factors such as a shortage of personnel and the complexity of legal procedures contribute to the formidable task that lies ahead".
	Non-physical risks	Policy risk	"We emphasized the importance of garnering support from the municipal council for such a plan".
		Sales risk	"2013/2014 presented significant challenges, given the collapse of the entire real estate market. Initiating a project in a location where nothing existed was risky".
		High ambition	"Embarking an urban area development of this nature requires ambition. Simultaneously, our daily experience demands a realistic perspective on the overall situation".
		Public sentiment	"In 2013, mentioning the development was met with skepticism in the city; it was a time when such initiatives were viewed cautiously".
		Project delay	"This is the essence of urban area development: a long-term endeavor. While aspiring to follow a blueprint, the couse often takes unexpected turns".
	Costs/funding	Cutbacks	"Numerous decision had to be made, especially when it came to financial considerations".
		Affordability	"The overarching ambition is to enhance affordability, translating to more housing units: more social and affordable apartments".
		Funding methodology	"Elevating the standard of public space has had a positive impact on real estate values".
	Benefits	Private party	"To some extent, insurers benefit from the implemented measures"
		End-user	"Developing a nature reserve and adapting it for current residents of the city has the potential to foster the city's overall growth".
		Municipality	"While the municipality stands to gain from the development, I believe the associated risks are primarily borne by the municipality".
	Responsibility	Allocation of responsibility	"The municipality carries a duty of care for public spaces".
		Funding responsibility	"As for financing, the responsibility is shared equally, with a 50-50 contribution".

Appendix D: Data management plan

Plan Overview

A Data Management Plan created using DMPonline

Title: Navigating Risk to Resilience. Examining the impact of flood hazards on the investment decision-making process in residential urban area developments.

Creator: Daniel Zantinge

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

Project abstract:

In the coming years, the Netherlands is expected to face various climate change-related challenges. Until 2030, the Dutch government has set the goal for the development of nearly a million dwellings, whereby 600,000 dwellings are being carried out in areas prone to flooding (ABF et al., 2021; Sweco, 2022). The urgency of implementing climate adaptation measures in area development is evident. Although the variety of climate adaptation tools may seem clear, the effective implementation of these measures is the main hurdle (Schultz, 2012). This research seeks to answer the following research question: *In which way do flood hazards impact the investment decision-making process in residential urban area development projects in the Netherlands?* In this qualitative study, two cases will be compared. With the use of explorative interviews, analysis of internal and external documents and semi-structured in-dept interviews, the cases will be analyzed. Afterward, an expert workshop will be held with other stakeholders to bridge the gap to standard practice. The insights of this research will be used to generate a ‘revised’ investment decision-making model with the successful implementation of flood hazard-related climate adaptation measures.

ID: 134474

Start date: 04-09-2023

End date: 19-01-2024

Last modified: 13-10-2023

Navigating Risk to Resilience. Examining the impact of flood hazards on the investment decision-making process in residential urban area developments.

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

My faculty data steward, Janine Strandberg, has reviewed this Data Management Plan (DMP) on 11-10-2023.

2. Date of consultation with support staff.

2023-09-27

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Contactinformation (Name, company name, function, phone number, E-mailadress)	txt., xlsx. (overview), PDF (informed consent)	Network of graduation company (Fakton), Outlook/in-person	Communication, and other administrative purposes	Project storage, Outlook (TU webmail)	The researcher (Daniël Zantinge)
Audio-recordings of interviews	MP3 or MP4 file	Audio recording via phone (Live) or via Teams-recording (Online).	Answering RQ2: 'How are climate risks incorporated into area developments?'and RQ3: 'What are the standpoints of stakeholders involved in the Decision making process regarding adaptation investments?' by analyzing the interviews (with the use of Atlas.ti)	The recording will be stored on the project storage anywa (Physical or online interview)	The researcher (Daniël Zantinge)
Coded data	Atlas.ti-file	Via transcribed interviews	Answering RQ3 (above stated row)	Atlas.ti project map (temporary), Project Storage.	The researcher (Daniël Zantinge)
Pseudonymised interview summary	docx	Summary of the audio-recording	Input for case study analysis, answering RQ2 and RQ3	Project storage	The researcher (Daniël Zantinge) Supervisors (Ellen Geurts and Zac Taylor)
Consented interview quotes	docx	Expert quotes of the audio-recording	Answering RQ2	Project storage	The researcher (Daniël Zantinge) Supervisors (Ellen Geurts and Zac Taylor)
External case documents (e.g., Masterplan, Public municipal documents etc.)	PDF, xlsx., docx., etc.	Direct sources (interviewees) Indirect sources (e.g., https://open.overheid.nl/)	Input for case study analysis, answering RQ3	Project storage	The researcher (Daniël Zantinge) Supervisors (Ellen Geurts and Zac Taylor)
Internal case documents (e.g., Financial documents such as GREX information)	PDF, xlsx., docx., etc.	Direct sources (interviewees)	Input for case study analysis, answering RQ3	Project storage	The researcher (Daniël Zantinge) Supervisors (Ellen Geurts and Zac Taylor)
Notes of the expert workshop	docx.	Direct sources (Invited experts)	Input for answering RQ4: To what extent can the allocation of costs and benefits be distributed between public and private stakeholders in the context of PAD?	Project storage	The researcher (Daniël Zantinge) Supervisors (Ellen Geurts and Zac Taylor)

4. How much data storage will you require during the project lifetime?

- < 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- Methodology of data collection

The methodology of data collection will be described in the thesis manuscript.

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- Another storage system - please explain below, including provided security measures
- SURFdrive

Project storage drive, TU Delft Outlook servers (temporary storge location for participants' emails).

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, first ask your Faculty Data Steward for advice. You can also check with the privacy website . If you would like to contact the privacy team: privacy-tud@tudelft.nl, please bring your DMP.

- Yes

The personal data collected through the interviews may involves the interviewees identifiers, such as name, company name and function for administrative reasons. The personal data is not presented in the thesis manuscript itself. The data will be anonymised (quotes etc.). The input from the interviewees is presented in the thesis manuscript.

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- Yes, data which could lead to reputation/brand damage (e.g. animal research, climate change, personal data)
- Yes, politically-sensitive data (e.g. research commissioned by public authorities, research in social issues)

The identification of interviewees is intricately tied to their respective roles in the project development process of specific cases. This connection extends to their individual reputations and perspectives. As a result, the thesis manuscript exclusively includes anonymized quotations from the interviewees.

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

The interview recordings and transcription summaries contained within the datasets will remain the exclusive property of the author of this thesis, Daniël Zantinge. These materials are not available for reuse or reproduction due to the nature of the interviews, which were personal and guided conversations between Daniël Zantinge and the interviewees.
Furthermore, the informed consent forms explicitly assure that these interview recordings will only be accessed by Daniël Zantinge or the committee/supervisors if deemed necessary. They will not be made accessible to the public, nor will they be published on the TU Delft Repository.

10. Which personal data will you process? Tick all that apply

- Names and addresses
- Telephone numbers
- Email addresses and/or other addresses for digital communication
- Signed consent forms
- Other types of personal data - please explain below
- Data collected in Informed Consent form (names and email addresses)
- Company name
- Function/job title
- Audio-recordings
- Professional opinions on topic 'Climate adaptation' and 'Urban Area Development'

11. Please list the categories of data subjects

Individuals actively involved in development projects susceptible to flooding, both currently and in the past.

12. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

Prior to commencing the interview, all participants will be requested to provide written consent, thereby indicating their willingness to take part in the study and to allow for data processing.

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

18. Does the processing of the personal data result in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if

any of the options below that are applicable to the processing of the personal data during your research (check all that apply).
If two or more of the options listed below apply, you will have to complete the DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA.
If only one of the options listed below applies, your project might need a DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to get advice as to whether DPIA is necessary.
If you have any additional comments, please add them in the box below.

- None of the above applies

22. What will happen with personal research data after the end of the research project?

- Anonymised or aggregated data will be shared with others
- Personal research data will be destroyed after the end of the research project

Intending that anonymized data is only to be shared in the thesis manuscript

23. How long will (pseudonymised) personal data be stored for?

- Other - please state the duration and explain the rationale below

Once the master's thesis is finished, all personal data will undergo permanent deletion. This includes the removal of items such as audio files of the interviews, for instance.

24. What is the purpose of sharing personal data?

- Other - please explain below

This does not apply

25. Will your study participants be asked for their consent for data sharing?

- Yes, in consent form - please explain below what you will do with data from participants who did not consent to data sharing

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- Not all non-personal data can be publicly shared - please explain below which data and why cannot be publicly shared

Public documents (e.g., Masterplans, news articles etc.) can be shared. The internal documents (shared by interviewees) cannot be shared.

29. How will you share research data (and code), including the one mentioned in question 22?

- No data can be publicly shared - please explain below

Upon publication of the thesis manuscript in TU Delft's research repository, the data will be accessible exclusively through the thesis manuscript itself. The original source data, including audio files of the interviews, will be permanently deleted as outlined in the informed consent form.

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

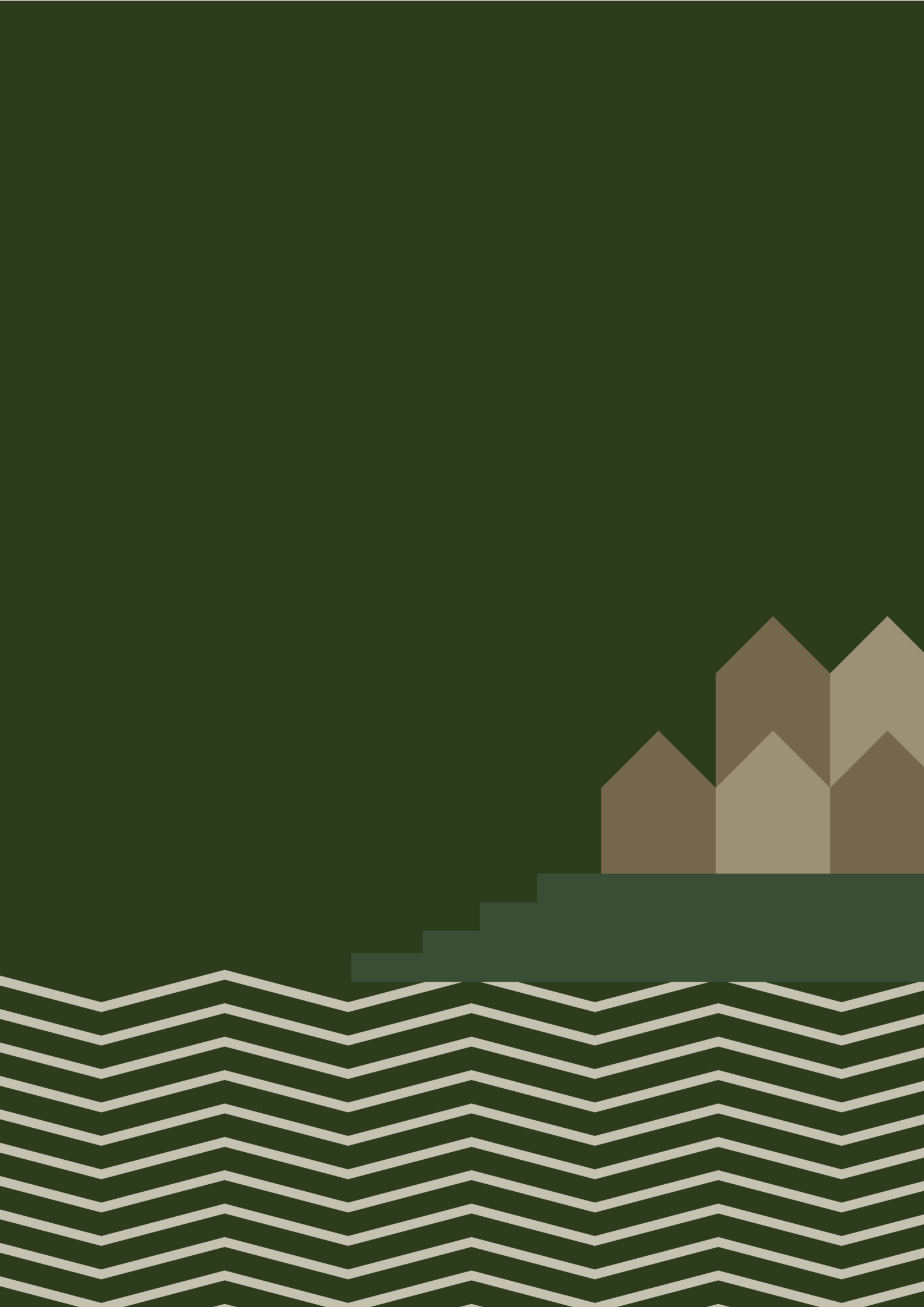
- Yes, the only institution involved

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

Supervisors of this master thesis:
1st supervisor: Ellen Geurts
2nd supervisor: Zac Taylor

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

Every interview will be summarized by the author of the thesis, Daniël Zantinge. This summary will then be shared with the interviewee for their review and potential revisions.
In the event that specific quotations are intended for inclusion in the master's thesis, these quotes will be anonymized and submitted to the interviewee for their consent before being incorporated.



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MSc Architecture, Urbanism and the Built Environment