Building Flood Resilience on a Local Level

A comparative case study of the emergency response and resilient recovery practices in Rotterdam and Semarang

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The completion of this thesis made my master's degrees and student life come to an end. This all feels unreal and would not have been possible without various paths and people along the way.

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Abstract

Dutch residents feel safe behind *their* dikes. Nevertheless, coastal cities are challenged by increasing flood risk due to the negative environmental impact of climate change and urbanization. In the field of flood risk management, there is a noticeable majority of transferring traditional technical flood control measures in policies from global North to global South countries. However, what can be learned from places where flood risk awareness is much higher due to more regular occurrences of flooding events? This qualitative research uses open-, semi-structured interviews, document analysis, and field trips to examine the response and recovery phase of the Multi-Layer Safety approach for the cities of Rotterdam and Semarang. Rotterdam is acknowledged for its network of flood-preventive hard infrastructural measures after the Great North Sea flood in 1953. Semarang is one of Indonesia's most prominent cities suffering from coastal floods. The results point to a focus on technical, organizational, and financial measures to reduce flood risk in the case of Rotterdam, which leads to the lack of awareness by inhabitants about the flood risk. Contradictory regulations and practices in the city of Semarang focus on community capacities to develop flood resilience, which illustrates how residents '*live with the water'*. A flood event has to happen before response and resilient strategies occur. Rotterdam could learn from Semarang's experiences that evacuations are not always necessary and that residents' awareness and a recovery plan improves public knowledge of disaster information, which can minimize risks.

Keywords: Flood resilience, Multi-Layer Safety model, Policy transfer, global North, global South

Content

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Abbreviations

NAP:	Normaal Amsterdams Peil (A height measure: 0 meters = average level of North Sea)
IPCC	The Intergovernmental Panel on Climate Change
MLS	Multi-Layer Safety
FRM	Flood Risk Management
UNISRR	United Nations Office for Disaster Risk Reduction
EU	European Union
FRAMES	Flood Resilience Multi-LayEred Safety
Wvr	Wet Veiligheidsregio's (Law for safety organisations per region)
DRM	Disaster Risk Management
NGO	Non-governmental organizations
WTS	Wet tegemoedkoming bij schade (Law for financial compensation in case of damage)
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Agency)
BPBD	Badan Penanggulangan Bencana Daerah (Provincial Disaster Managemetn Agency)
BAPPEDA	Badan Perencanaan Pembangunan Daerah (Spatial Planning Agency)
PUPR	Pekerjaan Umum dan Perumahan Rakyat (Ministry for Public Works and Housing)

1. Introduction

This chapter provides background on the research topic and the focus and scope of the research. After that, the research relevance, goal, and questions are written. The last part will elucidate the structure of the thesis.

1.1 Background

A news article discloses that one municipality located in the province of South Holland wants to build a new village, called the 'Vijfde dorp', as a response to the housing crisis in the urban agglomeration of the Netherlands (Dijk, 2021). The Netherlands experienced a shortage of approximately 331.000 houses in June 2020 (Rijksoverheid, 2020). To tackle the current and upcoming demand, the Dutch governmental institutions decided in 2021 to plan the construction of 961.000 houses by 2030 (Ministerie van Binnenlandse Zaken en Koninkrijsrelaties, 2021). Notwithstanding, the plan for the new village will be located in an unfavorable location for investments, according to the Spatial Planning Office in the Hague (Pols et al., 2007). The 'Vijfde dorp,' located in Zuidplaspolder, between Gouda, Zoetermeer, and Rotterdam, will replace the open green space in the polder and is geographically located at one of the lowest points in the Netherlands, namely six meters below the North Sea level. Moreover, the land assigned as the building area for 'Vijfde dorp' is currently coping with land subsidence and saline seepage (Pols et al., 2007). This example illustrates how safe the Dutch feel behind their dikes.

Another news article's title started with "Asia's coastal cities 'sinking faster than sea level-rise'" (Romero, 2022). The Intergovernmental Panel on Climate Change (IPCC) Fourth Report: Climate Change 2007 reports that sea-level rise has been happening around three millimeters per year, since 1993 (IPCC, 2007). However, Semarang, Indonesia's Central Java province capital city, has nowadays seen land sinking by three centimeters per year (Wu et al., 2022). If the subsidence sustains at present rates, this city will be challenged by flooding considerably sooner than projected by sea-level rise models (Wu et al., 2022). Notwithstanding these events and apparent risks, Semarang is a functioning and, at points, thriving city (Kron, 2012). The housing demand surpassed its supply. The Jakarta Post (2014) stated that a housing shortage of approximately 350,000 housing units was experienced in Semarang on July 2014. The significant and growing shortfall and a backlog of housing caused a series of policies (e.g., the 'One Million Houses' (OMH) program) by the government to build houses in the urban areas of Semarang (The Report - Indonesia 2019: Construction & Real Estate, 2019). There seems to be little to no awareness of the increased risk of enlarging the investments and housing stock in flood-vulnerable places. This raises the following question: What would it take to ensure the (new) city and village's inhabitants will stay safe from the water, even if the dikes break?

1.2 Focus and scope

Traditionally, cities in the global North respond to the flood risk by constructing hard engineering infrastructural measures (Ward et al., 2013). Rotterdam, a city located in a low-lying region of the Rhine and Meuse river Delta within the Netherlands, is known for its traditional solid network of levees and dikes that protect the city and polders from flooding (Adnan & Kreibich, 2016; Van Koningsveld et al., 2008). Historically, the city's name means 'dam on the Rotte (river)', which was chosen to celebrate the construction that protected the area from flooding in the 13th century (Hooimeijer, 2020). Furthermore, hard infrastructural protection systems like dams, sluices, and storm surge barriers have been situated throughout the Rhine, Meuse, and Scheldt river delta in South Holland to reduce the flood risk for Rotterdam's residents throughout the years (Esteban et al., 2020).

Coastal cities in the global South do not always have similar high-quality flood risk defense systems to reduce the risk of a flood, like Rotterdam. However, floods frequently occur in the top ten populous cities vulnerable to floods. To illustrate, 76 million Indonesian people live in high-risk flood zones, about 27% of the total national population. Semarang is one of Indonesia's largest cities suffering from floods. The city is located in a downstream area, which means that the city receives an abundance of water from the Kali Garang river, the Pengkol River, and the Bringin River. Remarkably, the low-lying areas in the northern part of Semarang experience severe annual flooding (Semarang City Government, 2016; Setiyono et al., 2022). Additionally, tidal floods occur due to the combination of a rising sea-level and land subsidence, by the extraction of underground water sources, a load of constructions, and the industrializations patterns on reclaimed land (Harwitasari & Ast, 2011; Doornkamp, 1998). Therefore, the cities Rotterdam and Semarang will be researched in this study.

1.3 Relevance

Building a new village in the Zuidplaspolder increases the flood risk: although the chance of flooding stays the same, the impact of an event increases (De Bruijn & Klijn, 2001; Sayers et al., 2013). Additionally, the effects of climate change increase the chance of flooding in small and large river basins, estuaries, and coastal areas due to many causes, including extreme rainfall, storm surge, tidal movement, tsunami, rising groundwater level, dam break, or sewer overflow (Harwitasari & Ast, 2011). Triggered by the effects of climate change, discussions on adequate ways of handling climate-adaptive urban planning and flood resilience have become more frequent (Brooks et al., 2006; De Bruijn, 2005; Spaans & Waterhout, 2017; Van Koningsveld et al., 2008).

To reduce the impact of flooding in coastal areas, local governments usually focus on (1) upgrading protection against flooding and (2) avoiding human enhancement of areas vulnerable to subsidence (Nicholls, 2002). To achieve this, non-technical or technical characters are used (Harwitasari & Ast, 2011; Klein et al., 2001; Hegger et al., 2016; De Bruijn, 2005). A concept that illustrates how both technical and non-technical measures can be combined in land use planning to achieve an integrated

flood management strategy is the Multi-Layer Safety (MLS) (Karrasch et al., 2021; Rijke et al., 2014) [see further explanation about MLS in chapter 2.4]. This research will focus on the emergency response during a flood and the resilient recovery after a flood, two layers of the MLS concept, in Rotterdam and Semarang. These two aspects generally get little attention in Flood Risk Management (FRM) strategies in the Netherlands (Esteban et al., 2020), whereas in Semarang, due to frequent flooding events, there is more experience and focus on emergency response and resilient recovery (Harwitasari, 2009; Wahyudi et al., 2017; Semarang City Government, 2016).

Not only to prevent the land from the flood but also to integrate adaptive flood risk approaches, countries are using international knowledge and experiences. Policy transfer is a well-known concept that addresses this mechanism (Dolowitz & Marsh, 1996; Wolman, 2009; Stone, 1999). However, a discussion has arisen about the fact that many policy transfers are initially oriented one-way, namely from global North to global South countries (Hasan et al., 2021; Brewer, 2011; Swart et al., 2014; Stone et al., 2020). This thesis takes a different orientation and focuses on what can be learned in dealing with flood risks in the global North from places in the global South, where flood risk awareness is much higher due to more regular occurrence of flood events.

1.4 Research goal and question

This research will explore if there is local knowledge from the global South that can enhance flood resilience strategies and policies in the global North to stimulate more two-way policy transfers. To gain qualitative insight into government and community perspectives and actions concerning the emergency response phase and resilient recovery practices during and after a flood, interviews, and documents are conducted and collected. Also, field trips have taken place to acquire more knowledge of the cases of Rotterdam and Semarang.

With this research, the following research question will be answered to provide insight into the local knowledge about flood resilience within one area in the global South and one area in the global North.

What can the coastal city Rotterdam in the global North learn about response and recovery as part of flood resilience strategies from the coastal city Semarang in the global South?

The following sub-questions are developed as research design to answer the central question:

1. What are the main issues among flood response and recovery in Rotterdam and Semarang?
2. Who are the critical stakeholders in flood response and recovery in Rotterdam and Semarang?
3. What are the critical elements in flood response and recovery in Rotterdam and Semarang?
4. What is the role of citizens in flood response and recovery in Rotterdam and Semarang?

1.5 Thesis structure

The following chapter, Chapter 2, provides the theoretical framework for this research. After which Chapter 3 expands on the research methodology. In Chapter 4, the results of the data collection are shown. This is further questioned in Chapter 5, where the results are analyzed and placed in the broader academic debate. Also conclusions from the results are drawn in this chapter. Finally, the research's reflection is described Chapter 6.

2. Theoretical framework

During the literature review, the research started with an analysis of the following three articles: (1) A strategy-based framework for assessing the flood resilience of cities – A Hamburg case study (2) A comprehensive assessment of multilayered safety in flood risk management – the Dordrecht case study, and (3) Learning Lessons and Transferring Policy across Time, Space and Disciplines by Stone (1999). These articles are considered relevant research because of the topic of interest (e.g., the first article discusses the key concept of this research: flood resilience), the prominent citations (e.g., the third mentioned article from Stone (1999) is cited by 775 kinds of research in November 2022 - *SAGE Journals)*, and the approach method of the researcher (e.g., The first and second articles include a case study that applies a flood resilience framework). Henceforth, a 'snowballing effect' occurred since interesting articles were added in citations. This process continued until no more relevant research was found.

To give this chapter more structure, the following questions are answered: (1) why do we need flood resilience? (2) how is flood resilience developed? and (3) how is flood resilience adopted in the global North and South? From this, a theoretical framework is built which discusses the introduction to flood management. Followed by the development of the conceptualization process of resilience and the emerge of flood resilience in particular. After that, the Multi-Layer Safety framework is explained to operationalize the flood resilience concept. Hereafter, flood resilience is framed in the global North and South context. Eventually, the concept of a policy transfer will be defined, and a conceptual model will be given to illustrate the key concepts of this study and its relations.

2.1 Introduction to flood management

In many human activities, water is irreplaceable. It plays a vital role in sustaining activities of human life, including industrial production, agriculture, energy, sanitation, transportation, and preserving ecosystems that provide valuable services for humans and nature (Bogardi et al., 2012; Xie, 2006). The convenience of accessing water has been a critical determinant of human settlements near water bodies (Chiu et al., 2022). However, insecurity appears when and where water is in short supply or excess (Bogardi et al., 2012). When water is in overflow, a flood appears. A flood typically covers dry land with water that escaped or has been released from the normal confines of a natural watercourse (Carter, 2012) (Bruijn et al., 2008).

A flood can occur naturally, be generated by humans, or be naturally modified by humans (Yevjevich, 1994). Flood risk is determined not only by the "*temporary covering by water of land, that normally is not covered by water*" (CEC, 2007, p. 3) but also by the impact of the excess of water on (vulnerable) people, their assets, and their values (Becker, 2014; Kates & Kasperson, 1983; Crichton, 1999; Brikholz et al., 2014). White (1945), a geographer known as the father of flood plain management (American

Association of Geographers, 2022), once stated in his thesis: *"[..] floods may be acts of God, but flood losses are largely acts of man"* (p. 2).

To calculate the risk, vulnerability and capacity are considered important indicators in flood management (Kron, 2009; Barroca et al., 2006). A standard formula presented by Agrawal (2018) illustrates that the disaster risk (R) is equal to the hazard threat (H) multiplied by the vulnerability (V) of the area. The risk level also depends on social and economic values; when there is more that can be damaged by flooding, the risk increases. Experience demonstrates that flood risk can be alleviated, but there is no possibility of completely eliminating it (Yevjevich, 1994). Coping with floods concerns all measures that society can initiate to alleviate the impacts of floods (Yevjevich, 1994). Traditionally hard-engineered solutions, including dikes, levees, pumping facilities, floodways, seawalls, tunnels, storm sewers, gutters, culverts, and detention basis, are used as practical measures to defend land areas from a flood. However, Chiu et al. (2022) also highlight the adverse requirements of continuous maintenance and renovations of these engineered flood control systems. Noordwijk et al. (2017) add that the risk of a flood is also increased by the engineering solutions, as room for natural unfolding water systems is reduced. Besides, the risk of economic damage increases as places become more attractive for people and businesses to locate themselves, including the process of urbanization (Chan, 1997).

Even though floods can lead to disasters, defined here as events that threaten and disrupts people's lives and livelihoods in a way that results in human causalities, environmental damage, property losses, and psychological impacts (Undang-Undang Republik Indonesia, 2007), other authors describe a substantial level of a flood has a positive effect on parts of the ecosystems and biodiversity. For example, during low water levels, habitats in systems are isolated from each other, and regular tidal flooding and freshwater supply create a suitable ecological environment (Thomaz et al., 2007; Sarita & Sreekanth, 2018).

In recent decades, globally, many innovative flood defense strategies have been developed to deal with the flood, including nature-based strategies such as 'building with nature', 'green infrastructure', and 'sponge city', that involve sustainability, resilience, and climate change adaption (Gralepois et al., 2016; Chiu et al., 2022). This trend goes beyond the assumption of flood risk management. In a broader sense, FRM includes planning a system to reduce flood risk and hazards to control flood hazards (Plate, 2002; Schanze, 2006). It is more a rational way of balancing the costs of mitigation and adaptation measures and recovering to 'normal' within the shortest possible time (Kuhlicke, 2019). Whereas a resilient flood risk management strategy might be a more appropriate strategy nowadays, as the resilient strategy also focuses on reducing the impacts of a flood by taking into account the societal consequences and ecological aspects (De Bruijn & Klijn, 2001; Karrasch et al., 2021). In comparison, resilience is far beyond the least possible (Karrasch et al., 2021; Manyena, 2006). Based on this statement, this research will elaborate more on the concept of flood resilience. Besides, planners and decision-makers in the

field gradually realize that mitigation alone is difficult to achieve. An adaptive and flexible approach is vital for resilient strategies in decision-making (Lu & Stead, 2013; Mai et al., 2020).

2.2 Resilience

Over the last decade, practices have increasingly focused on the capacity of affected communities to respond to possible risks and changes (Klein et, 2003). This approach put resilience at the core of the debate in research on urban and coastal areas (Manyena, 2006). However, despite considerable attention and frequent use of this concept, resilience remains ambiguous, with multiple interpretations in policy discussions about cities (Amirzadeh et al., 2022; De Bruijn, 2005; Davoudi, 2012). One reason for this is the different epistemological orientations of resilience thinking (Zhou et al., 2009). The concept of resilience emerged from a combination of ideas from different disciplines and paradigms (Amirzadeh et al., 2022).

Psychological and ecological domain

Several studies claim that resilience evolved in the 1940s from the discipline of psychology and psychiatry. Researchers N. Garmezy, E. Werner, and R. Smith are accredited for initiating research interest in and clinical attention to personal strength rather than weakness in overcoming adversity (Johnson & Wiechelt, 2004; Pooley & Cohen, 2010; Nolan & Fisher, 2013; Waller, 2001, cited in Manyena, 2006). Ahern et al. (2008) define the key theme of resilience as an "adaptive stress-resistant personal quality" (p.32). Resilience here concentrates on the risk factors to measure chronic and acute illness for adults and children, focusing on vulnerability in impoverished and troubled families (Dawber et al., 1951; Werner & Smith, 1982). People were considered resilient if they did not develop problems (Garmezy et al., 1984). Today, the definition is being applied in multiple fields, including social science and disaster management [Figure 2.1] (McClymont et al., 2019; Amirzadeh et al., 2022; Manyena, 2006).

Figure 2.1: The concept of resilience in various sciences (Amirzadeh et al., 2022)

Notwithstanding, Holling's (1973) definition of resilience as a "*measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables*" (p. 14), in the field of ecology has contributed to numerous studies in resilience thinking (Gunderson, 2000; Davoudi et al., 2013; Folke et al., 2010). Holling (1973) argues that resilience originates in the field of ecology. Davoudi's (2012) work, which is also commonly cited by scholars, argues that the concept has developed in different stages from a clear physical meaning in 'engineering resilience' to the field of ecology 'ecology resilience' towards 'evolutionary resilience'.

Engineering, ecological and evolutionary resilience

Resilience is derived from the Latin word "*resi-lire*", which means 'springing back' (Davoudi, 2012, p. 300). In accordance, physicists adopt the term 'engineering resilience' to describe the material resistance to external shocks. For that reason, engineering resilience is characterized as a system's ability to return to the previous state or equilibrium after an extraneous impact or disturbance (Holling, 1973, as cited in Davoudi, 2012). The concept developed following the growth of systemic thinking in 1960 towards 'ecological resilience', where ecologists began to use the word and expand the meaning by adding adaptability of the system alongside resistance and bounce-back capacities. The main difference here is that ecological resilience supports the possibility that systems bounce forth in other stable domains instead of the focus on a single permanent equilibrium (Davoudi, 2012).

System thresholds, including climate change, called the idea of equilibrium-based interpretations into doubt. Therefore, recent literature shows that resilience is not merely based on 'springing back', or 'bouncing forth to a stable state', but on the 'adaptive capacity' of complex socio-ecological systems to respond to possible unexpected risks and changes (Davoudi, 2012; Davoudi et al., 2013; Klein et al., 2003). Evolutionary resilience acknowledges the powerful capacity of people to review their experiences and to intentionally add this learning into their interplay with the social and physical environment (Rota, 2012). Unpredictable and possible irreversible behavior are included. Consequently, the concept is also defined as socio-ecological resilience (Folke et al., 2010). It recognizes that the natural, as well as the societal world, can suddenly change and become something fundamentally new and different when exposed to disturbances (Davoudi, 2012). This perception of resilience is considered a new paradigm or paradigm shift in how scientists think about the world (Mcentire et al., 2022; Davoudi, 2012; Jones, 1993).

From outcome to process

A recent resilience definition written in the strategy of the Hyogo Framework for Action at the United Nations World Conference on Disaster Reduction 2005 is in line with the 'evolutionary resilience' type of thinking: *"the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this*

capacity for learning from past disasters for better future protection and to improve risk reduction measures" (UNISDR, 2005, p. 4). On the other hand, political scientist Wildavsky (1988) derived resilience from Hollings's (1961) definition as "*the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back*" (p. 77). These definitions illustrate that over time, there has been a shift from a more outcome-oriented concept towards a more process-based definition, leading to the desired outcome (Manyena, 2006; Kaplan, 1999; McCubbin, 2001). This shift in the concept of resilience leads to a new way of tackling disasters and provides new policy options (Manyena, 2006).

2.3 Flood resilience

The conventional thinking of preventing floods using structural measures, such as building levees and dams, has been challenged by observing the levee effect (Sung et al., 2018). This phenomenon is defined as an increasing fragility of an area to rare flood in the long run by overreliance on structural engineering-based solutions. A result might be the shift from regular flood events to rare but catastrophic disasters (Montz & Tobin, 2008; Baldassarre et al., 2015). This led to a growing amount of studies that moved away from 'defending' a population and its assets against a hazard towards a more balanced combination of tackling both (1) the probability of an event and (2) managing its consequences for the communities at risk (Morley, 2004; Evans et al., 2006; Penning-Rowsell & Wilson, 2006). Studies underscore the importance of incorporating the resilience-based approach of embracing uncertainty and learning how to live with floods. (Liao et al., 2016; Disse et al., 2020; Baldassarre et al., 2015; Restemeyer et al., 2015; Folke, et al., 2010). Systematic reviews by scholars conceptualize flood risk management and flood resilience as either two ends of a perspective, equivalent to flood resistance versus flood resilience (De Bruijn, 2005; Abdulkareem et al., 2018; Orr et al., 2016). Notwithstanding, this dichotomy does not always go up, as some argue that resistance is an inherent part of resilience (Holling, 1973; Davoudi, 2012; Godschalk, 2003). The commotion of the two approaches will be explained in the next paragraph to clarify the definition of flood resilience.

Flood resistance vs. flood resilience

Some publications distinguish flood resistance and resilience approaches assuming that resistance strategies are characterized by engineered and maintained flood control infrastructure or measures to keep water in its confines. Meanwhile, resilience strategies express the acceptance of floods as unpreventable events, embracing uncertainty, minimizing flood impacts, and emphasizing living with floods (Sung et al., 2018; De Bruijn, 2005; Abdulkareem et al., 2018; Lamond & Proverbs, 2009). Within the original understanding, other scholars argue that resistance and resilience are not counterparts of each other (Holling, 1973; Davoudi, 2012; Godschalk, 2003). Holling (1973) argues the "*persistence of relationships within a system*" as part of resilience (p. 17). Davoudi (2012) touches upon the

'robustness' of resilience, and Godschalk (2003) uses the statement "*the power to resist attack or other outside forc*e" by describing resilience (p. 139).

The synonymous terms indicate that resistance is an essential condition for resilience (Restemeyer et al., 2015). Also, Hegger et al. (2016, p. 3) view "*resistance as an enhancing factor for resilience*", and Gersonius et al. (2016) argue that a resistant strategy may also make a city more resilient. However, according to Kuang and Liao (2020), there is the possibility to mitigate flood impacts without flood resistance. Bertilsson et al. (2019) focus on community resilience by bringing people together, reviewing policies, and making the communities resilient. Boats, temporary footbridges for transportation, and living in stilt houses are adaptive measures from communities where livelihoods depend on periodic flooding without engineered flood control measures (Liao et al., 2016).

This research, therefore, follows Zevenbergen, Gersonius, and Radhakrishan's (2020) definition of flood resilience: "[..] *to go beyond the ability to 'resist' when exposed to high water levels, which have been foreseen in the design, towards the ability to 'recover' from a flood event (and/or to reduce the impacts that arise when flows occur that exceed the design standard) and to 'adapt' or to 'transform' the existing approach based on the recognition that the conditions have been or will change in the future*" (p. 2). This definition takes a broad understanding of flood resilience by including the approach of flood resistance without stating that it should be the base of flood resilience. Also, it embraces the deployment of measures reducing flood risk through a combination of the dimensions of robustness, adaptability, and transformability. Even though the conceptualization of flood resilience has multiple variations of its components (Bahadur & Pichon, 2017), these three dimensions are generally considered important attributes of flood resilience (Karrasch et al., 2021; Folke et al., 2010; Restemeyer et al., 2015), and will therefore be explained in the next paragraph.

Robustness, adaptability, and transformability

Flood resilience can be improved by increasing the aspects of robustness, adaptability, and transformability in flood risk zones (Karrasch et al., 2021). Robustness refers to the strength of a city to withstand a flood event utilizing engineered structures like levees, dams, and embankments. Consequently, this dimension also refers to the concept of 'engineering resilience' and requires high public funds to construct and maintain.

If flood events continue occurring and overtop the initial protective measure, adaptability is necessary to ensure flood resilience (Restemeyer et al., 2015). Adaptability is a process-oriented concept that emphasizes incremental adjustment and is required to maintain flood resilience through different flood events over time (Keck & Sakdapolrak, 2013; Heazle et al., 2013; Kuang & Liao, 2020). The dimension aims to limit the damage of a flood and implies adjusting flood risk-prone hinterland. To achieve this, adjustments in the physical and social spheres are required. Examples are the elevation of houses on poles and the adaptation of information provided to people on how to prepare for floods. To invest in

this kind of precautionary measures, political support and people's willingness are essential (Restemeyer et al., 2015).

Transformability as a dimension of flood resilience is defined as the ability to foster social learning. Only when the physical environment and people's mindsets change a transformation follows (Restemeyer et al., 2015). Spaans & Waterhout (2017) define transformability as *"the ability of a part of a complex adaptive system to assume a new function".* Adaptability and transformability are intrinsically connected; however, adaptability refers to short-term behavior, whereas transformation relates to a more extended period including a change toward a new system (Spaans & Waterhout, 2017). Transformations are primarily a result of many system adaptations and are, therefore, regarded to distinguish evolutionary resilience from the equilibrium-based resilience concepts (Davoudi et al.; Restemeyer et al., 2015). Transformation is also perceived as the capacity of a city to shift from 'fighting the water' to 'living with the water' (Pahl-Wostl, 2006; Restemeyer et al., 2015).

In conclusion, depending on the situation and context, one pillar might be more relevant than others and hence explain different resilience priorities. A framework helps to frame these priorities and indicates which other measures, institutions, and capacities are helpful in the long term. The Multi-Layer Safety model is one framework that combines the dimensions of robustness, adaptability, and transformability to increase the aim of flood resilience and will therefore be elaborated upon in the next section (Restemeyer et al., 2015; Karrasch et al., 2021)

2.4 Multi-Layer Safety model

Parallel to the shifts from flood defense to flood resilience, and from fighting against the water to living with the water, the Multi-Layer Safety (MLS) concept has been invented in the Netherlands to aim for an integrated flood management strategy in the National Water Program 2009-2015 (*Nationaal Waterplan 2009-2015)* (Ministry of Public Transport and Water, 2009; Tsimopoulou et al., 2013). This document describes water management strategies between 2009 and 2015 to protect the Netherlands from the water and become safe for future generations. The Dutch government evoked the plan since the European Union (EU) Floods Directive (2007/60/EC) obligates its Member States to design a flood risk map and -plan for all water courses and coastlines (Hoss et al., 2013). The Floods Directive (2007/60/EC) is a legislation of the European Parliament to establish a framework for the assessment and management of flood risks in the EU to reduce the negative consequences of flooding on human health, economic activities, the environment and cultural heritage (CEC, 2007). Correspondingly, the basis of the MLS approach is derived from the Floods Directive 2007/60/EC that states in chapter 4 (article 7): "*Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness […]*" (The European Parliament and the Council of the European Union, 2007).

Therefore, the former classification of the MLS concept is based on the first three layers: (1) defending from floods (preventive-structural measures), (2) mitigation via spatial planning, (3) and crisis management through preparedness and emergency response [Figure 2.2] (Kaufman et al., 2016). However, the EU Interreg project Flood Resilience Areas by Multi-layEred Safety (FRAMES) added a fourth layer to the concept: (4) resilient recovery. FRAMES, a project co-funded by the North Sea Region Program 2014-2020, recognizes the lack of the originally MLS concept to make an impact assessment of a future event on society in the long term. This fourth layer allows embracing 'adaptive recovery' within the risk-based approach (Interreg North Sea Region, 2021). Together, these four layers can be tailored to local areas to manage a flood's consequences and probability.

Even though the Dutch invented the term Multi-Layer Safety, similar terms used in international literature are 'integrated flood risk management', 'multi-level approach' or 'multiple-lines of protection' (Tsimopoulou et al., 2012). The notion contributes to slowing down the continuous cycle of dike reinforcements and increases the sustainability of safety by anticipating on the consequences of flooding by combining actions for prevention, spatial adaptation, emergency response, and recovery. However, no region or authority can do this action alone. Therefore, the mobilization of local and social stakeholders is necessary. The outcome will be flood-resilient areas, communities, and authorities. Areas are improved by infrastructure and spatial planning measures, communities are better prepared, and authorities reduce recovery times and increase response capacity (Krol, 2017).

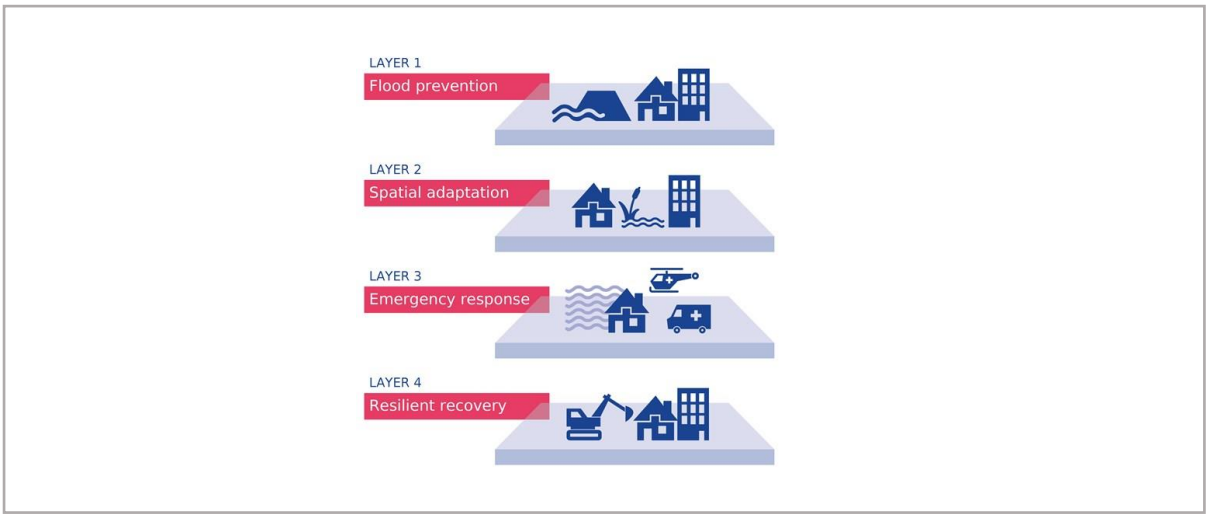

Figure 2.2: Multi-Layer safety concept by FRAMES (Interreg North Sea Region, 2021)

Flood prevention and spatial adaptation

Flood prevention, the first layer of the model, focuses predominantly on strategies of engineered approaches to prevent river, seawater, and heavy rainfall from inundating areas that are usually dry. Standard engineered solutions in this layer are building flood defenses such as dikes, levees, dams,

construction of reservoirs, as well as artificial drainage systems. Also, the exploitation of natural processes, like building with nature, is included in this layer (Interreg North Sea Region FRAMES, 2021). The focus in Dutch flood risk policies has, until now, mainly relied on layer one: strong levees and dikes (Egmond, 2004). Therefore, only this layer is supported by Dutch legal standards. (Kolen et al., 2020; Leskens, 2013).

The MLS theory ensures that if the first layer fails, different strategies from the other layers are still available (Tsimopoulou et al., 2013). Therefore, the second layer, spatial adaptation, comprises flood-proof solutions and proactive spatial planning to mitigate losses (Tsimopoulou et al., 2013). The flood-proof design includes the adaptation of existing and future constructions, like public networks, adaptive buildings, and adjustments to individual houses and infrastructure. Proactive spatial planning is landscape-oriented and includes broader areas like de-urbanization, flood risk zoning, and land-use planning policies and regulations (Karrasch et al., 2021)..

Emergency response

The third layer of the MLS model consists of crisis management through preparedness and emergency response of the community at risk. It aims to decrease the community's vulnerability. Active risk communication is crucial within this layer (Karrasch et al., 2021; Interreg North Sea Region FRAMES, 2021). Data sources such as models with predictions of floods, elevation maps, and rules of thumb are used to provide flood predictions (Leskens et al., 2013). To develop risk awareness and foster adequate behavior in case of a flood, crisis management includes evacuation routes and shelters, disaster management plans, risk maps, early warning systems, temporary physical measures, and medical help (Penning-Rowsell & Wilson, 2006; Karrasch et al., 2021; Interreg North Sea Region FRAMES, 2021).

Even though crisis management mainly concentrates on organizational measures (Hoss et al., 2011), this research will also focus on crisis management's social and physical measures. One reason for this is that the MLS approach is not internationally used and, therefore, lacks unification in its definition. The characteristics are dynamic, fluid, and highly context-dependent, which results in a fuzzy line between this layer and the fourth layer, resilient recovery (McClymont et al., 2019). This is also the reason that both layers are included in this study.

Resilient recovery

The fourth layer added by the FRAMES project's authors is resilient recovery. This layer recognizes the need to facilitate the return to 'normal liveable' conditions after a flood and, therefore, focuses on the long-term effects. It aims to reduce the vulnerability of people and damage in flood-prone areas by mitigating social and economic impacts (Interreg North Sea region FRAMES, 2021). Flood insurance and compensation are essential for individual and societal recovery. Examples are financial assistance, insurance policies, and recovery funds. A critical aspect of resilience to reduce vulnerability is to use

the experience from former events, also called ‘lessons-learned’ strategies, to transform towards innovative courses of action. In addition, the reconstruction of the individual, societal, and physical environment is determined by restoration activities. For instance, by storing hazardous materials in containers, reconstruction plans, health-supporting facilities, and well-water safety (Karrasch et al., 2021)

This research will focus on applying layers three and four, where traditional layer one and two measures are not sufficient on their own, cost-effective, or non-sustainable to achieve a solution to the increasing flood risk. This decision is partly based on the statement of Kolen et al. (2020). They stated that there is no Dutch legislation or regulation about assessing judgment for contingency plans. While for prevention standards, layer one and two, an apparent result requirement with a test prescription is formulated in law. One reason is the tradition of designing and testing flood defenses since the early 1960s. In 1996 this was legally framed with the Flood Defenses Act, which is now the Water Act, in the Netherlands. Countries like the United Kingdom and Japan show that much more can be done regarding resilient recovery in disaster management (Okumara et al., 1998; Hall et al., 2003; Leskens et al., 2013). Additionally, the fourth layer, resilient recovery, is not based initially on the MLS concept. Even though there is acknowledgment by more and more authorities, experts, and practitioners, it has so far not been developed in a transnational way (Restemeyer et al., 2017; Neeraj et al., 2020; ALGA, 2022; FRAMES, 2021).

2.5 Framing Flood Resilience in the global North and South

According to Kloß (2007), the global South is framed as a concept that overcomes references as the ’Third World’, and is linked to processes of decolonization and nation-building. The ‘First-’ and ‘Second World’ countries are mostly linked to the countries in the global North. The global North and global South concepts in most literature referred to the economic labels ‘developed’ and ‘under developed’ and also to the in- or exclusion of international decision-making processes (Litonjua, 2012; Odeh, 2010; Bowen, 2010). Lopez (2007) expresses that the ‘South’ becomes the parts of the world that have encountered the most political, social, and economic cataclysm. Also, this part has suffered the most from enormous challenges, like the impact of globalization. Zhang et al. (2021) add that there is a difference between the spatiotemporal patterns of urban development in the North and South, which can generally be geographically divided by the latitudinal line. The division line is recognized as close to the boundary of the countries: the United States, the United Kingdom, Germany, Russia, China, and Japan. Figure 2.3 illustrates the global North/South line that exhibits geographical differences in global urban development during 1992-2018. Countries on the north side of the line are mostly high-income countries, while lower-middle-income and low-income countries lie predominantly in the southern part (Zhang, 2021). Therefore, the North-South division line implies a relationship with the socioeconomic

conditions of the countries. However, this does not imply a strict division between these parts of the world but more a geographical difference (Zhang et al., 2021).

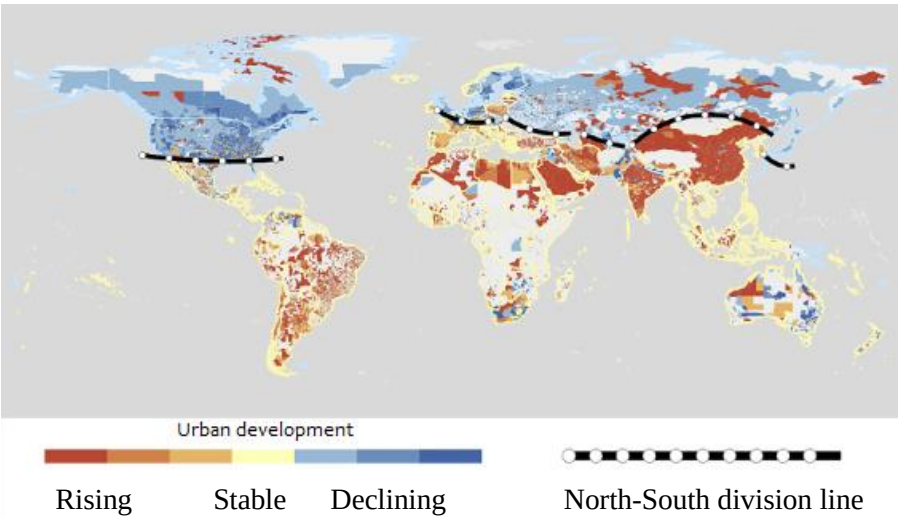

Figure 2.3: Division line of the global North-South (Zhang, 2021).

Flood challenges in the global North and global South

Urban development is a consequence of urbanization (Downs, 2010). It is expected that 68% of the world's population will live in urban areas by 2050 (United Nations, 2018), with rapid urbanization processes in developing countries (Leeson, 2018). This urbanization process is related to the degradation of environmental quality, including the quality of water, air, and noise. Simultaneously, humans are increasingly influencing the climate and earth's temperature by burning fossils and cutting down forests (European Commission, 2021). The negative impacts of urbanization and greenhouse gas emissions cause, for example, growth in ice melts (sea-level rise) and more intense rainfall (flash floods) due to global warming (Chapman et al., 2017). These consequences affect coastal cities, which are more vulnerable to natural hazard threats due to their geographical location (Kron, 2012).

Coastal floods are considered as most dangerous and harmful natural disasters (Douben, 2006). Despite the higher risk of the consequences from such kinds of natural disasters, approximately 15% of the world's population lives within 20 meters of mean sea-level areas (Brooks et al., 2006). Consequently, an average of 46 million people per year experience storm-surge flooding (Hoozemans et al., 1993), and an estimation of 1.5 billion people live in high-risk flood zones (Rentschler & Salhab., 2020). The most significant number of exposed people live in East and South Asia. Over two-thirds of this population is exposed to significant flood risks (Rentschler & Salhab, 2020). Countries in the global South are particularly vulnerable to prolonged adverse impacts on livelihoods and well-being because of poverty and significant flood risk (Rentschler & Salhab, 2020). Furthermore, the impact of climate change will

increase the frequency and intensity of extreme weather events (Mirza, 2003). These meteorological and hydrological factors contribute to these countries' physical and economic damage and losses by flash floods.

In conclusion, even though countries in the global South encounter a rise in urban development [Figure 2.3], which is defined by Hopkins (2001) as a focus on regulations and investments in infrastructure and buildings, the cities in the global South have a higher share in losses and damages from flood events than North countries. One factor for this is the lack of ability to confront the hazard and its consequences (Harris et al., 2013; Akram & Hamid, 2014).

Flood resilience in the global North and South

To integrate climate challenges into land use planning, cities within the global North and South set up differing strategies, including physical infrastructure strategies and numerous land development and management tools (Anguelovski et al., 2016). Countries within the global North mainly have advanced engineering solutions (Cheshire, 2015). In history, flood events have assisted governmental institutions to improve recoveries after floods and mitigate future floods' impacts (McClymont et al., 2019). As a result, communities show restraint in taking ownership of their own flood risk (Cheshire, 2015).

Countries in the global South encounter a lack of official technocratic flood risk management practices, resulting in the community taking responsibility for its own flood resilience (Odermerho, 2015; Borba et al., 2016). This could indicate that there has not been a paradigm shift (as explained in Chapter 2.2) towards integrated flood resilience processes within the global South (McClymont et al., 2019). However, the global South instead uses past adaptation strategies of local knowledge to guide a long-term framework of the future through an iterative learning process. This participatory process empowers the translation of system feedback to be integrated into new knowledge for further movement.

2.6 Policy transfers

The global South experiences difficulties concerning the training and retaining of academic researchers and practitioners to address local, regional and global challenges (Amarante et al., 2022). It lacks the ability to develop alternative strategies for problem-solving in local contexts. Hence, dependency from the global South on the global North for solutions to local problems has increased (Reidpath & Allotey, 2019).

The process of policy transfers is widely acknowledged as a valuable approach to learning from policymakers on different counterparts of the world elsewhere. A commonly cited definition of policy transfer in literature is given by Dolowitz and Marsh (1996). They define policy transfer as "*a process in which knowledge about policies, administrative arrangements, institutions, etc. in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place*" (p. 344). To examine a policy transfer, Dolowitz and Mash (1996) developed a

framework based on the prospective question of Rose (1991): "*Can a program now operating in country X be put into effect in country Y in the future?*" to indicate the aspects of a possible transfer (p.19). The framework appears helpful in examining what factors a policy transfer makes more successful (Fawcett & Marsh, 2012).

According to Wolman (2009), a policy transfer is the subdivision of the extensive term 'policy diffusion', which is the spread of a policy across units regardless of whether that spread results from knowledge or other factors, such as convergence. Both concepts are part of the broader literature concept 'innovation diffusion', the spread of new activities among individuals or organizations.

Transfers often occur to public organizations that do not have the expertise to cope with the challenges they face. Therefore, the institutions are looking for solutions from governmental or non-governmental bodies with the knowledge or prior experience regarding the challenge. According to Stone (1999), policy transfers occur at the sub-national level, between states in federal systems, and across local governments, municipalities, and boroughs. These cross-national policy comparisons are considered a contribution to national innovation developments. National governments are considered to act like an introvert, and without international knowledge diffusion, changes will be limited (Schneider, 1988, as cited in Stone, 1999).

One-way policy transfers and flood resilience

Climate change demands scientists and policymakers to increasingly focus on making long-term water policies and stimulate a transformation toward flood resilience planning (McClymont et al., 2019; Liao, 2012; Kolen & Helsloot, 2012). Swart et al. (2014) state that knowledge sharing and development are key elements to support adaptation to climate change internationally. Policy transfers are the key to increase flood-resilient approaches around the world. Nevertheless, knowledge about flood resilience is not equally transferred between countries in the global North and South, as the global North domains as a leader in sharing their policies globally (Hasan et al., 2021). Therefore, Swart et al. (2014) aim for global South countries' input in close collaboration with European countries. Also, Brewer (2011) wants a shift in the concept of policy transfers from the current narrow focus on North-South to a more extensive paradigm in advanced climate-friendly technologies.

Global South countries are ignored as sources in the traditional paradigms; therefore, an expansion of the policy agenda of the international climate and trade regimes is missing. The Paris Agreement describes that developed countries should continue taking the lead by undertaking economy-wide absolute emission reduction targets (Boβner et al., 2020). However, this does not automatically mean a North-South focus in policy transfer or that developed countries could not learn from developing countries.

Additionally, overall policy transfer decisions are taken by state actors. Stone (2000) aims for an increasing role of non-state actors such as NGOs, think tanks, and consultants. Mcewen and Jones (2010) go one step further and specifically call for more integration of local flood knowledge into science, policy, and practice as an aspiration for experts to build community flood resilience. Increasing the understanding of all actors on the possible adaptive flood resilience solutions can stimulate the implementation of adaptative planning worldwide (Restemeyer et al., 2017).

2.7 Conceptual framework

Based on the above literature review, the following conceptual model is proposed to illustrate which concepts are important to consider further in this research [Figure 2.4]. Also, it helps understand the relations between them. This thesis takes flood resilience as a key concept. The MLS concept is used to operationalize flood resilience in flood risk areas by integrating four layers as separate 'building blocks' to receive flood resilience. Flood resilience policies are currently diffused from the global North towards the global South, considered a 'one-way transfer'. The red colored pillars show the research aim by exploring what Rotterdam (located in the global North) could learn from Semarang (located in the global South) based on the MLS layers' emergency response and resilient recovery to consider the possibility of 'two-way transfers'.

This chapter gave answers to the questions from the introduction of this chapter: (1) why do we need flood resilience? (2) how is the concept developed? and (3) how is the concept adopted in the global North and South? However, a brief conclusion is also written in Appendix A. The appendix includes an elaborative framework of the key concepts and its sub-concepts or characteristics to show extensively how the literature review's concepts and approaches are related.

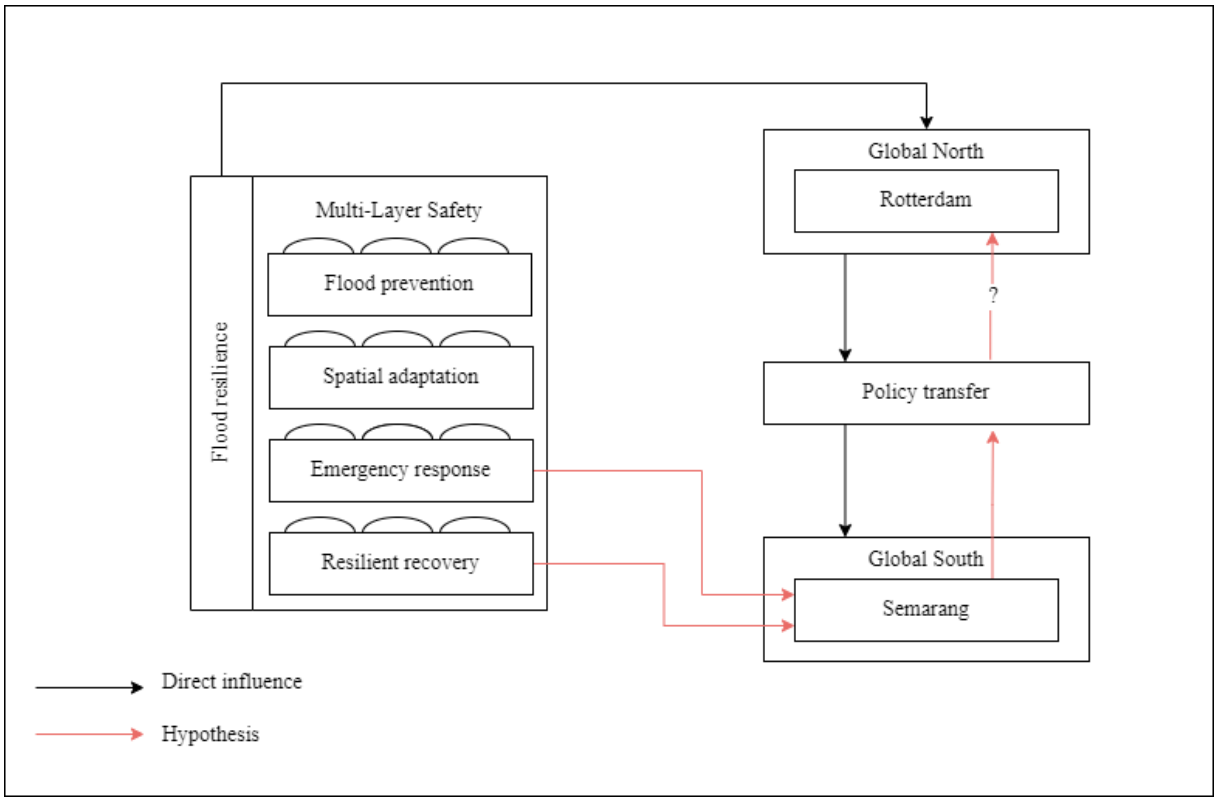

Figure 2.4: Conceptual model (Own source)

3. Methodology

The following chapter discusses the methodology of this research by describing the research strategy, the two case studies, the research progress, the data collection methods and analyses, and ethical considerations.

3.1 Research strategy: two case studies

In order to answer the research question: "*What can the coastal city Rotterdam in the global North learn about response and recovery as part of flood resilience from the coastal city Semarang in the global South?*", the implementation of the response and recovery phase in both Rotterdam and Semarang will be analyzed and subsequently be compared. A case study approach, with both Rotterdam and Semarang as cases, was deemed a suitable approach for this research. According to Yin (2009), case studies are a favored strategy for considering 'what' questions to explore the phenomenon defining features or consequences. Also, it focuses on " a contemporary phenomenon within a real-life context" (Yin, 2009, p. 1). It is a research strategy that creates information on past events and does not require control over the physical environment or social interactions. A comparative case study is used in this research to compare the case of Semarang with the case of Rotterdam, as it allows the researcher to analyze the data in each situation and across different situations (Yin, 2009). A holistic overview can be generated that creates opportunities to understand multiple variables, similarities, and differences between the cases of Rotterdam and Semarang (Yin, 2009; Vannoni, 2014). The two cases are representative cases of flood-prone areas located in cities in the global North and South, assuming that lessons learned from the case of Semarang are to be informative considering communities' experiences.

Case selection

This research requires the selection of cases where a significant portion of its population lives within at-risk floodplain settlements to allow contextualization of the study. Based on this criterion and the following arguments [see also Table 3.1], Rotterdam, located in the Netherlands, and Semarang, located in Indonesia, were selected for the study [Figure 3.1 + 3.4]. The selection criteria for the case studies are based on the theoretical scope, including the concepts of policy transfers, the global North and South, flood resilience, and the Multi-Layer Safety approach to allow comparisons and extract lessons from the cases that can be transferred (Yin, 2009). The timeframe of the data collected for this research is from October 2021 to October 2022.

Table 3.1: Selection criteria case studies

Selection criteria	Description
Flood risk area	A significant portion of the city's population should live within at-risk floodplain settlements.

Spatial boundary (Yin, 2009)	The case should be considered a city by the norms of the government. Therefore, the administrative boundary of a city is accounted for.
Experience flood management	The case must have a history of floods.
Location city 1: Global North Location city 2: Global South	One case should be located in the global North, and one should be located in the global South to compare the difference between two different parts of the world.
Availability and accessibility of information	Information about the case should be accessible for document analysis. Besides, to hold interviews, at least one key informant can be identified and is willing to participate.
Variety	The cases differ in their implementation strategies of flood resilience.

First of all, geographically, Rotterdam and Semarang are both historical harbor cities interwoven with small rivers and canals, bringing a long history of floods. The relation to the sea was, and is, still important for the country's economy in both cities. Industrialization, population growth, and urbanization led these cities to become, the biggest coastal city, based on population, in its country (United Nations, 2018). However, these factors go together with fast urban development and an increased risk of floods in both Rotterdam and Semarang (Esteban et al., 2020; Marfai & King, 2008). Therefore, from a historical perspective, one would expect Semarang and Rotterdam to know how to cope with flood challenges.

Nowadays, both locations have become more vulnerable to flood challenges due to a certain degree of the effects of climate change. Also, land subsidence is a development that has one enormous impact on both cities (Oude Essink et al., 2004; Marfai & King, 2008). Parts in central Semarang sink up over eight centimeters per year (Mahya et al., 2021). Also, several locations in Rotterdam sink more than one centimeter a year (Gemeente Rotterdam, 2022). Because of these challenges, both cities were selected for the project: 100 Resilient Cities, initiated by the Rockefeller Foundation. This project supported 52 cities over the world to face various challenges and be able to recover, grow and develop better resilient cities (100 Resilient Cities, 2022). Although the two cities have faced similar susceptibility to flooding in history, these cities have reached different levels of vulnerability to risk over the years.

Rotterdam

Rotterdam is the second largest municipality in the Netherlands based on its population and is located in South Holland province [Figure 3.1]. The city is home to 651.600 inhabitants within 21.755 ha of land and 10.695 ha of water (CBS, 2021). Rotterdam is a harbor city on the west side of the Netherlands with the largest seaport in Europe. The port is located on the southwestern bank and is vital for the city

and the country's economy. The 'Nieuwe Maas' river flows through Rotterdam into the North Sea and divides the city into northern and southern parts [visible in the 'Veiligheidsregio Rotterdam-Rijnmond' map of Figure 3.2]. Rotterdam is the midpoint of the Delta area, where the North Sea integrates with the rivers: Maas, Rijn, and Waal. The city has traditionally been at risk of flooding. 80% of the city lies below the North Sea level. In fact, several parts lay around six meters below sea-level. Since 1900, the water levels have risen three times to three meters above sea-level: in 1916, 1953, and 1966 (Gemeente Rotterdam, 2022; Esteban et al., 2020).

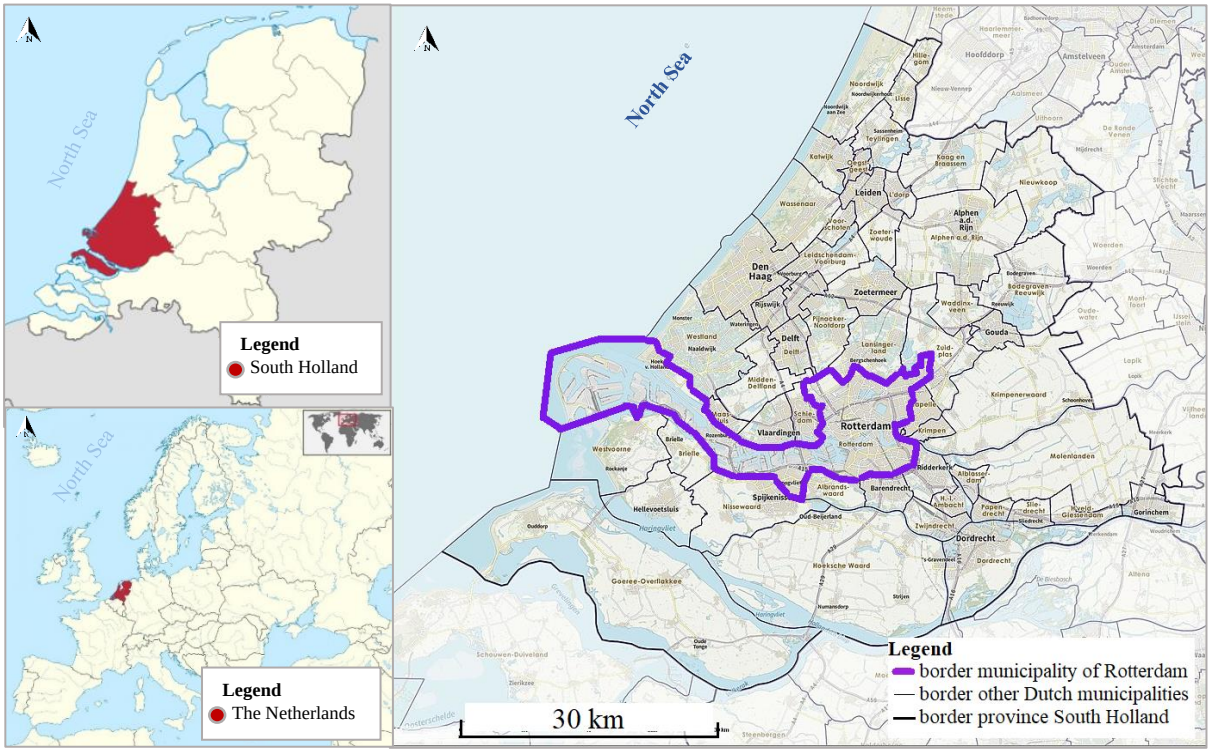

Figure 3.1: Rotterdam's administrative boundaries (based on maps from the websites: Openstreetmap and Commons Wikimedia)

The flood in 1953 underscored the power of the sea. The Great North Sea flood that hit the Netherlands, Belgium, and the United Kingdom, inundated 160,000 ha of polder land and caused a total of 1835 dead in the province of South Holland (Watson & Finkl, 1990). This triggered the modern flood management, including the coordination of emergencies by 'Veiligheidsregios' (explanation in chapter 4.3) (Esteban et al., 2020).

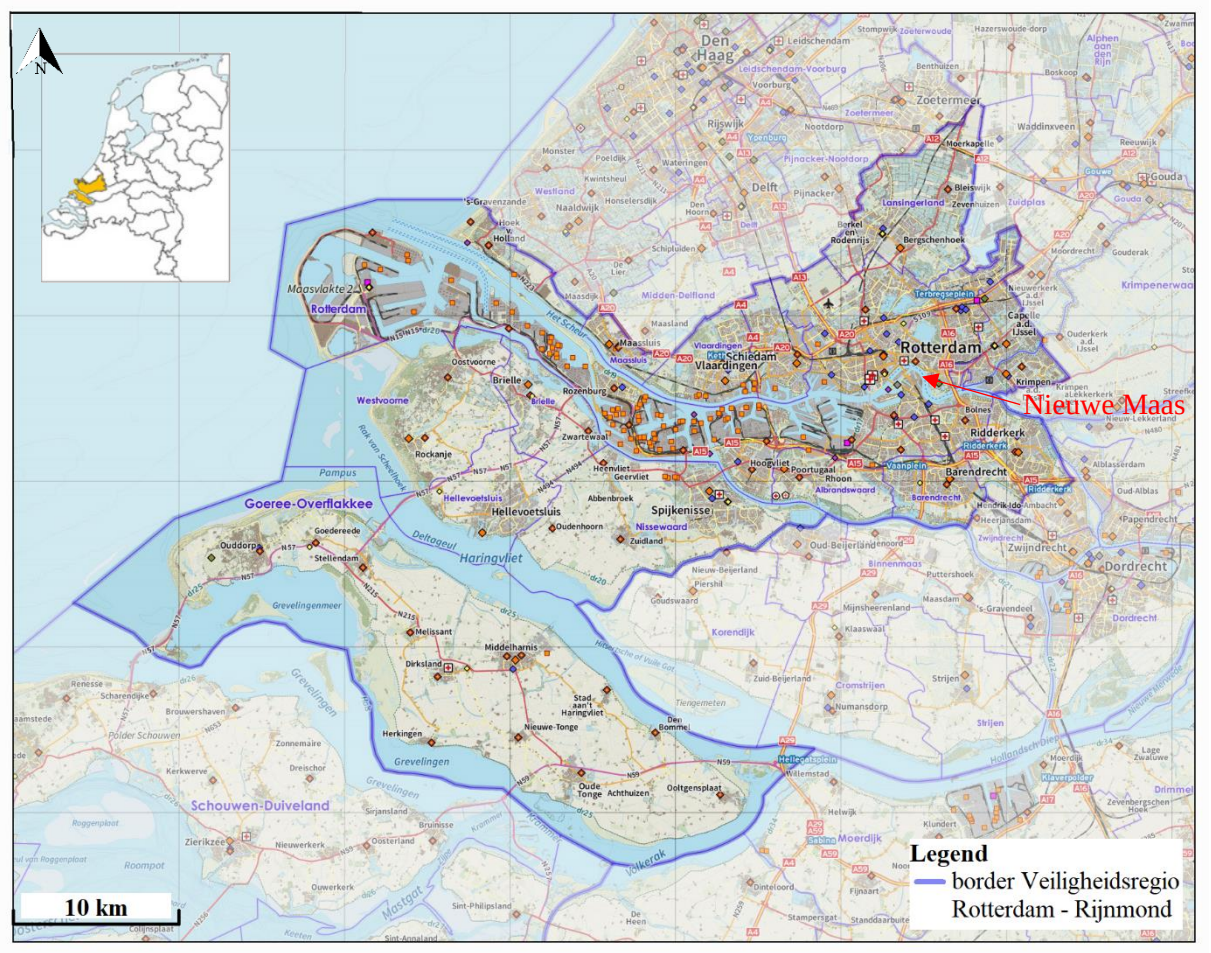

Figure 3.2: Administrative boundaries Veiligheidsregio Rotterdam-Rijnmond (based on: VRR – Risico- en Crisisbeheersing 2020)

One of the most extensive defense systems against high water from the sea in the southwestern part of the Netherlands is the Delta works, consisting of five storm surge barriers, two locks, and six dams (Ministery of Infrastructure and Water, 2022). The storm-surge barrier, Maeslantkering, has protected Rotterdam from the water flowing through the Nieuwe Maas since 1997. This barrier closes at a water level forecast of 3.00 + NAP; in this way, the water level behind this barrier can only rise to a limited extent. The waterboards Delfland, Hollandse Delta, and Schierland en de Krimpenwaard, together with the Dutch national water board, control the water management in Rotterdam [Figure 3.3] (Gemeente Rotterdam, 2022). The function of the waterboard will be described in Chapter 4.3.

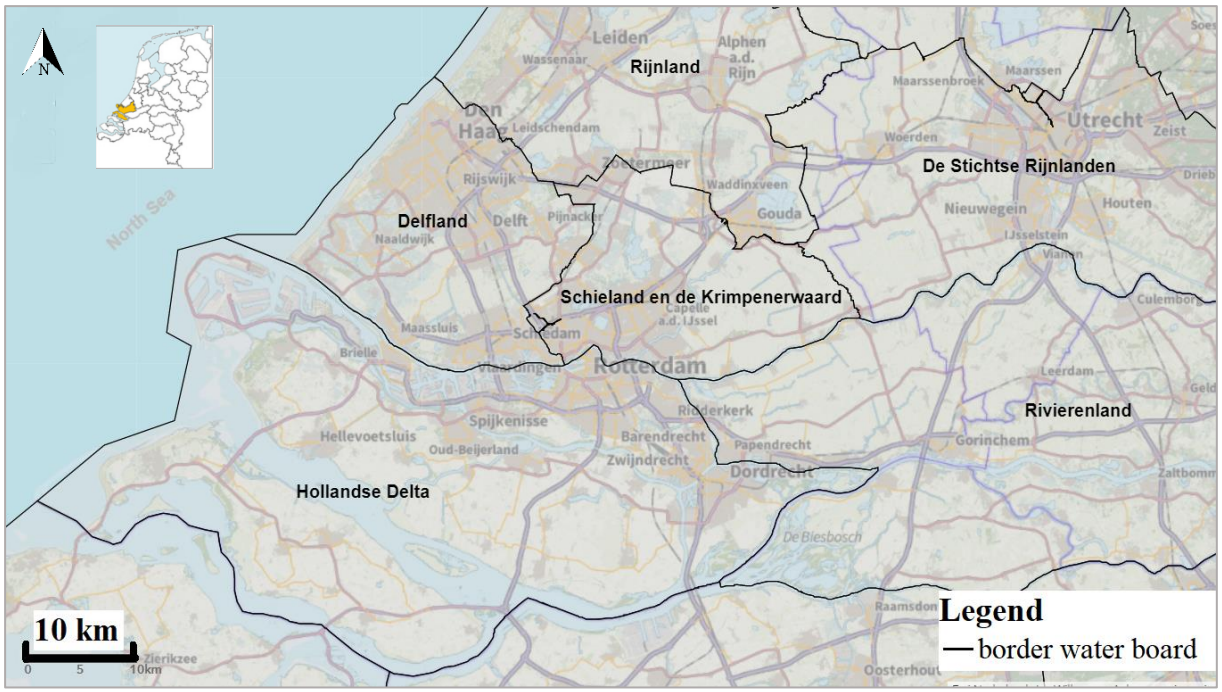

Figure 3.3: Waterboard boundaries Rotterdam (based on layer provided by the website: OpenstreetMap)

The development of flood management and the rebuilding of spatial infrastructures after the near-complete destruction of the city center in World War ll resulted in how Rotterdam is organized nowadays (Watson & Finkl, 1990; Esteban et al., 2020). The city of Rotterdam can be seen as a front-runner and worldwide leader in water management with ambitious strategies for resilience (Esteban et al., 2020). It is illustrated as an excellent example of how to manage a constantly changing environment. Rotterdam was honored with the C40's award for the Rotterdam Adaptation Planning & Assessment (RAS) because of its innovative climate actions (C40 Cities, 2016).

Semarang

Semarang is the capital and largest city of Central Java, with a population of 2.067 million in 2014 (United Nations, 2018). Based on these statistics, the city is among the top ten largest cities in Indonesia. The city, located on the northern coast of Java, has a coastline of 13,6 kilometers and consists of a total area of 37.370 ha [Figure 3.4] (Regional Development Planning Agency of Semarang City, 2016). The geographical location is directly adjacent to the Java Sea and has ensured that Semarang's sea port is still important today for the regional center of the island Java. The city is the main hub connecting Jakarta, Surabaya, Surakarta, and Yogyakarta (Regional Development Planning Agency of Semarang City, 2016).

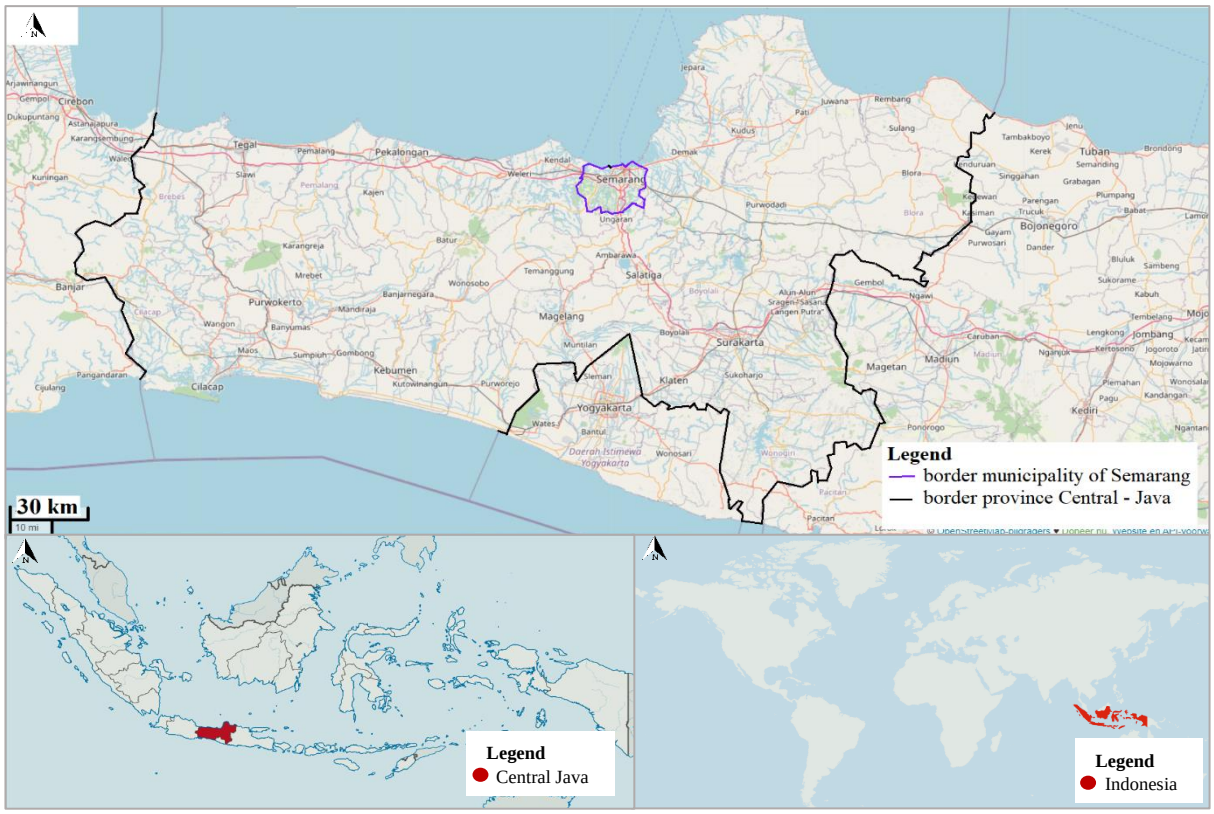

Figure 3.4: Semarang's administrative boundaries based on maps from the websites: WikimediaCommons, FreeWorldMap, and OpenstreetMap)

The spatial layout of Semarang is divided by locals between lower- and upper Semarang ('Semarang Bawah' and 'Semarang Atas'), to designate the low- and highland part of Semarang [Figure 3.5] (Kurniawan & Suharini, 2021). Most areas in Semarang city are classified as lowlands. Topography parts in Semarang's lower areas predominantly range from 0 to 0,75 meters, while parts in Semarang higher areas range from 0,75 to 348 meters (Regional Development Planning Agency of Semarang City, 2016). However, the lowest point is likely lower than the record, considering that regular floods affect the level of lowlands on the shoreline (Kurniawan & Suharini, 2021).

Large rivers such as Kali Garang, Pengkol River, and Bringin River flow through Semarang, which makes low land areas floodplains to these rivers. Semarang features a tropical climate zone, where most months of the year are marked by significant rainfall. The annual precipitation ranges from 1500mm to 3000mm (Regional Development Planning Agency of Semarang City, 2016). During rainfall peaks, rivers overflow, and floods occur (Setiyono et al., 2022; Kurniawan & Suharini, 2021).

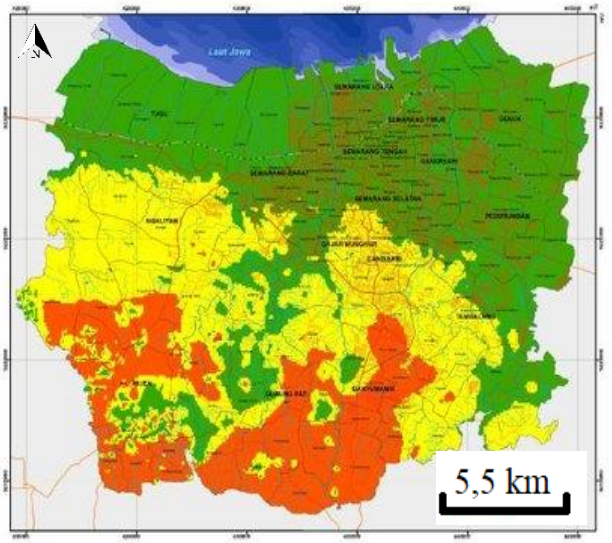

Figure 3.5: Low- and highlands in Semarang City (Based on: Akbar et al., 2019)

In the northern part of Semarang, floods are also caused by overflowing sea tides of the Java Sea. The lower areas are affected by land subsidence, where parts sink up to eight centimeters per year (Mahya et al., 2021). Together with a rising sea-level coastal floods are caused. The last registered coastal flood was the coastal flood on the 23rd of May, 2022. Triggered by tidal waves, the seawater barrier bursts and affected 8,335 people (OCHA, 2022).

Semarang's population growth led to a higher urban settlement density (United Nations, 2018). As a result, areas that should be water catchment areas or contribute to hydrological management are now residential areas. (Kurniawan & Suharini, 2021). This increases the risk of pluvial or flash floods. Within thirteen districts in North Semarang, residents live in slum settlements or relative circumstances (Ridlo et al., 2014). Living in slum settlements makes people even more vulnerable to floods and disasters (Dewi et al., 2021; Huq, 2012)

Conclusion

This comparative case study hands an interesting opportunity to focus on residents that experience the advances of well-integrated technical measures and residents that are vulnerable to flood risk. Vulnerable residents are focused on other strategies to deal with a flood. Based on these considerations, it would be interesting to examine how cities with similar experiences of flood risk in the past, and thus similar expectations when it comes to risk management, could differ exceedingly in implementing flood resilience now. A comparative case study of two cities in two different parts of the world with similar expectations but different outcomes would, therefore, be an interesting and suitable research area for this study.

3.2 Research progress

First, the research started with conducting results for Rotterdam, after the collection and analysis, the researcher started to collect and analyze results from the case Semarang. This research aimed to conduct two to three open interviews per case to get to know the topic and the cities' backgrounds regarding flood resilience at the start of each case study. Additionally, it was intended to hold three to four semi-structured interviews with stakeholders from different governmental levels in each case. Ultimately, two open interviews and three semi-structured interviews have taken place in Rotterdam. Afterward, only one interview was conducted in the case of Semarang due to no timely response from stakeholders.

As a result, a pragmatic approach has been chosen to understand Semarang's case in-depth. Various data collection methods have been added to the research, to increase the internal validity of the research (Yin, 2009). First, various rapport documents from UGM and Google Scholar databases are used to obtain detailed information about flood response and recovery in the case of Semarang (Appendix D). Also, news articles from prominent media sources (such as newspapers and news sites) are studied to understand the situation in Semarang clearly. However, no systematic analysis of the media output has taken place. Besides, the field trip to Semarang made it possible to observe the area and speak informally with the local residents of Semarang. Conversations were based on a semi-structured interview and have been added to the findings of this research.

To increase the validity of the pragmatic data collection methods, three times a -three hour- informal discussion with four Urban and Regional Planning master students from UGM took place to justify and control the information interpreted from the Semarang case.

3.3 Data collection and analysis

To explore the possibility of a policy transfer about flood resilience from Semarang to Rotterdam, this thesis follows a qualitative case study approach to explore the under-researched topic. The application of the concept of flood resilience in planning practices could be expressed as a complex social phenomenon (as it involves practices of various stakeholders, from communities to government). Qualitative case studies' strength is that they produce concrete, context-dependent knowledge to understand behavioral acts (Flyvbjerg, 2006). Details of the two cases help enrich information and capture the complexities of flood resilience.

Open - and semi-structured interviews were used for primary data collection. Document analysis, including reports and the study of several media articles, is used as a secondary data collection method. In addition, field trips to both cities are made to get first impressions and a better understanding of the study area. This mix leads to the confirmation and reliability of outcomes. Also, it reduces the influence of potentiality biases within the data (Clifford et al., 2010; Yin, 2009).

3.3.1 Open interviews

The data collection for this research started with open conversations with two representatives from the municipality of Rotterdam [Table 3.2]. This approach was chosen to explore the first selected case Rotterdam and obtain information about flood resilience and the four layers of the MLS concept. Furthermore, these first two open interviews helped the researcher to understand the organizational structures regarding water management in the Netherlands and get the researcher comfortable with the topic. Also, the basics of water management practices in the context of Indonesia were explored because of work experience of the government official participant in Central Java.

The use of open interviews gives room for spontaneity in questions and answers. It has enabled the researcher to improve her understanding by using the interviewee's answers as the start of a new question. Open interviews stimulate a natural flow of the discussion between the researcher and interviewee, which helps to make the respondent feel more comfortable. Furthermore, more empowered respondents are less likely to bias their responses toward what they perceive to be socially desirable (Grimm, 2010). Since the open interview's purpose is very explorative, simplistic open questions were asked, for example, how prevents the city itself from a potential flood? Or, how is the governmental organization involved in flood resilience practices? The topics used for the open interviews can be found in Appendix B.

Table 3.2: Overview of open interviews

No. + Case study	Organization	Gender	Date	Language interview
1. Case Rotterdam	Municipality of Rotterdam	Female	17 – 12 - 2021	Dutch
2. Case Rotterdam + Semarang	Municipality of Rotterdam	Male	05 - 01 - 2022	Dutch

Selection respondents

Clifford et al. (2016) indicate that participant selection is an essential part of scientific research; therefore, participants have been selected carefully. This research uses purposive sampling for the open interviews to determine the selected participants representing one part of the population in the empirical research data. The sample of participants was selected based on the following criteria: (1) considered representative as an expert in the field of flood resilience, (2) considered representative as an expert in knowing the opportunities and issues regarding flood management within at least one area of study. The purpose of this sampling method is based on the argumentation of Guarte and Barrios (2006), where purpose sampling enables to do "*a random selection of sampling units within the segment of the*

population with the most information on the characteristic of interest" (p. 277). Thereby, the researcher gets the most abstractive, relevant information from the interviews for the results by exploring characteristics of flood resilience and Multi-Layer Safety.

3.3.2 Semi-structured interviews

Although the high flexibility of the open interviews in Rotterdam resulted in a flow of new ideas and understanding of the concepts, the researcher decided to hold one semi-structured interview in the case of Semarang, based on limitations during the research progress (chapter 3.2) and ethical considerations (chapter 3.4). In advance, three semi-structured interviews with five interviewees were added after the open interviews in the case of Rotterdam to increase the generalizability and reliability of the research [Table 3.3] (Ahlin, 2019).

The use of semi-structured interviews helps to keep an eye on the beforehand created framework to receive a more desired outcome without too many distractions (Ahlin, 2019). Nonetheless, it encourages two-way communication with open-ended nature, where clarifications are still possible (Ahlin, 2019). Both cases' semi-structured interviews were used to understand in-depth how the concepts of emergency response and resilient recovery of the MLS model are adopted in Rotterdam or Semarang. The interview guides for this interview method can be found in Appendix C.

Table 3.3: Overview of semi-structured interviews

No. + Case study	Organization	Amount of attendees	Gender	Date	Language interview
1. Case Rotterdam	Waterboard Schieland en de Krimpenerwaard	2	Male (2)	01/02/2022	Dutch
2. Case Rotterdam	Province of South-Holland	2	Male & Female	04/02/2022	Dutch
3. Case Rotterdam	Veiligheidsregio Rotterdam-Rijnmond	1	Male	24/02/2022	Dutch
4. Case Semarang	Semarang City Government - BAPPEDA	1	Male	19/05/2022	English

Selection of respondents semi-structured interviews

The snowball technique is used to recruit experts for the semi-structured interviews in Rotterdam. This technique allows respondents to specify other 'potential' respondents that can participate in the research (Parker, Scott, & Geddes, 2019). The interviewees of the open- and first-conducted semi-structured interviews were asked to appoint experts related to the topics discussed. Therefore, the social networks of the respondents of the first interviews were used to target experts that are not easily accessible. By using the social networks of former respondents, the knowledge of multiple experts can be received.

This includes knowledge about the most detailed and practical information within the emergency response and resilient recovery phase per context. Furthermore, this method is used because the number of suitable participants was difficult to access. One reason for this is that government officials, in most cases, have busy agendas.

A limitation of this method is that newly acquired participants can share the same values and characteristics as the former respondent because of the nomination by the former respondent (Parker et al., 2019). However, bias is minimized by filtering the recommended participants on the following criteria: (1) the relation between respondents and (2) the work history of the potential respondent. Nominated contacts were asked by full name and, if possible, contact details like email addresses or phone numbers to contact the potential respondents.

In the case of Semarang, the social networks of Dutch participants could not be used to select an government official. Therefore, the purposive sampling method used for the open interviews is also used to conduct the semi-structured interview in Semarang.

3.3.3 Interview analysis

Even though two different types of interviews were conducted, the same analysis strategy took place for both open and semi-structured interviews. The -open coding, axial coding, and selective coding- types of analysis were used to deduct the variety of patterns in the results of the interviews (Creswell & Poth, 2018). The analysis part started with the outcomes of the first-taken open interviews. The open interviews' topic framework and, afterward the semi-structured interview guide were used as a basis to analyze the transcriptions of all the recorded interviews (Appendix B and C).

Foremost, transcriptions were printed out to start color-coded manually. The researcher had a personal preference for working on hardcopies since it helped her creating a clear overview of text fragments. The first step of the coding process started with open coding: dividing the data into discrete parts and labeling them by codes (Creswell & Poth, 2018). Similar codes were given to transcriptions of the open and semi-structured interviews. However, the number of codes increased remarkably during the analysis of the semi-structured interviews due to the discussion of new topics. After open coding and searching for connections (e.g., causal connections and similarities) between codes on hardcopy, the codes were implied in the program Atlas.ti to make a clear overview of connections between the codes. Categories, based on themes and topics in the interview guides, helped to organize all the codes in the program (axial coding). After that, a connection between the theoretical concepts and categories was used to write a "*storyline*" and make an understandable abstraction between the codes (selective coding) (Creswell & Poth, 2018, p. 139).

Table 3.4 gives an example of the code structure from the transcriptions. In the case of Rotterdam, interviews were held in Dutch; therefore, transcriptions of this case are in Dutch. For this research, the researcher translated quotes from these transcriptions into English.

Table 3.4: Example interview coding

Interview	Quotation	Code
Respondent Open interview	*" So, on the Meuse river lays the Maeslantkering, which closes when the seawater, if the water level gets too high, closes so that no more water can flow from the sea into Rotterdam."*	Flood defense *Flood prevention Rotterdam*
Respondent Semi-structured interview	*"[…] In fact, we simply implement the Security Regions Act, which means that we have mapped out our risks, we have a risk profile, which is, in other words, the basis of how we see our region […]".*	Law and Policies *Emergency response Rotterdam*

3.3.4 Document analysis

During the collection of the interviews, documents were analyzed to collect data for this thesis. Document analysis for the Dutch case took place predominantly after every single interview. This is because interesting policy- or planning reports were mostly sent by the interviewees after the interviews to illustrate or elaborate more on a topic that was discussed in the interviews. One stakeholder on a national level in the Dutch case that was not interviewed sent a document about the practice of Dutch water-safety laws, regulations, and policies that was helpful to add to the results. The documents helped the researcher to uncover meaning, develop understanding, and discover insights relevant to the research problem (Merriam, 1988). Likewise, the collection of documents aimed to retrieve extra detailed information and discover insights on the policies and strategies from stakeholders and organizations related to the emergency and recovery phase. Organizational and institutional document analysis is considered as an important research tool to receive objective data in detail; therefore, objective and precisely worked out norms, and plans of flood resilience practices per case have been analyzed (Bowen, 2009).

For the Semarang case, institutional restrictions made it not possible to acquire documents via the interviewed stakeholder. Therefore, research via the UGM database *(Perpustakaan)* and Google Scholar made it possible to collect objective data (e.g., public-published governmental - and NGO documents). Specifically, the information about the responsibility of Semarang's stakeholders regarding the response and recovery phase was discovered in-depth by these documents. Additionally, prominent media sources, such as newspapers and news sites, were studied to clearly understand the situation in the context of Semarang. News articles are used to follow the difficulties the city experiences regarding flood management. The information adds new insights above the provided information by the state official or analyzed policy and planning documents. The aim of adding a media analysis is based on the

argument of Lasswell et al. (1952, as cited in Macnamara, 2005): *[…] content analysis operates on the view that verbal behaviour is a form of human behaviour, that the flow of symbols is a part of the flow of events, and that the communication process is an aspect of the historical process […] content analysis is a technique which aims at describing […] what is said on a given subject in a given place at a given time"* (p. 34). Newspapers communicate critical views and greater transparency to monitor the implementation of government policies in Indonesia (Kakiailatu, 2007). However, media texts are open to varied interpretations; as such, it is not possible to do an objective analysis of these resources (Macnamara, 2005). Therefore, the articles are only used to support claims or give a background of situations described by respondents during the field visit, explained in the following paragraph. No systematic analyses have taken place.

Appendix D shows the documents for both cases used for this research. These documents are available at request by the researcher.

3.3.5 Field visits

The researcher visited Rotterdam for one day and Semarang for two days to collect partial data for the research. According to Malarvizhi et al. (2017), a field visit helps the research to provide real-world experience and contextualize the information in practice to develop a deeper understanding. On the 4th of February, an interview with the respondents of the waterboard was held. Afterward, a small tour around the water defenses in the Kralingen and Stadsdriehoek of Rotterdam was made together [Figure 3.6]. This research uses photos and information shared during this tour as background information and visualization.

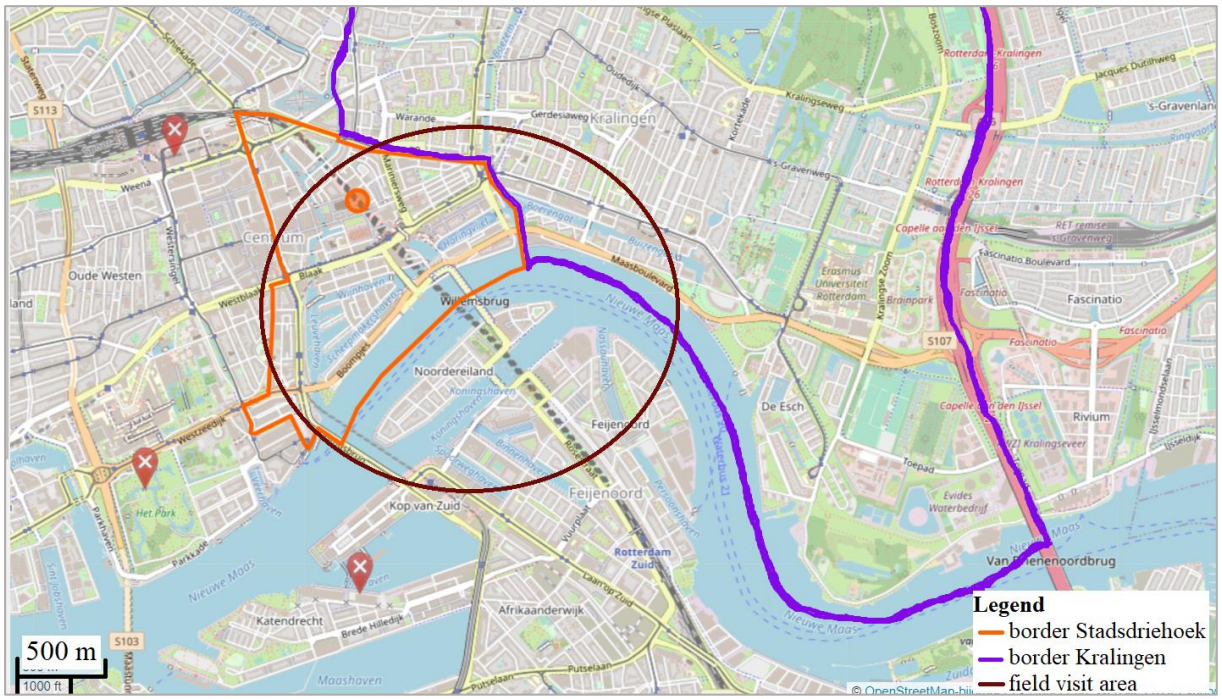

Figure 3.6: Kralingen and Stadsdriehoek in Rotterdam (own source, with use of the website OpenstreetMap)

Later, a field trip from the 18th of June to the 19th of June 2022 was made to Semarang. Throughout the visit to Semarang, first impressions of the case study were made, and small discussions with the community took place. At three different places in the village *Kampung Bahari Tambak Lorok* of Semarang, a place that is affected by tidal floodings daily, residents were asked about their experiences with the flooding [Figure 3.7]. However, since the researcher could not speak the local or Indonesian language fluently, an Indonesian tutor accompanied the field trip to introduce the area and translate questions. Questions asked to residents were based on a semi-structured interview approach [Appendix E]. The questions were determined in advance, but following-up questions were based on the residents' answers. Determining questions in advance made it easier for the translator to start conversations with the interviewees of the community. The discussions of the residents in the community were kept by taking notes.

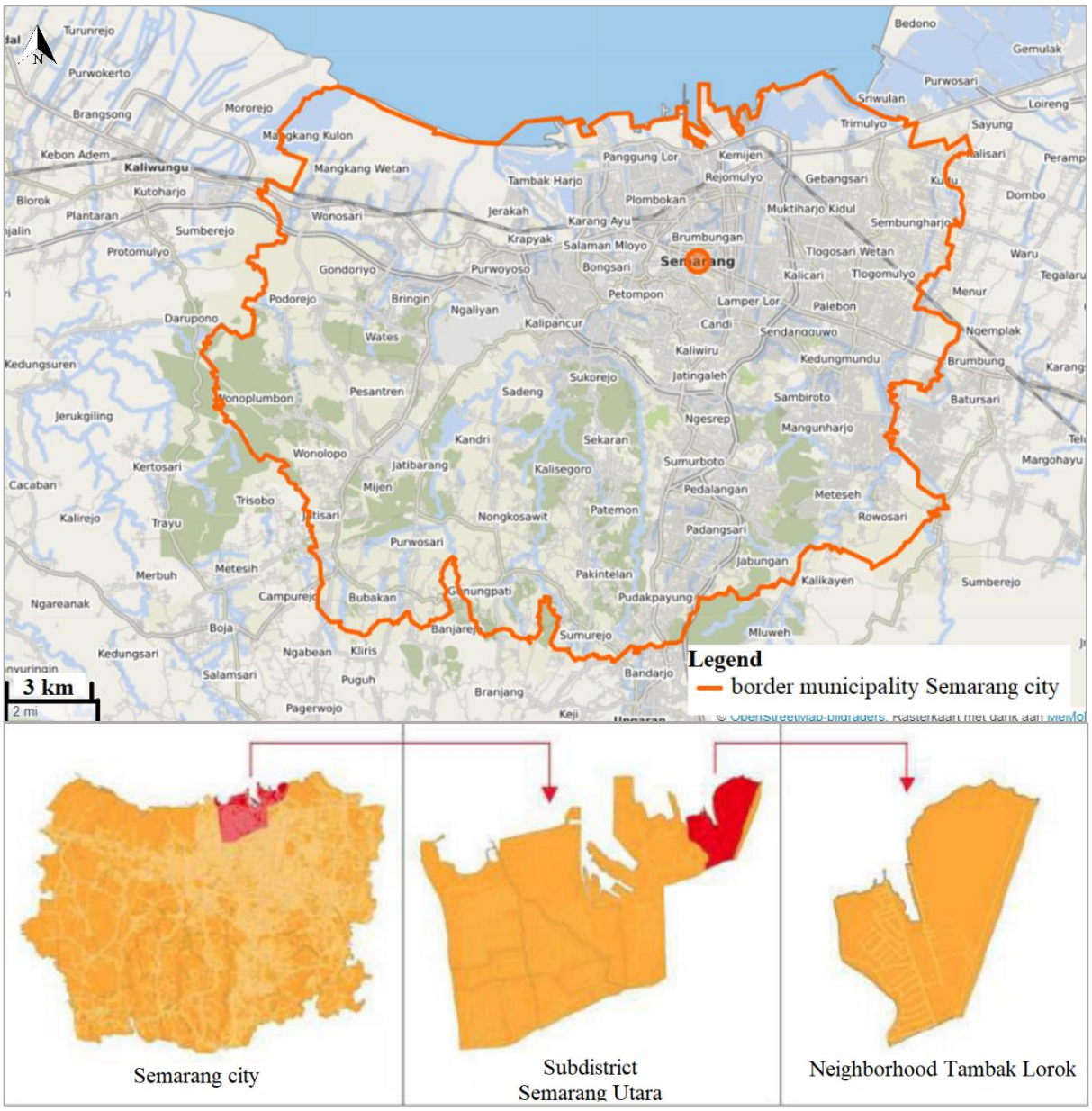

Figure 3.7: Semarang city's districts and neighborhood Tambok Lorok (based on: Akbar et al., 2019, with use of the website OpenstreetMap)

For this research, the discussions with the community in Semarang are added to the data collection to increase the research's credibility. Therefore, patterns were observed after creating codes for text fragments in the researcher's notes. The process for open, axial, and selective coding has also taken place for these interviews. A single justification for the inclusion of this method in the research is based on the evidence from the interview with Semarang's government official. The interview analysis made clear that the community plays a certain role in flood resilience practices.

3.3.6 Informal discussion

Three -three-hour- informal discussions with six Urban and Regional Planning master students from UGM have taken place. The discussions were used to justify and control the data information interpreted from the Semarang case. Language barriers caused it was not possible to interpret data as precisely as possible. The students are born and raised in flood-vulnerable areas of the islands of Central Java, Sumatra, and Papua and speak Indonesian. Also, they are familiar with the case of Semarang due to former research they have done in the city. The student discussions clarified ambiguities after the interview and document analysis in Semarang's case. The three discussions have taken place on the 24th of August, and the 26th & 28th of October.

3.4 Ethical considerations

This research used different steps to add transparency and confidentially to the data collected. Firstly, transparency contributes to accountability and replicability and ensures that prevention and correction of disputable data are unmercenary (Clifford et al. l, 2010). This research increased transparency by adding instructions to the interviews about the research goal in Rotterdam's case. In Semarang's case, the themes and main questions were also sent in advance. This difference is generated due to a socio-cultural and political difference between the two cities. The expert in the case of Semarang was not confident to do the interview unprepared and preferred to get an overview of the topic and possible questions in the Indonesian language in advance. Also, since the formality of the interview in Indonesia with a political stakeholder is different compared to the Netherlands, the researcher's supervisor dr. Tri Mulyani Surnarharum helped to prepare the interview and joined the meeting as a mediator and translator, in case needed. Additionally, interviewees were asked after every interview if they wanted to receive the results of the thesis or got the opportunity to participate in the presentation afterward.

Secondly, another important ethical consideration is the confidentially and anonymity of interviewees (Clifford et al., 2010). To encourage this, informal consent is asked at the start of the interviews. At the start of every interview, the researcher also clarified that interviewees' responses were anonymized and only written under their 'umbrella' type of names, such as community or government. However, photos taken during the field trips are an exclusion from this. Citizens' permissions to use the photos for the research were asked in advance or after the photo was taken.

Furthermore, recordings of interviews in the program Teams or Google Meet or by a recording app, transcriptions, and contact details were, after the consent of the interviewee, stored on the two times password-secured Google Drive of the researcher during the research and will be deleted after completion of the research. Lastly, all interviews were conducted at a location (including online opportunities) specified by the participant(s). This has reduced the barrier to participation, which has benefited participants' willingness.

4. Results

The Multi-Layer Safety concept is used in the theoretical framework to operationalize the flood resilience concept. This chapter identifies four layers of the MLS concept for the cases of Rotterdam and Semarang. The chapter starts with an overview of the similarities and differences between the two cases in the four layers [Table 4.1]. A summary of layers one (flood prevention) and two (spatial adaptation) of the cases will be given in the background section following the table. Lastly, this chapter will elaborate on layers three (emergency response) and four (resilient recovery) during and after floodings in the context of Rotterdam and Semarang, as this is the main focus of the research.

4.1 Overview MLS: Rotterdam and Semarang

The table below visualizes the similarities of both cases in bold letters; however, the cities arrange the completion of the layers differently, which is described briefly after the bold letters. The differences per layer are also briefly introduced in the table.

Table 4.1: MLS similarities and differences for Rotterdam and Semarang

		Rotterdam	Semarang
Flood prevention	Similarities	**Utilizing hard-infrastructural measures:** - building and strengthening dikes - Maeslantkering: storm-surge barrier - installation of water pump stations - broaden and deepen rivers flowing through Rotterdam **Standards to reduce flood risk** - Primary flood defenses are standardized by norms specified in Dutch law to decrease flood risk until 2050	**Utilizing hard-infrastructural measures:** - a sea wall - installation of water pump stations - several retention points upstream and downstream of rivers flowing through Semarang **Standards to reduce flood risk** - Statistic achievements are made to reduce percentages of areas that are inundated by floods in the planning document 2021-2016
	Differences	Financial capacities: Water boards take responsibilities and actions regarding the delta works and dike maintenance due to tax income.	Lack of financial capacity to build more hard infrastructural measures to keep water out of urban areas
Spatial adap	Similarities	**Many residents living in flood risk areas** - Housing shortage led to people living in outer-dike areas	**Many residents living in flood risk areas** - Poor-quality/informal house settlements on flood-prone land
	Differences	Possible to build safely in outer-dike areas since: - Primary flood defenses are in order - Multi-story buildings	Not possible to build safely in flood-prone areas because: - The drainage system is outdated and cannot handle peak flows during heavy rainfall. - Poor quality of infrastructure cannot

tation			withstand damaging geotechnical and hydrometeorological forces
Emergency response	Similarities	**Law** that sets requirements for regional crisis management - Veiligheidsregio's Act **An authority that coordinates** emergency services - Veiligheidsregio	**Law** to improve understanding and awareness of disasters - Law on Disaster Management (UU 24-2007) - Spatial Planning Law (UU 26-2007) **An authority that coordinates** DRM responsibilities - The National Disaster Management Authority (BNPB) - Disaster Prevention Agency - Women Empowerment Agency - Health Agency - Public Agency - Social Agency
	Differences	Governmental institutions work out scenarios for what this means for the emergency services and citizens two to five days in advance of a flood threat,. Inhabitants are not used responding to disasters - Residents are individualistic set	A monitoring system installed in 19 rivers flowing through Semarang should warn residents; however, financial incapabilities prevented decent work. Community capacity is used to respond to disasters - Communities have strong social networks and social capital: Disaster preparedness groups - Warning by traditional and modernistic signs - Community helps to evacuate others
Recovery	Similarities	**Government involvement** Residents are dependent on the government for compensation.	**Government involvement** The Public- and Social Agencies step in during drastic situations to manage a disaster.
	Differences	The unknown - Responsibility of all stakeholders - There are no plans based on how to recover from flood	The known - Community capacity: residents use their budget, infrastructure, and facilities to decrease the risk of a next flood. - Communities are 'living with the water.' - Contingency plan as a protocol for sub-district levels

4.2 Background information Rotterdam and Semarang

Flood prevention in Rotterdam

As mentioned before, Rotterdam's flood risk has significantly decreased since 1950 with the implementation of the Delta works and coastal maintenance. The Dutch national and regional water board(s) have an essential role in taking measures regarding the Delta works and coastal maintenance, including building and strengthening dikes, installing water pumps, and broadening and deepening the rivers to handle large amounts of water. These measures are taken to decrease the flood risk now and in the future. The Maeslantkering is the primary flood prevention system for the city of Rotterdam [illustrated in Figure 4.1]. Primary flood defenses in the Netherlands are all standardized by norms specified in law.

The law allows differences in the strength of dikes. The strength of the dike and the value of the economic hinterland determines its durability of the dikes. For Rotterdam, this results in a probability of flooding of usually 1/10.000 or 1/4.000 on the north side of the city [Figure 4.1] but a chance of 1/300 in the southern area. One reason for this is that the hinterland behind the dikes in the southern region is mainly agriculture.

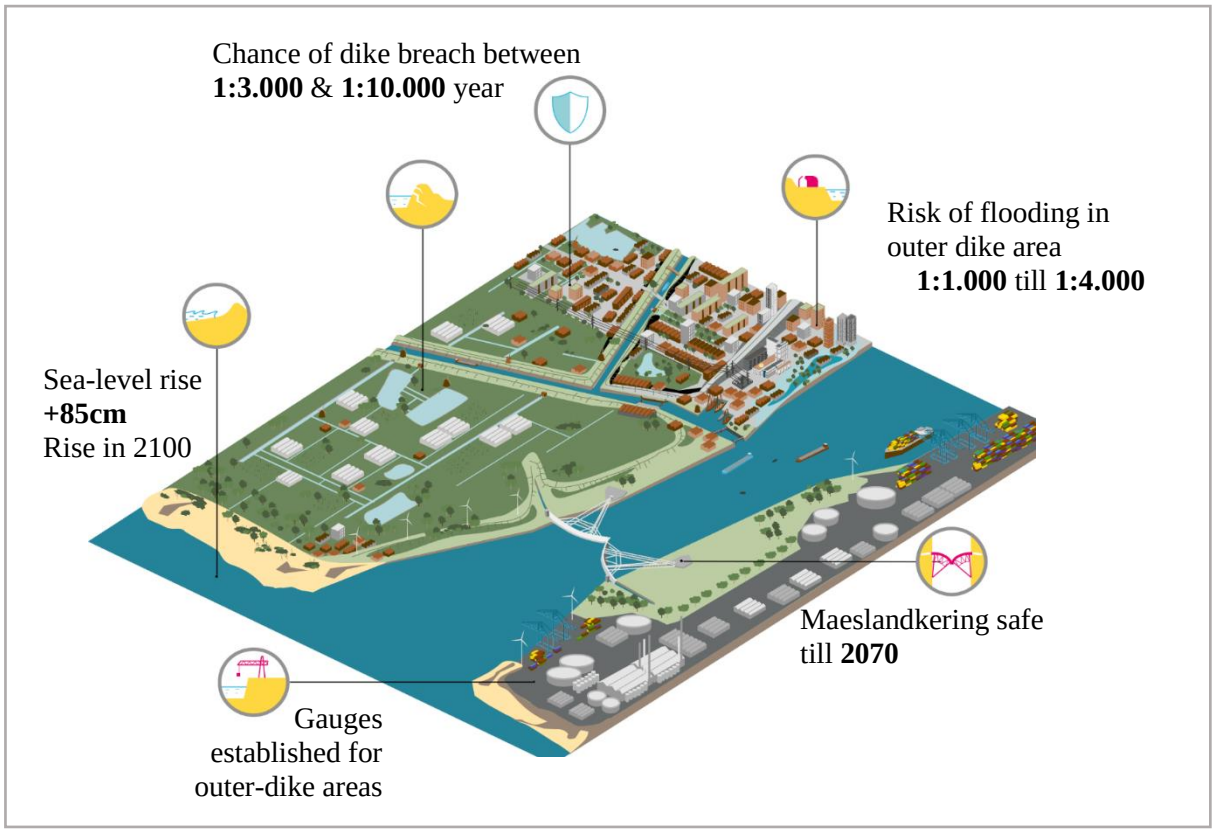

Figure 4.1: Flooding probability Rotterdam (Rotterdams WeerWoord, 2019)

Figure 4.2 below visualizes how secondary flood defenses in Rotterdam are intertwined with the city landscape and, therefore, not always recognizable. The map shows how Meuse boulevard, a primary flood defense at the height of the Erasmus Bridge, connects to secondary flood defenses. The photos illustrate how flood barriers like 'Schiedamsdijk' and 'Oostzeedijk' are intertwined in the urban environment.

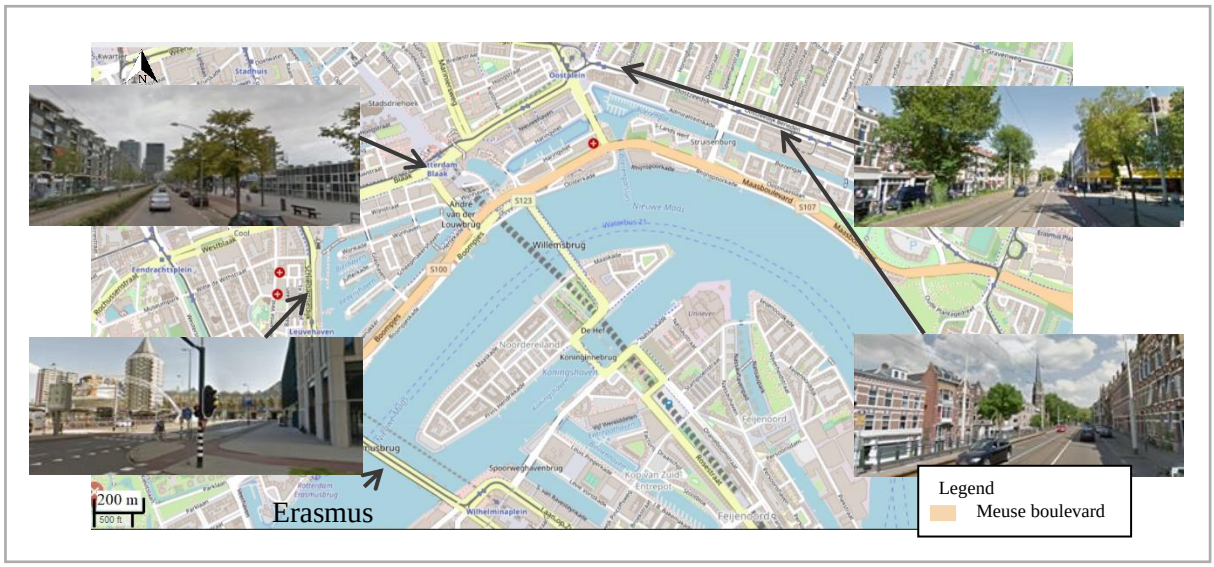

Figure 4.2: Flood defenses in Rotterdam (based on: Gelder, 2022, with the use of the website OpenstreetMap,)

Flood prevention in Semarang

Semarang has improved its flood situation compared to a few years ago. In 2016, 9% of the administrative area was inundated by floods, while in 2020, only 1.3% of the area in Semarang was inundated by floods. However, according to interviewees, these statistics exclude the piggy fields and fishery locations within Semarang's administrative boundary. This means that parts of Semarang still experienced a flood during high tide almost every day, while statistics denied it. In the fishery village Tambak Lorok, known in Indonesia as *Kampung Bahari Tambak Lorok*, water reaches knee height multiple times per week [Figure 4.3].

The Spatial Planning Agency's planning document 2021-2026 shows that administrative boundaries include the piggy fields and fishery areas. This adjustment of the operational definition in statistics increases the percentages of areas inundated again and, therefore, the outcome of achievements. To decrease the percentage of areas inundated by floods, many programs focused on improving the flood situation in Semarang. Involved programs include hard and soft infrastructure measures to minimize flood risk. Hard-engineered measures to prevent urban areas in Semarang from floods include a sea wall and a drainage pumping station that sealed off the estuaries of the two main rivers: the Semarang river and Baru river. Water upstream will be stored in retention ponds to be pumped out. Retention ponds can hold 130,000 cubic meters of water.

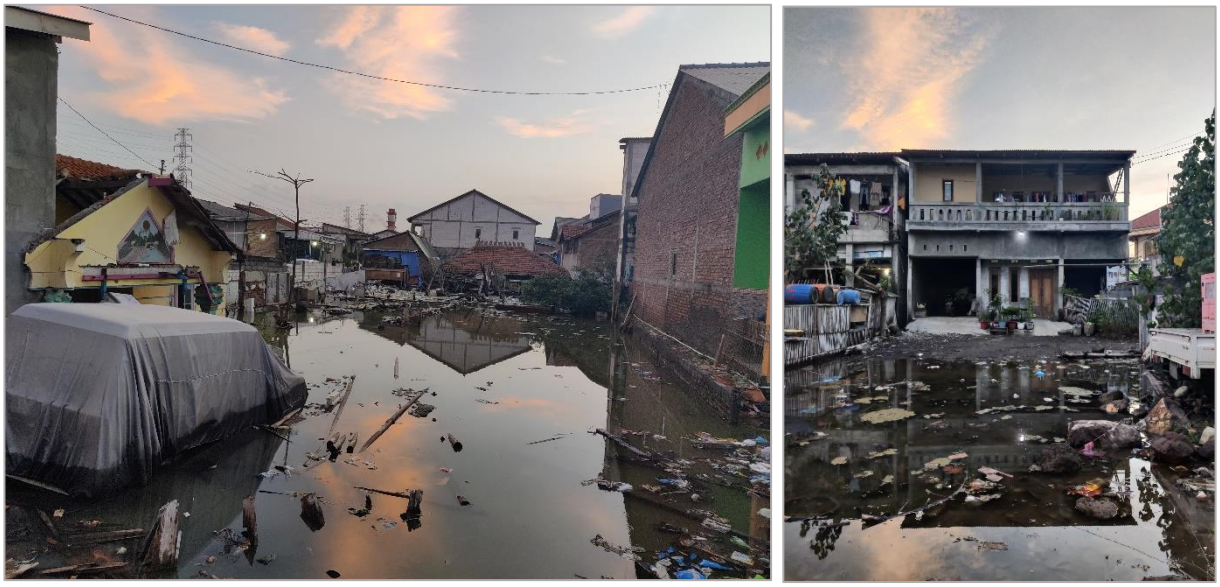

Figure 4.3: Tidal flooding in Kampung Bahari Tambok Lorok (photos by author)

However, the seawall broke on the 23rd of May 2022, and the water reached shoulder-level heights of residents living in the Tambak Lorok area. According to locals, the harbor industries have influenced the number of floods the community is experiencing now. The load of buildings, in combination with other factors, including groundwater extraction by industries and residents, causes land subsidence. Semarang does experience a lack of financial capacity to build more hard infrastructure measures to keep the water out of all the urban areas. Therefore, Semarang focuses mainly on increasing 'soft' capacities to reduce flood risk, explained in the following MLS layers of Semarang.

Spatial adaptation in Rotterdam

Residents of the Netherlands still love to live on the West coast of the Netherlands, despite flood risks. Therefore, among other reasons, Rotterdam has a significant housing assignment. 50.000 houses will be constructed, of which 1/3 are planned in outer dike areas. Currently, 25.000 houses are located in outer dike areas already. Therefore, the outer dike-area population and business activity are growing. The interviewees mentioned that building safely in outer-dike areas is possible as the primary flood defenses are in order. The Maeslantkering closes when the water level is more than +3.0 NAP. This trade-off has been compared with the economic damage of cargo ships that otherwise have to wait.

Spatial adaptation in Semarang

In Semarang, urban population growth is a motivating force for flood risk. Inadequately (un)regulated large-scale urban developments have increased the vulnerability of people and assets. New urban migrants are mostly compelled into flood-prone areas because of the affordability. The poor conditions

of informal housing settlements along the north side of Semarang often built without building licenses and occupancy certificates, increase its residents' risk. Furthermore, low-quality infrastructure is constructed in vulnerable areas without adequate conformity to risk-informed-planning regulations and urban-design codes. Semarang city's drainage system is already outdated and has insufficient capacity to handle peak flows during storm events, which are likely to happen once in twenty years. As a result, buildings and urban infrastructure cannot resist harmful geotechnical and hydrometeorological hazards (The World Bank, 2019).

Figure 4.4: Housing settlements in vulnerable areas of North-Semarang (photo by author)

4.3 Emergency response in Rotterdam

Population and economic growth have increased the vulnerability of floods in the Netherlands, up to a damage 6-13 times greater than in 1950. However, the number of drowning victims is lower estimated than in 1950 due to better warning, evacuation, and more robust multi-story buildings. In times of crisis, the Veiligheidsregio Rotterdam-Rijnmond is in charge of the crisis management team in Rotterdam. Therefore, the focus of this paragraph will be on the functions and responsibilities of the Veiligheidsregio. However, an overview of all the involved stakeholders will be given first.

Stakeholders

The following table gives an overview of institutions and residents, considered as critical stakeholders that are actively involved and dependent upon each other regarding the emergency response and practices on the city level of Rotterdam. The table shows the responsibility per stakeholder.

Table 4.2: Overview of stakeholders Rotterdam

Stakeholder	Stakeholder's description	Responsibility during emergency response
Dutch National Waterboard (Rijkswaterstaat)	The Dutch National Waterboard is the executive organization of the Ministry of Infrastructure and Water Management, one of the 28 agencies of the national government. It works for a safe, livable, and accessible Netherlands (Rijkswaterstaat, 2022). It is the management center of (arranging substantial investments for) the central water systems and storm surge barriers.	- It makes predictions of the water levels - Takes action with the regional waterboards in times of storms (e.g., closing primary flood defenses) - According to the disaster legislation, it can declare a disaster and arrange funds to identify the people affected.

Province South - Holland	The Province of South Holland is a sub-area in the west side of the Netherlands, with its regional governance regularly concerning an intermediate level between national and local government [Figure 3.1].	- The institution services a supervisory role for waterboards and municipalities - Limited to act in calamities operations since their role in water management is relatively small.
Dutch Regional Waterboard	The regional waterboard is responsible for enough clean water and protection against too much water in a specific area. It uses the data from the national waterboard and implements the activities from governmental policies. People and organizations located within the waterboard borders pay waterboard tax to receive regional water management services, such as the maintenance of small weirs and pumping stations [Figure 3.3]. However, they also control if flood defenses meet (new) standards set by the national waterboard. This makes the waterboards powerful as they have their tax associated with one function: water management.	- The responsibility of the water boards starts at the dikes and includes everything between the dikes. This includes the regional water systems and secondary flood barriers to stop water from the outside. - In times of storms and high water, the waterboards and the national waterboard take action. For instance, flood defenses will be closed, and dikes will be monitored.
Municipality of Rotterdam	Rotterdam's municipality is one of the 352 municipalities in the Netherlands and performs direct tasks for their residents' housed in the area [Figure 3.1] (Rijksoverheid, 2022).	- Is responsible for risk communication and awareness among civilians (based on water-level information received by the national waterboard) - coordination of evacuation - responsible for taking action about possible water depths based on handout strategies (hoogwaterprotocol) for citizens located in outer-dike areas
Mayor of Rotterdam	The mayor, together with the councilors, forms the day-to-day management of the municipality. Also, the mayor of Rotterdam is chairman of the Veiligheidsregio: Rotterdam – Rijnmond.	- Is responsible for the crisis organization in times of floods. Tasks are mainly based on evacuation and information provision for residents *"He has to point out to people who live outside the dikes. The fact they live in an outer-dike area"* – interviewee.
Veiligheidsregio Rotterdam-Rijnmond	Veiligheidsregio Rotterdam-Rijnmond is one of the 25 veiligheidsregios in the Netherlands, with its primary task being the facilitation of emergency services	- In charge of the crisis management team in Rotterdam: takes care of coordination and cooperation between emergency services

	like firefighters, ambulances, police, and military.	- Responsible for crisis planning and operations during the crisis.
Residents	Residents are the people housed in Rotterdam	- Responsible for informing about the flood risk of the inner- or outer dike area they live in and the realization of its consequences

Veiligheidsregio Rotterdam- Rijnmond

The Dutch Security Region Act (Wet Veiligheidsregio's, Wvr) sets requirements for regional crisis management. In order to comply with this, a policy plan, risk profile, and crisis plan is developed. Veiligheidsregio Rotterdam-Rijnmond is one of the 25 Veilgheidsregios in the Netherlands and has been mainly responsible, together with the municipality, for crisis management in the city of Rotterdam since 2007 [Figure 3.2]. The primary task of the Veiligheidsregio is to facilitate services regarding the need for firefighters, the transport of patients via ambulance, and to maintain public order and safety in general for the police (VRR - Risico- en Crisisbeheersing, 2020).

The moment a flood threatens, often five days in advance, the organisation receives the organization. However, within the area around the coast, it is a maximum of two days in advance. In the meantime, a planning staff, including members of the police, fire brigade, ambulance, the Port Authority, the municipality, and Rotterdam Rijnmond environment service, together with the Rijkswaterstaat and the waterboards, will work out scenarios. If the planning staff concludes the situation is a high risk, an upscaling procedure starts. For every region, a risk profile indicates the specific area's risks. The Regional Risk Profile of Rotterdam describes the approach to all 29 possible crises in the region. This is an 'all-hazard' approach that includes a description of the processes, authorities, tasks, responsibilities, and agreements on preconditions, such as reporting and alarms, scaling up and down, leadership and coordination, information management, and crisis communication (VRR - Risico- en Crisisbeheersing, 2020).

The crisis plan also contains the responsibilities, tasks, and powers of the measures and facilities that the municipality takes concerning disaster relief and crisis management, as well as the agreements that have been made with other parties in the event of (possible) disasters and crises involved parties (Article 16, paragraph 20 Wrv). The plan describes how the various services and organizations cooperate in the fight against crises and disasters. The plan offers structure and uniformity to this collaboration. The basic principle of the crisis plan is integrating multidisciplinary actions in a crisis at an operational level. The core is, therefore, that management is geared to the nature of the crisis and available capacity. The crisis plan sets the framework for the operational performance of disaster relief and crisis management as policies and resources are determined from the plan (VRR - Risico- en Crisisbeheersing, 2020).

The information above from the document analysis is also in line with the interview information. However, in practice, the performance of the security region is context-depended.

"In practice, it will always be the case that a crisis team will meet in the event of an imminent flood, and my experience is that many plans actually remain on the shelf. Because every situation is so specific that you can never say, oh, it is completely according to the model, the way the model initially thought the flooding would proceed".

Based on factual information from the national and regional water board(s), a crisis team will make decisions and create an image about what is threatening the area to inventory what it means for emergency services. However, even though preparations are made, it is impossible to be fully prepared.

"I have to say, you are never sufficiently prepared for a flood, and actually, this is also not possible."

To add, until now, the Veiligheidsregio Rotterdam-Rijnmond is used to relatively small crisis-management practices. The agency classifies its incident levels from level one: where a multidisplinair collaboration between the veilgheidsregio is needed, to level five: where the incident transcends the region level. In formal settings, the veiligheidsregio has never reached a level-five incident until now. Within the multidisplinair collaboration in level one, a collaboration between specific Veiligheidsregio is made on forehand. However, an interviewee argues the usefulness of this administrative boundary.

"I just think water does not care about administrative boundaries; why did the Veiligheidsregio ever make such a SCOR (the level system) connection at all?"

Role of citizens

Many residents in Rotterdam do not know if they live in inner- or outer dike areas. Also, they are not informed about this. Government officials say that residents are responsible for informing where they will live and the risk of a flood in the place. Also, in times of a flood event, most residents in Rotterdam will not even notice the causes as they live in skyscrapers. Floodwaters are unlikely to reach people living above ground levels.

"You do not want to do that kind of panic communication either. So, it is a complicated dilemma in the Netherlands, let us say, because we are the best-secured delta in the world. The chance is minimal, but the consequences are huge. So, we invest a lot in it and must keep working on it. However, at the same time, the realization that something can go wrong, of course, is just small. Moreover, that is what everyone pays for .. "

Also, the Dutch typically have an individualistic mindset. In times of crisis, it is possible to manage people in general terms, but residents assess their own level, for their own interests.

"[..] the government can say: you must go there because it is safe there. However, a resident's response can be: ja toedeledoki; I have family living on the other side of the country; I am going there."

4.4 Emergency response in Semarang

Disaster risk is a critical public policy consideration in Indonesia. Following the devastating Indian Ocean Earthquake and Tsunami in 2004, the need to improve understanding and awareness of disasters became apparent. The earthquake, measuring 9.1 on the Richter scale, struck off the west coast of Sumatra (Australian Government; Australian Institue for Disaster Resilience, 2004). Since then, legal and institutional arrangements on Disaster Risk Management (DRM) have seen significant progress, with the Law on Disaster Management (UU 24-2007) and the Spatial Planning Law (UU 26-2007) both approved in 2007. Within the context of urban development, the Spatial Planning Law 2007 is particularly relevant. It supports Indonesia's medium- and long-term development planning. It includes various key DRM aspects, including requiring open spaces for evacuation and creating safety zones for residential areas prone to natural disasters.

Stakeholders

The following table explains the actively related stakeholders and their responsibilities for the MLS concept's response layer in Semarang's case.

Table 4.3: Emergency response stakeholders Semarang

Stakeholder	Stakeholder's description	Responsibility during emergency response
National Disaster Management Agency (BNPB)	BNPB was established in 2008 with a mandate to improve the coordination of DRM responsibilities between government agencies, non-government organizations (NGOs), and international partners. The organization builds disaster risk reduction and preparedness culture, integrated into national development.	BNPB regulates DRM and maps out the hazard of a flood. The hazard, vulnerability, and risk are displayed via the INARISK application to inform people. The organization will help rescue people if the disaster is at a national level.
Regional Disaster Management Agency (BPBD)	BPBD is a governmental agency that carries out disaster management tasks in the regions of provinces and cities based on policies set by the BNPB. Together with BNPB, they coordinate various aspects of disaster risk management.	Rescues people to evacuate in Semarang
Government Spatial Planning Agency (BAPPEDA)	BAPPEDA formulates and implements local policy on development planning through formulating technical policy, coordinating planning formulation, and supervision. BAPPEDA is the central government agency within the	BAPPEDA's departments: The Disaster Prevention Agency, the Women Empowerment Agency, and the Health Agency coordinate together to emergency response processes. The last two are involved in coordinating disaster preparedness. This involvement is

	economy, development, and welfare department of the Semarang City Government and operates with BAPPENAS	because special attention is needed for the poor and minority or marginalized groups, the most vulnerable groups.-For instance, disaster-related programs from the Women Empowerment Agency are designed to improve women's fate in emergencies since gender imbalance in education, economy, politics, and health will worsen during emergencies. This group usually prioritizes their children and families.
City Government	The local government is responsible for city administration, budgeting, and decision-making. The Semarang City Government consists of the Mayor, the City Manager as the chief executive, and four city assistants.	The City Government coordinates organizations during emergencies. The mayor invites all DRM-involved agencies and discusses who does what.
Residents	Residents housed in the city of Semarang.	Communities help each other out during crises. For example, the elderly house gets help from the community.

Regarding the budgeting of DRM activities carried out by the institutions mentioned above, the Indonesian Ministry of Finance assigns national budget resources to BNPB. Also, it has a contingency plan and budget for unexpected emergencies, such as disaster events. The local government takes a similar budgeting approach for their DRM-related expenditures. Semarang's local government relies heavily on budget allocations from the central government to finance resilience-building initiatives, including structural and non-structural measures.

Structural measures

As a hard-infrastructure measure, the government helps to warn people with a Flood Early Warning System in times of crisis. The warning system is installed in all 19 rivers flowing through Semarang to monitor the water in the rivers. This system helps to warn people or indicates when the government has to take action when an incident happens within the rivers. As an outcome, the Flood Early Warning System, implemented in 2012, led to community-based disaster risk reduction (Semarang City Government, 2016). However, news coverage in the media is dominated by the fact that the warning system in rivers is not optimal for working. High maintenance costs and the rob of batteries from the system are factors that left out decent working facilities in a few rivers.

Role of citizens

Due to the inadequate performance of warning systems, residents are 'used' to responding to disasters. The increased frequency of flood events has put additional strain on people, ecosystems, and the local economy. Past extreme climatic events have led to significant economic losses, including reduced productivity across sectors, temporarily increased commodity prices, and changes to social networks and social capital (UNHABITAT, 2013)

Social networks and capital have become stronger by sharing reliable information about emergencies. Communities in Semarang can identify disaster risk characteristics, propose solutions for reducing flood risk suitable to the local wisdom, increase community capacity, and organize a disaster preparedness group.

Community preparedness is considered necessary in high-risk areas of Semarang. Community groups help the government respond to a flood in the first fifteen minutes of a disaster, as these minutes are most critical to reducing the consequences. Community groups make the residents living in the flood-prone area aware of the flood via traditional or modern signs. A traditional sign is a sound of a slit drum (*kentongan)* that warns people to evacuate. The slit drum uses a unique morse code known by the residents living in the flood-prone area to inform them about the threat of a flood. Nowadays, residents with smartphones are (also) warned by a text message in a group chat or a social media application, e.g., Whatsapp. The government argues that the community organizes the evacuation of people via the sign to minimize causalities of disaster when the government cannot reach the area affected by the disaster.

4.5 Resilient recovery in Rotterdam

For the recovery phase in Rotterdam, plans will be created after a crisis has happened since the chance of a flood is significantly small. Therefore, according to interviewees, no plans include information on how to recover from a flood in an area.

" […] I have to say, for us, the recovery phase has not worked out yet, or actually not worked out at all [..]

[…] a fourth layer, the recovery, that is.. that is not arranged in advance."

[..] However, I have to say; we are really into crisis management. For many people in our profession, the recovery phase is something we are likely to ignore."

One area that will be flooded tomorrow needs another recovery plan compared to an area that will be flooded 100 years from now. Urban and regional developments assure the need for change in plans. The housing assignment in the country illustrates how an undeveloped area now requires another recovery plan if it transforms into a build-up area in 20 years.

Interviewees say that the responsibility for the recovery phase "*lies in the hands of everyone*." According to them, the future is complex and unknown. It is very situationally determined, for example, whether a rural area is flooded with only agricultural areas or if urban areas are also affected.

"[..] We are already taking an enormous step in the Netherlands if we recognize that it is good to consider the recovery [..]

In the Netherlands, it is not possible to insure against breaches of primary flood defenses such as the Maas, Waal, Rhine, and IJsselmeer. One reason for this is the risk of bankruptcy by insurers. In this case, the national government determines if it will compensate people. This is also the case when disaster damage costs are uninsurable, unavoidable, and non-recoverable. For example, the flooding in Limburg on July 2021 is briefly illustrated. After the flood event, the cabinet decided that the flooding had become a disaster according to the disaster legislation (Wet tegemoetkoming bij schade, WTS), which made it possible to free up money for victims. However, this money is considered an allowance, not compensation; parts of the damage remain at their own risk.

4.6 Resilient recovery in Semarang

In Semarang, various government institutions are responsible for making areas resilient after a disaster. However, the role of citizens is considered the most critical. Therefore, this paragraph starts off with an overview of the responsibilities per stakeholder and will afterward elaborate more on the role of communities in the recovery phase.

Table 4.4: Resilient recovery stakeholders Semarang

Stakeholder	Stakeholder's description	Responsibility in resilient recovery
National Disaster Management (BNPB)	See table 4.3	BNPB organizes the recovery of areas and takes care of the communities after a disaster through better rehabilitation, reconstruction, support, and governance of DRM logistics equipment.
Government Spatial Planning Agency (BAPPEDA)	See table 4.3	BAPPEDA works together with PUPR after a disaster to make a recovery plan
The Ministry for Public Works and Housing (PUPR)	PUPR aims to realize reliable public works and public housing infrastructure. The ministry formulates a five-year strategic plan for public works and -housing to achieve national development targets. It accelerates the	PUPR is the operator that (re)builds the buildings and has the responsibility to inform residents how to

	development of water resource infrastructure, road infrastructure, residential infrastructure, and public housing to realize Indonesian's people quality of life. It controls the development to support management functions such as planning, organizing, implementation, and supervision.	build resilient to overcome the next disaster
Ministry of Agrarian Affairs and Spatial Planning (ATR/BPN)	ATR/BPN has the task of formulating, determining, and implementing policies in spatial planning, agricultural, and land infrastructure. It also assists the president in administering state government by the Presidential Regulation of the Republic of Indonesia Number 20 of 2015 concerning the National Land Agency. ATR makes the regulation for building permits in Semarang	ATR changes the regulation of spatial patterns and structure after a disaster to decrease the risk of a next disaster
Residents	See table 4.3	Local communities clean drainage and learn from a disaster. They build two-story buildings and elevate roads.

Role of citizens

Due to a lack of financial capacity, governmental institutions train, educate, discuss and sell information about the subdistrict's flood risk situations to its residents. The government does this to enhance the community's capacity against floods. According to the government official, the communities are the experts in the areas. Communities live in vulnerable areas and have the most knowledge about the situation in the area. This is visible because residents of the flood-prone area know almost precisely when it is high tide, when the floodings occur, and when the water will go away. Figure 4.5 illustrates the water left in the street and a living area, even though the tide was getting away again.

Figure 4.5: Frontside (left) and inside (right) of an house between high and ebb-tide (photos by author)

During the field trip to Semarang, the researcher observed that even though the area flooded during high tide, residents did not hesitate to continue their daily activities [Figure 4.6/4.7]. Motorbikes drive through high water levels, and children play in higher-located areas. Residents live in their homes, while the water level standstill in the living area for a couple of hours [Figure 4.5]

Figure 4.6: Daily activities continue during high water-levels (photos by author)

The community does not evacuate during high-tides floods. One response from a resident: *"Do we have to evacuate every day then?"*. Instead of evacuation, residents elevate their furniture by buying rocks. Mattresses are moved from lower areas to the top of tables to sleep upon. When heavy rainfall occurs, residents are extra alert as the flood can be more intense, resulting in higher water levels in residents' houses. The working residents will head home to help the community and elevate belongings to higher levels.

The many floods that reached the coastal villages in the municipality of Semarang and the soil subsidence caused by water abstraction, made houses sink drastically [Figure 4.8]. In response, the government helps to recover or builds new houses for the households living in houses that are severely damaged. Simultaneously, other residents who also experience flood damage do not get financial help.

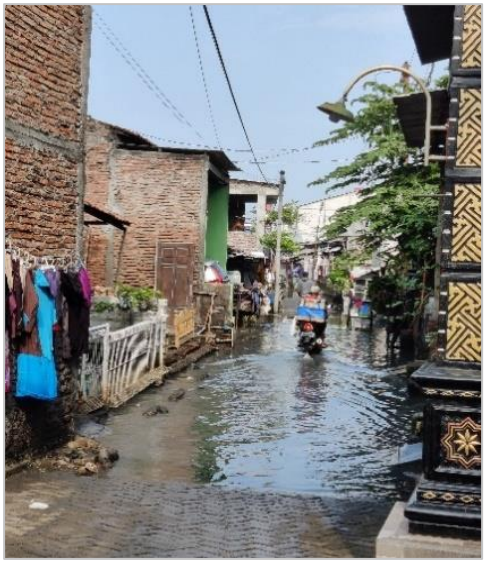

Figure 4.7: Motorbike drives through high water levels (photo by author)

Figure 4.8 A sinking house in Semarang (photo by author)

Minimal measures by Semarang's government led to a strong community capacity, where residents use their budget, infrastructure, and facilities to decrease the risk of a next flood. Figure 4.9 illustrates an elevated street as a response to former floods. This measure makes it easier for inhabitants to travel from A to B in times of a flood. Figure 4.10 shows that residents build new homes higher than the road level to decrease the chance that their belongings get damaged during the next flood. Also, the right house in the photo illustrates that the first floor is used as a parking space, and their living and sleeping areas are located on the second and third floors.

Communities stay in the area because of the affordability of houses. Also, families in the community are dependent on the job of the men that work in the area as fishermen. Families cannot just quickly leave as there will not be work elsewhere for these men. Besides, the residents cannot afford to pay high costs for commuting if they move to another area.

Figure: 4.9: Elevated street (photo by author)

Figure 4.10: Raised house levels (photo by author)

5. Conclusion and discussions

This chapter will answer the research's sub-questions (written in chapter 1.4) by connecting the results to the literature. Firstly, all four sub-questions will be answered and divided between the response and recovery phases and split per case. Eventually, the answer to the main question and relevance of the research for planning, governance, and society are given. Lastly, the study's limitations and recommendations for the cities of Rotterdam and Semarang are described.

5.1 Emergency response

This paragraph highlights the role of citizens, critical stakeholder(s), leading issues, and -elements regarding the organization of the emergency response in Rotterdam and Semarang afterward.

Rotterdam

Nowadays, evacuation coordination, warning systems, and high-rise buildings help lower the number of 'future victims' compared to the flood disaster the country experienced in 1953. National governmental institutions use prediction measures to calculate floods two to five days in advance. Rotterdam depends on this warning system to set up scenarios for emergency services and warn residents. For instance, during the storm Corrie in January 2022, people were asked to remove cars parked close to the dike before a flood occurred to avoid damage. This example shows that citizens are asked to follow the advice of the Veiligheidsregio.

Dutch law states that the Veiligheidsregio is in charge during a flood. This means that not the municipality of Rotterdam but another organization is in charge during a flood emergency. The Veiligheidsregio is considered a critical stakeholder since it prepares the risk profiles and crisis plans and coordinates emergency services such as firemen, ambulances, and police. Until now, the organization has only been mobilized for a small-scale crisis, like the before-mentioned storm Corrie. The reason for this is that no disasters have occurred during their existence. Consequently, residents have no experience in how to respond during a disaster. They are expected to follow up instructions on given by the Veiligheidsregio in times of flood. However, the individualistic culture in the country might lead to individual choices by Rotterdam's residents. As a result, the mindset of residents during a flood can be considered the main issue. At the same time, the responsibility of one organization during the emergency response to a flood is regarded as a critical element. Centering the responsibility clarifies who is responsible for tasks and activities during the response phase.

Semarang

Communities in Semarang experience frequently predicted and unpredicted floods. Recently, floods have increased due to various effects of climate change, urbanization, and industrial developments around Semarang's coastal area. The research results show that governmental institutions have installed

early warning systems in all rivers flowing through Semarang to monitor the water level, warn communities, or take action if changes are observed. However, the fact that communities still experience multiple floods shows that the system does not work correctly. Two factors are the robbery of batteries and the lack of maintenance. The government cannot get a hand on this, mainly due to a lack of financial capabilities. As a result, the role of the community has become more critical in times of flood.

The first fifteen minutes are particularly critical in times of a flood. Community groups prepare and warn the inhabitants of flood-prone areas via a traditional or modernistic signal. A morse code is produced with a slit drum to warn people; also, many residents receive a warning via their smartphone (e.g., social media). However, instead of evacuation, inhabitants prefer to raise their belongings to higher places or use rocks to elevate personal equipment if the water level reaches a certain level inside houses due to the flood frequency. Based on the community's behavior, the government recognizes that the community is in charge during a flood. Communities are considered critical stakeholders since they know the area the best. As a result, national and regional regulations in Indonesia focus on improving, understanding, and shaping awareness of flood risk by residents. Community awareness and responses are considered critical elements in the emergency response phase during a flood in Semarang.

In conclusion, Rotterdam can learn from Semarang's community capacity and improve awareness among residents regarding the emergency response.

5.2 Resilient recovery

This paragraph highlights the conclusions of the resilient recovery outcomes in Rotterdam and Semarang.

Rotterdam

In consideration of the results from the case of Rotterdam, there are no plans made in advance that focus on the recovery phase of a disaster. The amounts of scenarios Rotterdam needs to consider plays a particular role in this. One area that will be flooded tomorrow needs another recovery plan compared to the same or another site that will be flooded 100 years from now (e.g., due to urban and regional developments). The timeframe (*when)* and location *(where)* of a flood could occur are uncertain. This leads to the question mark of what to do after a flood.

All the stakeholders are considered responsible actors after a flood event, including government agencies and residents. Nevertheless, the welfare and socialist culture in the Netherlands makes Dutch residents in inner-dike areas pay tax as some insurance premium in advance of a flood. Therefore, inhabitants can be expected to look at the Waterboard and other governmental bodies to take the lead and pay for recovery. However, only if the government decides the flood event becomes a disaster occurring to the disaster regulations, residents have the opportunity to apply for allowances.

Semarang

Semarang's case results show that the city uses community capacity to respond to floods during the emergency and recovery phases. Residents' tolerance, budgets, infrastructure, and facilities are critical elements to recover a city from a flood. The area's recovery is depended on citizens' adjustments after a flood (e.g., increasing house levels). The government enhances community capacities against surges by educating residents. In a few cases, the government supports households by recovering or building new houses when a flood dramatically damages former dwellings. The role of citizens is critical to achieving resilience recovery in Semarang.

In conclusion, what could Rotterdam learn from Semarang's resilient recovery? A brief answer to this question is: acknowledging the importance of a plan for recovering from a flood and the value of community capacity.

5.3 Discussions

A remarkable finding in the case of Rotterdam is that the city is mainly based on financial and organizational structures with 'hard-engineering measures' to decrease flood risk. This was also acknowledged by the research of Cheshire (2015) and McClymont et al. (2019), who claim that cities in the Global North mainly have advanced engineering solutions and historical flood events have improved the mitigation of future flood impacts by governments. In fact, this argument implies that layers one (flood prevention) and two (spatial adaptation) of the MLS concept could be a long-term outcome of layer four, resilient recovery. Therefore, the MLS concept could also be considered a cycle where a flood event causes the need for response recovery and adjustments in flood prevention and spatial adaptation measures [Figure 5.1]. This underlies the convenient relationship between the layers and the difficulty of considering the difference between spatial adaptation and resilient recovery. The case of Rotterdam gives an example of this. The flood in 1953 resulted indirectly in changes in flood protection and spatial adaptation practices (e.g., raising dikes and multi-level story housing). However, the reconstruction of individual, societal, and environmental assets is also considered part of resilient recovery (Karrasch et al., 2021). It is hard to divide the layers between clear lines. What time frame after a flood decides if the adaptation strategy is resilient recovery, flood prevention, or spatial adaptation?

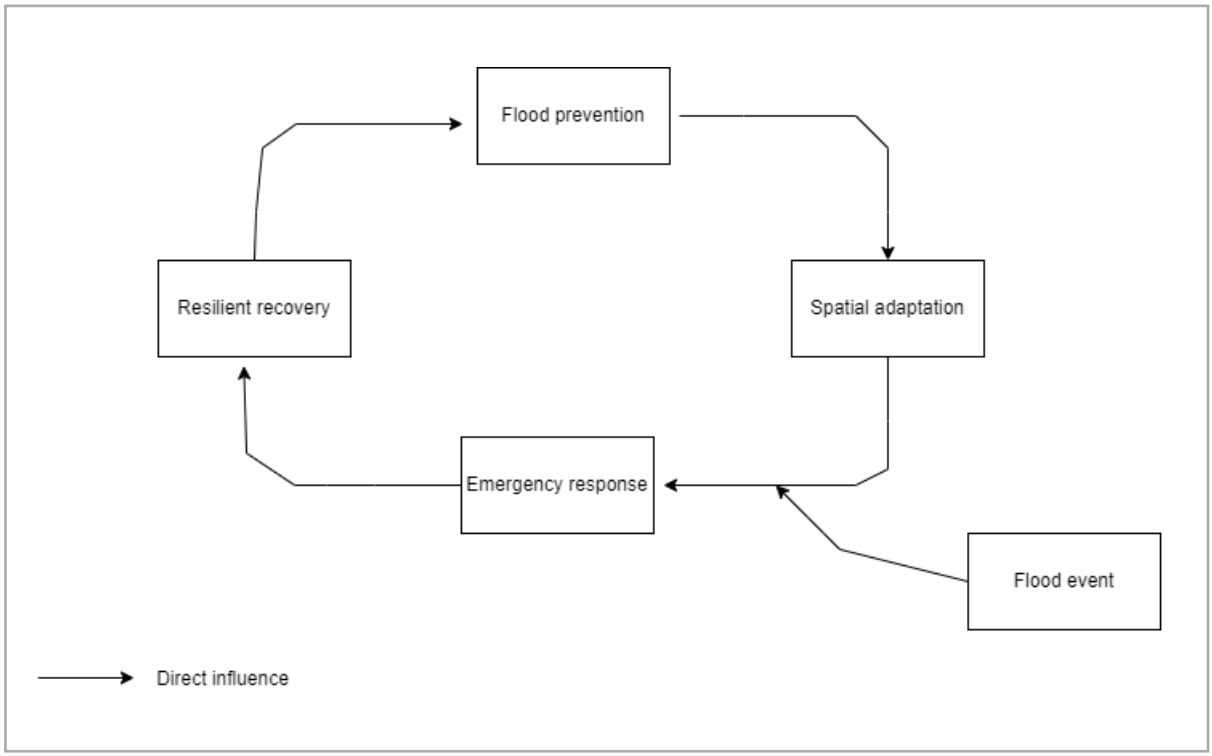

Figure 5.1: Multi-layer concept adjusted to cycle (own source)

Furthermore, studies about flood resilience in literature underscore the importance of incorporating the resilience-based approach of embracing uncertainty and learning how to live with the water (Liao et al., 2016; Disse et al., 2020; Baldassarre et al., 2015; Restemeyer et al., 2015; Folke et al., 2010). In the case of Semarang, communities are not 'fighting against the water' but are 'living with the water.' The transformation from 'fighting' to 'living with the water' is also discussed in the literature of Pahl-Wostl (2006) and Restemeyer et al. (2015) as an essential key to resilience. Results show that communities in Semarang continue their activities in high-water levels and do not hesitate to evacuate. This entails that people live with the water instead of fighting against it. However, this does not imply that they want to live with it. This invokes the theory of Kaika (2017), who elaborates on the idea that citizens are 'injected' with a new way of thinking about cities and their flood risk, but at the same time, government proposals are based on previous policies and methodological frameworks. In this case, residents are 'injected' with policies from the global North without consideration of Semarang's context and its residents' circumstances. 'Living with the water' should be a quality of life and not a mode to survive.

Semarang lacks adequate functions in the first and second layers of the MLS approach. Therefore, it can be discussed that this important key of flood resilience: 'living with the water,' should be applied in combination with the 'other building blocks' to complete in some extent all the layers of the MLS concept. Nevertheless, a lack of economic resources has influenced the fact that the government cannot pay for multiple hard-infrastructural measures that improve prevention to withstand the next flood event

in Semarang. This is in line with the research of Lopez (2007) and Zhang (2021), which already expressed that Semarang, located in Indonesia, is a low-income country that experiences more socio-economic challenges than Rotterdam.

5.4 Conclusions

In the previous section, the findings of the sub-questions have been concluded and discussed. This led to the answer to the main question: "*What can the coastal city Rotterdam in the global North learn about response and recovery as part of flood resilience strategies from the coastal city Semarang in the global South?".*

The MLS cycle illustrates that flood events influence the response and resilient strategies [Figure 5.1]. Rotterdam could learn from the real-life experiences of citizens and government institutions in Semarang how to respond as a city during and after a flood. Firstly, Semarang illustrates that evacuations are not always necessary in the case of high water levels. The possibility of allowing a certain water level of a few centimeters on the ground floors in houses can already be enough to stay safe in the area instead of evacuating. Awareness campaigns by the government can help to inform (new) inhabitants living in lowland areas, for instance, the new inhabitants that will move into the village in the Zuidplaspolder. As a result, people and project developers that build houses in lowland areas can choose to allow space for water in (new) homes. Secondly, Rotterdam has no plan on how to recover from a flood because of the unknown of future climate change effects. The city can learn from the experiences in Semarang and consider introducing a contingency plan including different scenarios and the role of communities in how to recover after a flood might occur. For instance, a scenario to consider is a global sea-level rise of one meter by 2300 (Oppenheimer et al., 2019), which is supposable if no changes to reduce carbon emissions are taken. Public knowledge improves the provision of disaster information, and preventive actions can be taken to minimize disaster risks.

5.5 Relevance of the research

Firstly, compiling the four layers of MLS in flood resilience practices around coastal cities significantly helps to reduce the chance of a flood disaster. The emergency phase and resilient recovery play a considerable part in this. This research may be helpful for Rotterdam's municipality project: Rotterdam WeerWoord since the results could increase awareness and share knowledge about flood resilience practices creatively among Rotterdam's residents. On a larger scale, results could be used by the initiative 100 Resilient Cities of The Rockefeller Foundation, how they can support vulnerable cities to integrate a practical roadmap to resilience considering context dependency based on technical or community capacities. Also, the results may be helpful for planners, policy-makers, and city- and other levels of government institutions engaged in projects of cities that experience a high flood risk.

Secondly, this research adds to the knowledge gap in the academic debate related to local- scale practices in global South cities appropriate for policy transfers. Global South cities can play essential roles in increasing flood resilience. Community involvement can encourage awareness of the flood risk. This research stimulates researchers to have new insight into the use of policy transfers and consider practices from the global South for input.

Lastly, the results display the relevance of considering resilience's meaning in all the MLS approach's fourth layers. Not only technical engineered measures in the first, second, or even third layer, such as dikes, multi-story buildings, and early warning systems but also community support is essential to consider. The way the cases obtain to be framed, based on different contexts including economic, technical, socio-cultural, and political, is presumably common in the context of the global North or global South and could potentially help support other flood risk cities.

5.6 Limitations

The findings of this study have to be seen in light of some limitations. Access to people and data in the case of Semarang was limited compared to the case of Rotterdam due to stakeholders' absence of timely response and institutional restrictions to share confidential information. Subsequently, other research methods have been used, including informal interviews with a community living in Semarang and a database search for (institutional) documents about flood resilience in Semarang. This has caused results from different perspectives of stakeholders. The case of Rotterdam is viewed from a governmental perspective. In contrast, the Semarang case is based on one interview with the government and using NGO documents and community perspectives to write the results. This helped to get more information on how Semarang's community is actually 'living with the water' and will recover from a flood. However, it limits to giving a broad government point of view during and after a flood.

The data collection process in Semarang gave a new insight into the possibility of changing initial strategies during the research. While open interviews worked out well as starting point to explore the research topic in Rotterdam, an open interview in Semarang was not possible due to ethical norms. Therefore, the research methodology has been adjusted after the first part of the data collection. A lesson learned by the researcher is that **"**an understanding of cultural norms, approaches, and behaviors along with flexible and adaptable methodological and high ethical awareness are vital" in doing research (Halder et al., 2022, p. 1).

Rotterdam's case outlined detailed processes and tasks of government organizations but lacked the inhabitant's perspective on how to deal with a flood during and after an event. The semi-structured informal interviews in Semarang led to the inclusiveness of more perspectives. Still, the single interview with one government official led to fewer insights into policy determinations and concrete actions regarding the response and recovery of the government in flood risk places in Semarang. Due to the limited time, it was impossible to get a deeper understanding of the perspectives of Rotterdam's

inhabitants. Therefore, no equal comparison between the cases could be applied. Takeaways from this research are the difficulties of comparing locations situated in different cultural-political backgrounds. Busy agendas, response time, the willingness of government stakeholders, language barriers, and institutional restrictions should be considered in further comparative research between cities located in the global North and South.

5.7 Recommendations for Rotterdam

From these findings and limitations, recommendations can be made. In Rotterdam, most residents have yet to learn about the flood risk they experience. An idea uncovered during the interviews in Rotterdam is that the municipality of Rotterdam, like the municipality of Dordrecht, should send a letter every year with possible risks relative to the water level, including corresponding recommendations. This may improve the awareness among residents of their flood risk vulnerability: Karrrasch et al. (2021) showed that active risk communication is critical in developing risk awareness and fostering adequate behavior in crisis management. Moreover, Indonesian governmental institutions recognize that the community should be in charge during a flood and focus their national and regional regulations on improving, understanding, and shaping awareness of flood risk by residents. By shifting the responsibility focus from the Dutch government to Rotterdam's residents, the ability of communities to prepare for, withstand, and recover from a flood event will increase community preparedness. According to the Semarang case results, community preparedness is the critical part of disaster management.

Practices within the recovery phase of Semarang illustrate that residents are 'living with the water'; residents living in Rotterdam can learn from this by accepting a low level of water inside their houses. However, context is an essential factor to consider since the mentality of residents living in Rotterdam is different. People are expected to not accept an increasing water level in their houses. The demographic, economic, social-cultural, technologic, ecologic, and political context is critical before transferring a policy or practice to other regional, national, and international cities. Therefore, policy programs in Rotterdam should change their focus on the illustration of opportunities or benefits for residents to accept water levels in houses. Acceptance is essential to become adaptive to (future) climate change effects.

6. Reflection

This chapter critically reflects on the research process and outcomes and suggests future research.

6.1 Reflection on the research

The overall study is considered to have been a meaningful research analysis. Applying the theories and concepts has framed a solid base to give insight into the flood resilience practices at two completely different places, namely Semarang and Rotterdam. A strength of the research is the mixed-method approach. Open- and semi-structured interviews, a document analysis, and the addition of field trips had a valuable contribution to the derived insights of the literature. This method effectively uncovered the MLS practices carried out by stakeholders in both cities.

However, choosing a comparative case study approach took much time to conduct the research. During the research process, the researcher spent more than half a year in both countries: the Netherlands and Indonesia. As its strength, this time gave the researcher a clear overview of the context and institutions in both cases. Also, it gave the possibility to adapt to the environment and cultures in both cities. However, a drawback of using multiple methods in both cases and a time limit for the research has resulted in more data needing to be discovered. The perspectives of residents in the Rotterdam case and the perspectives of multiple government officials in the case of Semarang are missing. Overall, I still recommend using a mixed-method approach for both cases. However, a piece of advice would be to calculate more time to conduct research, so all stakeholders' perspectives can be included since it provides insightful information.

The research outcome formulated aligns well with the research objective and central question. Nevertheless, looking back critically on the results, potential improvement aspects have also been identified. First, it needs to be determined whether the sample size is representative enough to draw conclusions. Even though professionals made an effort to approach residents via the snowball technique, directly and indirectly, one respondent in Semarang was the maximum that was reachable given the timeframe. Also, looking back at that interview, it seemed the participant gave formal government-desired answers. Given the very different opinions on the fulfillment of practices in stakeholders' response and recovery phase, it would have been preferred to do more interviews to ensure data saturation was reached in the case of Semarang. At the same time, the response of 'favorable answers' by the government was also experienced by other peers of UGM during their research studies. Given the political background, I suppose restrictions of transparency by government institutions are accustomed. In this manner, while it would have favored doing more interviews to back both cases, it is suspected that the interview sample was close to saturation.

Nevertheless, the sample for both cases is not representative of Semarang and Rotterdam. A limited response was received from government officials related to the response and recovery of one agency for Semarang, and no (informal) interviews with residents in the case of Rotterdam have taken place. No residents of Rotterdam were included in the sample, even though the response and recovery phases affect them. One reason for this is that during the data collection of the Semarang case, the importance of this stakeholder role became clear. Considering the timeframe of this research, it was not feasible to include the perspectives of Rotterdam residents after the case of Semarang. Therefore, generalization of the results is not possible; however, results effectively bring forward the possibilities of using local practices of flood resilience from the global South in the global North context.

6.2 Future research suggestions

The plurality of flood risk management research is focused on policy transfers from the global North to the global South. There still needs to be more research on the practice of flood resilience strategies from the global South to the global North. This research has portrayed that global North cities could learn from global South cities' response and recovery standards. While this study has taken a step forward by showing what communities and the government do during and after a flood event in Semarang and Rotterdam, it would be interesting to see whether the same relation holds in other places in the global North and South. Due to this research's time frame, it was not possible to include multiple cases. Therefore, a suggestion for further research will be to explore the same topic across a broader subset of geographically flood risk vulnerable cities to see if the same relation goes up and results will be generalizable. It would be interesting to include constraints of the limitations addressed by incorporating government and community or residents' perspectives in all cases to see how these interferences relate to policies and practices in the emergency response and resilient recovery. Also, it should be considered that this research focused on the third and fourth levels of the Multi-Layer Safety concept and briefly discussed the first and second levels. Because of this, no statement can be made of the overall flood resilience of the areas in the research. That being the case, another research suggestion will be to consider all the levels of the Multi-Layer Safety concept to more in-depth assess the effect of all layers more. In conclusion, this research lays the foundation for further research on looking for opportunities how to include input from global South countries in policy transfers and the relevancy of the Multi-Layer Concept nowadays. Moreover, the findings of this study provide an appealing point of departure for further research inquiries on policy transfers and flood resilience.

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Appendices

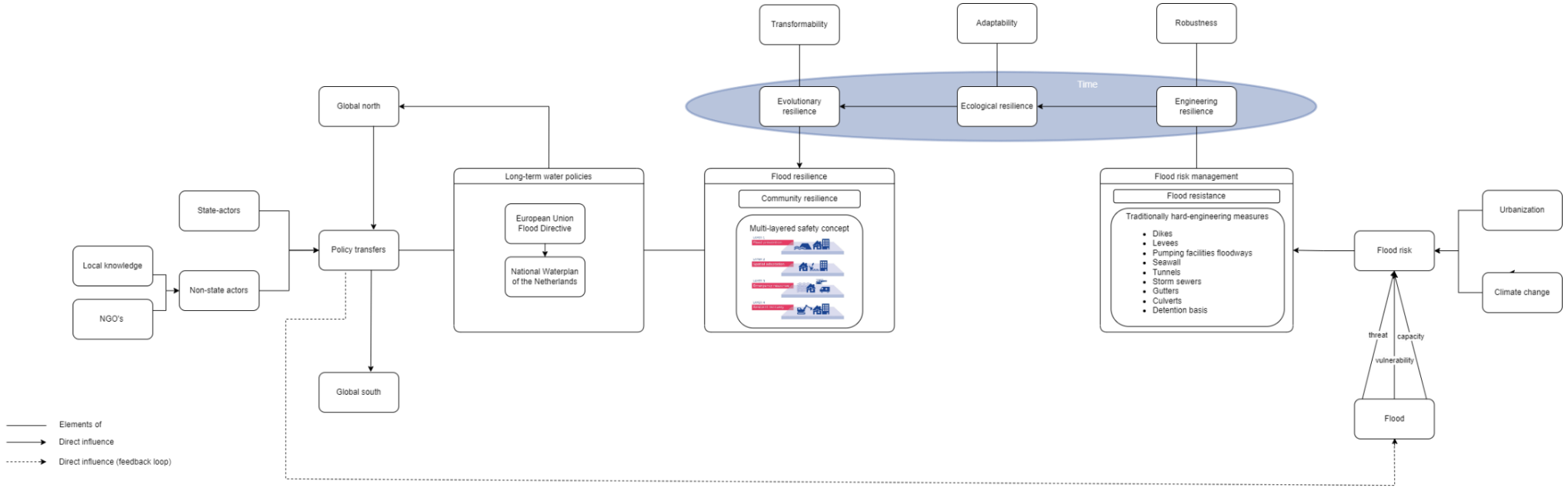
Appendix A: Elaborated theoretical framework

The following theoretical framework explains relations between key- and sub concepts. The model in the figure below answers briefly the three questions of the theoretical framework: (1) why do we need flood resilience?, (2) how is the concept developed?, and (3) how is the concept adopted in the global North and South? The figure shows that due to flood capacity, a flood threat, and the place vulnerability a flood risk is developed. However, also urbanization and effects of climate change have an influence on the increase of a flood risk. As a consequence, flood risk management is considered as an approach to mitigate the influence of a flood risk. Flood resistance strategies as traditional hard-engineered measures like dikes, are part of flood risk management and are, therefore, visualized 'inside' the concept of flood risk management.

The concept resilience has had different stages of its meaning. Within this thesis, its first stage 'engineering resilience' could be seen as an element of flood risk management. The attribute 'robustness' is considered as an attribute of 'engineering resilience', and is therefore linked as an element of 'engineering resilience'. The paradigm shift from engineering- to ecological- to evolutionary resilience can be seen as a process that changed the definition resilience by time. The paradigm shift illustrates that flood resilience practices are the outcome of the 'evolutionary resilience' stage. Resilience is not seen as an outcome anymore but as an process. To increase flood resilience in flood risk areas, the MLS concept can be used as a framework by for example decision-makers. Therefore, the MLS framework that includes the prevention, protection, preparedness, and recovery aspects is illustrated 'inside' the concept of flood resilience.

The change of interpretations of resilience and challenge of the levee-effect in the global North leaded to a new way of tackling disasters and provide long-term water policies by using flood risk management and resilience practices. The European Flood Directive caused the making of the National Waterplan in the Netherlands. Long-term water policies from the global North are used in the global South, since the global South is depended on knowledge in policies from the global North to control water management. Therefore, a policy transfer will indirectly occur as a response to floodings and can therefore be considered as the dependent variable. One main explanatory variable, or independent variable here is flood resilience, because policy transfers are depended on the knowledge of flood resilience strategies. To conclude, the feedback loop illustrates that policy transfers in the end have an effect on the amount of floods. A positive effect if the policy worked out, and a negative effect if the policy did not worked out.

The question here is, could cities within the global North learn from flood resilience practices of cities located in the global South? Theories specified that policy transfers are not only influenced by the knowledge of state actors, but also of non-state-actors that includes local knowledge.


Transformability
Adaptability
Robustness
Time
Evolutionary resilience
Ecological resilience
Engineering resilience
Global north
Long-term water policies
European Union Flood Directive
National Waterplan of the Netherlands
Flood resilience
Community resilience
Multi-layered safety concept
Flood risk management
Flood resistance
Traditionally hard-engineering measures
Dikes
Levees
Pumping facilities floodways
Seawall
Tunnels
Storm sewers
Gutters
Culverts
Detention basis
State-actors
Local knowledge
Non-state actors
NGO's
Policy transfers
Global south
Flood risk
Urbanization
Climate change
threat
capacity
vulnerability
Flood
Elements of
Direct influence
Direct influence (feedback loop)

Appendix B: Topic list open-interviews

Topics to discuss for the open interviews translated to English.

Topic list **Open interviews** Government officials	Setting up interview: - Thank for participation – contribution is essential for research - Introduce myself and purpose of study - Upset + timing interview (themes – duration around 1.5h) - Privacy: shared information anonymized by pseudonyms personal details stay confidential - Consent and confidentially: each interviewee must give their informed consent. Level of confidentiality of the interview: Completely anomized data can be shared with other researchers/published in scientific journal YES/NO - Recording: okay? *Keep in mind:* *RQ: What can Rotterdam learn about flood resilience from Semarang?* *1. What are the main issues by flood resilience in cities?* *2. Who are critical stakeholders in flood resilience on city level?* *3. What are critical elements in flood resilience on city level?* *4. What is the role of citizens in flood resilience in the Netherlands and Indonesia?*
Introduction	Name Function
Flood risk	The Netherlands / Indonesia Rotterdam / Semarang - Experience - Scenarios - Stakeholders
Flood resilience	Defintion
Multi-level safety concept	Defintion
Role citizens	
Role government	
Best practices	National level International level
Conclusion	*Suggestions for potential new interviewees* *Thank* *Interest in results - ask e-mail*

Appendix C: Semi structured interview guide government officials

Semi-structured interviews framework translated to English.

Interview guide Semi-structured interviews Government officials	Setting up interview: - Thank for participation – contribution is essential for research - Introduce myself and purpose of study - Upset + timing interview (themes – duration around 1h) - Privacy: shared information anonymized by pseudonyms personal details stay confidential - Consent and confidentially: each interviewee must give their informed consent. Level of confidentiality of the interview: Completely anomized data can be shared with other researchers/published in scientific journal YES/NO - Record: okay? *Keep in mind:* *RQ: What can Rotterdam learn about flood resilience from Semarang?* *1. What are the main issues by flood resilience in cities?* *2. Who are critical stakeholders in flood resilience on city level?* *3. What are critical elements in flood resilience on city level?* *4. What is the role of citizens in flood resilience in the Netherlands and Indonesia?*
Introduction	Could you tell me something about the company you work for? Are you familiar with the concept flood resilience? How is [the organisation] involved with the concept flood resilience? Is [the organisation] involved in any projects about flood resilience? What is their role/responsibility?
Flood resilience Multi-layer safety concept	Definition concept Example third layer: emergency response Example fourth layer: resilient recovery
What if?	What is the risk that Rotterdam/Semarang will be flooded? On what idea is this idea based? Preparation Rotterdam - Semarang Scenarios -> applicable MLS? What do you know about resilient recovery in Rotterdam/Semarang? What is going well? Where could start problems? How can they be solved? Are there alternative strategies? – on each level? What is the role of [the organisation] in this kind of happenings? Who are the important stakeholders? Who share the responsibility? What indicatest he government's seriousness in addressing this issue? What are things within projects that are, in your opinion, are out of expectation? Why is this happening?

Stakeholders flood resilence rotterdam/semarang	Who? Which organization? NGO's? Communities/individuals? What is there role/responsibility?
Role inhabitants	How are inhabitants involved in processes? Do you think it is enough? How can it change? - before flood - during flood - after flood To what extent is the expectation different from reality?
Increasing flood risk	How to prevent areas against the raising risk of flooding? Layer 1, 2 ,3, 4 - What is the strategy to regulate crisis in times of flooding? - Are there experiences in former events when it comes to anticipating on flooding? What did this look like? Governance (munipality, province, land), NGO, communities, individuals
Rotterdam/Semarang as example	Is Rotterdam/Semarang an example for other cities? Which ones? Why do you think that? What is the most important factor if the risk of flood is low? What are they doing well? What can Rotterdam/Semarang do better?
Examples of other cities	Do you have an example of a different city, with similar flood risk experience, where Rotterdam/Semarang can take an example from.
Comparison	Do you think Rotterdam has flood resilience activities/processes/policies that could be relevant in the context of Semarang, Indonesia? (or the other way around?) What do you think are the biggest differences between flood resliience in Rotterdam and Semarang?

Appendix D: Overview document analysis

Documents that are analyzed for this thesis are shown in the table below.

Case	Type of document	Publisher	Title	Year	Topic description
Rotterdam	Action plan	Gemeente Rotterdam: Rotterdams WeerWoord	Urgentiedocument – *Urgency document*	2019	This document operates on climate change-related effects Rotterdam experiences (in the future). It illustrates maps of Rotterdam's risks of high water levels, extreme rainfall patterns, groundwater levels, heat, drought, and land subsidence.
	Planning document	Hoogheemraadschap van Schieland en de Krimpenerwaard	Met mensen en water: Waterbeheerplan 2016-2021 - *With people and water: Water Mangement Plan 2016-2021*	2016	This document describes the most important developments that will affect water management in the upcoming years. Waterboard tasks, programs, and goal achievements are explained.
	Presentation	Hoogheemraadschap van Schieland en de Krimpenerwaard + Gemeente Rotterdam	Stelsel van waterkeringen en kades Rotterdam – *System of flood defenses and quays Rotterdam*	2022	This presentation contains an overview of 'what if' floods happen and illustrates how to reduce the consequences of floods in particular district of Rotterdam.
	Research report	GovernEUR Erasmus + Deltares + Interreg North Sea Region FRAMES	Helpende handen – *helping hands*	2019	This document examines the offer of assistance in the event of (imminent) flooding of Alblasserwaard Vijfheerenlanden, a polder in the Dutch river area.
	Action plan	VRR – Risico- en Crisisbeheersing Veiligheidsregio Rotterdam-Rijnmond	Regional Crisisplan Rotterdam-Rijnmond 2020-2024	2020	The document describes the approach to all possible crisis situations in the region, an 'all-hazard' approach with descriptions of the processes, powers, tasks, and responsibilities. Also, agreements on preconditions such as reporting and alerting, scaling up and down, management and coordination, information management, and crisis communication are given.
	Operational policy document	Rijkswaterstaat & Expertisenetwerk waterveiligheid ENW	Grondslagen voor hoogwaterbescherming – *Principles for flood protection*	2017	The document describes the underlying principles of flood protection in the Netherlands: the development of the legal standards and the translation

					to assessment, design, and management.
	Analyze report	Rijkswaterstaat VNK Project Office	The National Flood Risk Analysis for the Netherlands	N/A	The document has mapped out the current flood risk in the Netherlands by giving history, facts, and figures.
Semarang	Policy note	The World Bank Group	Strengthening the disaster resilience of Indonesian cities – a policy note	2019	This policy note seeks to raise awareness of opportunities to reduce the vulnerability of Indonesian cities and their inhabitants
	Action plan	Published: Municipality of Semarang Initiated by: 100 Resilient Cities	Resilient Semarang – Moving Together Towards a Resilient Semarang	2016	This document contains 18 strategies and 53 initiatives to build and improve flood resilience in Semarang.
	NGO Research document	UNHABITAT	Annexure D – Case study: Climate change resilience building in the city of Semarang, Indonesia.	2013	This document gives an overview of Semearang's city-level governance and describes stakeholders related to flood resilience.
	Policy document	National Agency for Disaster Management (BNPB)	National Disaster Management Plan 2010-2014	2010	A disaster management plan is constructed based on Law Number 24, article 36 Year 2007
	Implementation report	The World Bank + Global Facility Disaster Reduction and Recovery	Building Indonesia's Resilience to Disaster: Experiences from Mainstreaming Disaster Risk Reduction in Indonesia Program		This document summarized works that are undertaken in the program: Global Facility for Disaster Reduction and Recovery (GFDRR).
	Newspage	Australian Disaster Resilience Knowledge Hub	Indian Ocean tsunami, 2004	2004	On Sunday morning 26 December 2004 a massive earthquake measuring 9.1 on the Richter scale struck off the west coast of Sumatra, Indonesia
		VOI	The Length Of The Broken Sea Wall At The Tanjung Emas Port In Semarang Reaches 20 Meters	Published 24/05/2022	The seawall broke in the industrial area Tanjung Emas Port, caused a flood of seawater reaching a length of 20 meters and a width of 1.5 meters
		Grundfos	Pump station solves chronic flooding, boosts quality of life in Semarang, Indonesia	N/A	Semarang City together with Grundfos build a new pumping station in 2013.
	News article	Kompas – regional	Alat EWS Tsunami di Cilacap Banyak yang Rusak, 370,000 Jiwa Terancam – *Many of*	Published 29/07/2022	Early Warning Systems in Cilacap on Central Java, are reported as damaged. Only 15

			the EWS Tsunami Tools in Cilacap were damaged, 370,000 people were threatened		out of 22 systems are functioning properly.
		CNN Indonesia	Dua Unit Baterai Peringatan Dini Tsunami di Agam Dicuri - *Two tsunami Earling Warning batteries are stolen in Agam*	Published 14/03/2019	2 Early Warning Systems battery units have been stolen in Agam Regency, West Sumatra.
		CNN Indonesia	30 Pendeteksi Tsunami di Gunung Kidul, Hanya 3 yang Berfungsi – *30 Tsunami warning systems in Kidul district, only 3 work*	Published 24/02/2020	Only 3 out of 30 tsunami Early Warning Systems are functioning in Yogyakarta. 2 are missing, and 25 are damaged and have not been repaired.
		RMOLJATENG	Banjir Rob Semarang, Early Warning System dan Penurunan Tanah – *Semarang Rob Flood, Early Warning System and Land Subsidence*	26/05/2022	4 factors that impact tidal floods in Semarang: 1. No optimal early warning system 2. Quality construction embankment 3. land subsidence 4. High tide sea water
		TVONENEWS	Atasi Banjir Rob, Pemkot Semarang dan Pelindo Regional 3 akan Buat Tanggul Laut – *Overcoming rob floods – Semarang City Government and Pelindo Regional 3 will create sea embankments*	30/05/2022	To overcome tidal flooding, Semarang City will create a sea embankment or sea belt.

Appendix E: Semi structured interview guide residents

Interview questions field trip Semarang

English - *Indonesian*

Interview guide **Semi-structured interviews** Residents Semarang	Setting up interview: - Thank for participation – contribution is essential for research - Introduce myself and purpose of study - Upset + timing interview (themes – duration around 5-10 min) - Privacy: shared information anonymized by pseudonyms personal details stay confidential - Consent and confidentially: each interviewee must give their informed consent. Level of confidentiality of the interview: Completely anomized data can be shared with other researchers/published in scientific journal YES/NO - Permission to use photos - Record: okay? *Keep in mind:* *RQ: What can Rotterdam learn about flood resilience from Semarang?* *1. What are the main issues by flood resilience in cities?* *2. Who are critical stakeholders in flood resilience on city level?* *3. What are critical elements in flood resilience on city level?* *4. What is the role of citizens in flood resilience in the Netherlands and Indonesia?*
Question 1	What is your experience with flooding? *Bagaimana pengalaman dgn banjir?*
Question 2	What activities are carried out during a flood? - evacuation - emergency actions - plans *Apa saja ug dilakvkan saat banjir?* *- Evakuasi* *- emergency actions* *- plans*
Question 3	What support does the neighborhood get from the government? - financial - service - recovery - infrastructure *Dapat support dari pemerintah apa saja* *- financial* *- service* *- recovery* *- infrastructures*
Question 4	What are you going to do after the flood? & Who is taking care of the recovery of the area?

	Apa yg mau kamu lakukan saat setelah banjir & siapa yg merocevery?
Question 5	Is there any support group? - preparation - emergency - recovery *Kelompok ada mgga?* *- Preparation* *- Emergency* *- Recovery*