THE INCENTIVES FOR DEVELOPERS TO ADAPT FLOOD-PRONE URBAN WATERFRONTS TO THE CHANGING CLIMATE

IN GOTHENBURG AND DORDRECHT
P2 RESEARCH PROPOSAL

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15th of June 2015, Delft

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(Cover illustration; own photo center Gothenburg, 12 September 2014)

Developments in flood prone urban waterfronts
ABSTRACT

The population in cities is increasing rapidly and in 2050 eighty-two percent of the European population is expected to live in cities and an increased amount of CO2 is changing the climate. Rising temperatures are causing the polar ice to melt, which is accelerating the sea-level rise, compounded with intense storms and increasing precipitation low-lying coastal areas are becoming vulnerable to flooding. The economic benefits of coastal cities are attracting business and households to invest here, which leads to the transformation of old harbors and industries into public spaces with multiple uses; commercial activities, housing, tourism and recreation to house the growing population.

To reduce the climate-related risks in urban waterfronts, involved actors are forced to mitigate and adapt the developments. Mitigation aims at avoiding the changing climate and adaptation aims at coping and managing the impacts of climate change. The hazardous impacts of the climate change can no longer be denied and therefore urban waterfronst have to adapt to the changing climate. An important actor in the development and adaptation processes is the private property developer, who buys, develops and sells urban waterfront properties.

In this research the incentives for developers to adapt urban waterfronts in flood prone areas in Gothenburg and Dordrecht will be studied. Two urban waterfront developments, Frihamnen and Stadswerven are selected for a comparative case study. Frihamnen, in Gothenburg is currently experiencing issues with the rising sea level and the waterfront developments in Stadswerven, in Dordrecht are facing the same challenges but they have the experiences from the old Dutch water management to learn from. Through an analysis of the urban context, market conditions, the demands and requirements of institutions and preferences of owners, insights on the incentives and actions of developers to adapt urban waterfronts will be gained. Recommendations for further developments in the waterfronts will be given, in accordance with the obtained insights and learned lessons.

Flooding, Waterfront developments, Private property developers, Adaptation & Comparative case study.
### ABSTRACT

5

### TABLE OF CONTENT

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>5</td>
</tr>
<tr>
<td>TABLE OF CONTENT</td>
<td>7</td>
</tr>
<tr>
<td><strong>1. INTRODUCTION</strong></td>
<td>9</td>
</tr>
<tr>
<td>1.1 Background</td>
<td>9</td>
</tr>
<tr>
<td>1.2 Problem definition</td>
<td>12</td>
</tr>
<tr>
<td>1.3 Research goal</td>
<td>15</td>
</tr>
<tr>
<td>1.4 Case studies</td>
<td>16</td>
</tr>
<tr>
<td><strong>2. RESEARCH DESIGN AND METHODOLOGY</strong></td>
<td>19</td>
</tr>
<tr>
<td>2.1 Research objectives</td>
<td>19</td>
</tr>
<tr>
<td>2.2 Research questions</td>
<td>21</td>
</tr>
<tr>
<td>2.3 Research strategy and design</td>
<td>25</td>
</tr>
<tr>
<td>2.4 Research method</td>
<td>25</td>
</tr>
<tr>
<td>2.5 Case study</td>
<td>26</td>
</tr>
<tr>
<td>2.6 Research planning</td>
<td>28</td>
</tr>
<tr>
<td>2.7 Validity and generalizability</td>
<td>29</td>
</tr>
<tr>
<td>2.8 Key definitions</td>
<td>30</td>
</tr>
<tr>
<td><strong>3. THEORETICAL FRAMEWORK</strong></td>
<td>33</td>
</tr>
<tr>
<td>3.1 Urban planning</td>
<td>33</td>
</tr>
<tr>
<td>3.2 Institutions</td>
<td>39</td>
</tr>
<tr>
<td>3.3 Adaptation</td>
<td>42</td>
</tr>
<tr>
<td>3.4 Resilience</td>
<td>50</td>
</tr>
<tr>
<td>3.5 Private sector</td>
<td>54</td>
</tr>
<tr>
<td><strong>4. CASE STUDIES</strong></td>
<td>57</td>
</tr>
<tr>
<td>4.1 Europe</td>
<td>57</td>
</tr>
<tr>
<td>4.2 Sweden</td>
<td>58</td>
</tr>
<tr>
<td>4.3 Gothenburg</td>
<td>62</td>
</tr>
<tr>
<td>4.4 The Netherlands</td>
<td>65</td>
</tr>
<tr>
<td>4.5 Dordrecht</td>
<td>69</td>
</tr>
<tr>
<td><strong>REFERENCES</strong></td>
<td>73</td>
</tr>
<tr>
<td>APPENDIX 1 Personal motivation</td>
<td>79</td>
</tr>
<tr>
<td>APPENDIX 2 Case selection in the Netherlands</td>
<td>80</td>
</tr>
<tr>
<td>APPENDIX 3 Interviews and inputs</td>
<td>81</td>
</tr>
<tr>
<td>APPENDIX 4 Content final report</td>
<td>83</td>
</tr>
<tr>
<td>APPENDIX 5 Connection topics theoretical framework</td>
<td>85</td>
</tr>
<tr>
<td>APPENDIX 6 Flooding news</td>
<td>86</td>
</tr>
<tr>
<td>APPENDIX 7 Neighborhoods in älvstaden</td>
<td>87</td>
</tr>
</tbody>
</table>
Developments in flood prone urban waterfronts

(Image: Wchuckster, 2012)
1. INTRODUCTION

This report is the research proposal and the first part of the research. The problem, research questions, design and methodology are supported by the findings in the theoretical framework. The objectives and actions stated in this proposal, will ensure that the second part of the research can successfully be conducted. This chapter will start with a short overview of global and European trends on urbanization and climate change. Followed by the situation in Gothenburg, regarding the expansion of the city on low-lying waterfronts and the related challenges. The Netherlands with its experience in water management and the situation in Dordrecht will be introduced for the comparative case study.

1.1 BACKGROUND

Urbanization

Fifty years ago 2.5 billion people lived on earth, nowadays the population has reached the 7 billion and in 2100 it is expected to reach the 10.8 billion (United Nations, 2012). The growth of the population is a fact and the impacts of this growth are becoming more and more visible. Cities are growing as well as the amount of cities, which is a so-called double urbanization (Nijkamp & Kourtit, 2013). Urbanization is stimulated by the benefits cities have of being the drivers of an accelerated economic growth (World Bank, 2009). Due to the economies of agglomeration, the productivity level of cities is high and this is important for the position of cities in a globalized world. Cities can be seen as a cradle of new and innovative industries, which makes them an attractive place to live (Kourtit, 2013).

Already in 2050, sixty-six percent of world’s population is expected to live in urban areas and in Europe this growth is expected to be even higher, with eighty-two percent of the European population living in urban areas (United Nations, 2012 & Djordjević, 2011). The growth of the urban population will mainly occur in coastal areas. According to Habitat, seventy-four percent of the urban population will live in coastal areas in 2025, compared to sixty-five percent in 2000 (Habitat, 2011).

Climate change

Meanwhile an increased amount of CO2 in the atmosphere is changing the climate. The rising temperatures are causing the polar ice to melt, which is accelerating the sea-level rise (Habitat, 2011). According to the Intergovernmental Panel on Climate Change (IPCC), the global sea level is expected to rise with 0.6 meter by 2100 (Parry et al., 2007). In extreme cases, there are estimations that the sea level could rise to 2.0 meters in 2100, dependent on the amount of Glacier ice that is melting (Pfeffer, 2008). The sea-level rise is threatening low-lying coastal cities, with inundation and flooding as well as polluted drinking water supplies due to saltwater intrusion and a reduction of livable land areas.
Compounded with more and intense storms such as hurricanes, cyclones and rainstorms, low-lying coastal areas are becoming vulnerable for flooding (Habitat, 2011). When almost a quarter of mankind is living in these low-lying coastal areas and is going to increase due to the urbanization, new challenges for the development of these urban waterfronts will emerge (Rahman & Rahman, 2014).

**Urban waterfronts**

The desire to live near water can be traced back to mankind’s earliest settlements, which gradually developed into fishing villages and then into the port of a city. Nowadays, these urban waterfronts are being transformed into public spaces with multiple uses; commercial activities, housing, tourism and recreation (Huang & Kao, 2014). The transformation of urban waterfronts, to expand port- and/or coastal cities is encouraged by the desire of people to live near the water and the demand for space to house the growing population. The transformation of old harbors entails opportunities and challenges, due to the cultural (historic and symbolic), ecological and economic values these areas posses. These complexities lead to multiple ends and means for the transformation of waterfronts. According to Frantzeskaki, waterfront transformations have to deal with institutional complexity such as conflicting regulations, non-existing planning laws, required planning and land-use policy changes, environmental restoration complexities and conflicting visions of the restored area between local authorities, citizen and businesses (Frantzeskaki, et al., 2014, p. 406).

Figure 2: Global trends and climate changes (own ill.).

So the transformation of urban waterfronts is a complex process and with the changing climate, these areas are becoming more vulnerable to flooding, which makes the process and the development of the urban waterfronts even more complex. To reduce the climate related risks, cities and especially urban waterfronts are forced to mitigate and adapt. The aim of mitigation is to reduce climate change and the aim of adaptation is to cope with the impacts from climate change. In other words; mitigation aims at avoiding the impacts and adaptation aims at managing them (Andersson-Sköld et al, 2015).
Mitigation and adaptation

Mitigation has already been implemented on international, national, regional and local levels, which includes technical and infrastructural investments, renewable energy and improved energy efficiency. But it is difficult to predict how these implementations will affect the climate and reduce its negative impacts (Laukkonen, et al., 2009). Therefore adaptation is needed and the aim of adaptation is to reduce the vulnerability of an area by minimizing direct and indirect impacts of the climate (O’Brien, 2012). Adaptations are long-term strategies, which focus on managing a problem that is not yet occurred, for example managing rising sea levels and increased precipitation in water fronts that may lead to flooding. Adaptation is often implemented on a local level while mitigation is more visible on a global or national level, with the implementation of regulations by authorities such as the global GHG emissions regulations (Laukkonen, et al., 2009).

Mitigation and adaptation activities are central to urban resilience strategies. Resilience means the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of the hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions (UNISDR, 2012, p. 92). Resilient cities are cities that can withstand a variety of shocks and stresses (Leichenko, 2011). On a building level, resilient buildings cost in average less to restore after a flood and it takes less time to restore the building (Lamond & Proverbs, 2009).

According to Rojas et al. (2011) private and public actors invest more in mitigation than in adaptation, it differs by a ratio of 20:1. But if no investments in adaptation are made, the cost caused by flood events in Europe will increase to € 98 billion per year, compared to € 52 billion in losses between 1998 and 2009. Also the amount of affected people will increase, from an average of 300.000 per year in 1998 to 2009, to 360.000 per year in the future (Rojas, et al., 2013). Where extreme weather events become more intense and/or more frequent, the economic and social costs of those events will increase (IPCC, 2014a, p. 383).
1.2 PROBLEM DEFINITION

The trends of urbanization, climate change and transformation of urban waterfronts are globally visible. There are many coastal and port cities that face these challenges and can be studied, but my interest in this topic arose when I was in Gothenburg and did a short research on how stakeholders are affected and how they can influence the impacts of the rising sea level and extreme rain events. During this research I observed that the threats of water in urban planning is a relatively new topic and a challenge for Gothenburg and Sweden. Therefore the developments in the urban waterfronts in Gothenburg are my starting point (personal motivation can be found in appendix 1).

Sweden

Gothenburg is confronted with extreme weather events, like increasing precipitation and rising sea levels. In 2011, Gothenburg flooded due to the high sea level and large amount of rain; the water level was 146 cm above mean sea level and 52 mm of rain fell in 48 hours (Sörensen & Rana, 2013). Like many European cities, the urban population is increasing. To house this growing population in Gothenburg, areas along the river; Göta älv are transformed into public spaces with multiple uses. Between 1990 and 2012 two areas; Eriksberg and Lindholmen were transformed into areas with commercial activities, housing and a campus for the university of Chalmers.

Frihamnen is the next area that will be transformed, it will house 1000 dwellings in 2021 and 9000 dwellings in 2040 (Göteborgs Stad Stadsbyggnadskontoret, 2014). Meanwhile the sea level is expected to rise 0,74 meter in 2100 and in extreme cases it could rise to 2,36 meter due to intense westerly or southwesterly winds in the coastal area of Gothenburg (Rullander, 2014). This is making Frihamnen very vulnerable to flooding, as it is located between 1.1 meter and 2.6 meter above the normal sea level (Sepehr, 2010). To ensure that Frihamnen will be able to withstand the rising sea level and increased precipitation, mitigation and adaptation strategies have to be implemented. As already mentioned, mitigation strategies are more visible on an international and national level and aim at avoiding the impacts of a changing climate. In Frihamnen the impacts can not be avoided anymore, therefore the impacts of the changing climate have to be managed through adaptation. The implementations of adaptation measurements are mainly local and will differ per site. Including these adaptation strategies in the urban planning is a challenge for many city authorities (Wamsler et al., 2013). Due to the relation between adaptation decisions and the demographic, cultural and economic context, it is difficult to separate climate change adaptations from social and economic events (Adger et al., 2005). Therefore adaptation strategies are linked to decisions in the public and private sector.

Public and private sector

The public sector includes the municipal actors, who makes the decisions regarding the territory on which a specific urban area development takes place. The municipality plays a role in public law (creating land-use plans, granting building permits, etc.) but it can also make use of the private law by pursuing its own land development (Franzen, et al., 2011, p. 26). On a higher level, it is the central government, that can be financially involved in an area development. Adaptation strategies are regulated by central and local governments, through land use regulations, building inspections, critical infrastructure protections and emergency planning (Vogel & Henstra, 2015).

According to Agrawala, the success of an adaptation depends heavily on the decisions made in the private sector (Agrawala, 2011). The private sector, consist of multiple participants; property developers, investors, builders, urban designers, architects, estate agents and end-users (Franzen et
al., 2011). There are already some examples of private involvement in the adaptation of public goods, but these interventions are mainly occurring in rural areas. For example in Scotland, where the ‘Sustainable Flood Management’ aims at encouraging farmers to enhance the capacity for flood storage on their private lands to reduce the public expenses of flood disasters (Tompkins, 2012).

But the involvement of private actors in climate adaptation strategies is not always that obvious, if they are not directly affected by the changing climate they will not feel the responsibility to adapt (Becker et al., 2014). According to a research by Klein and Juhola, adaptation is not the first priority of Swedish stakeholders. On a flood prone area, developments were allowed, because it would improve the local economy (Klein & Juhola, 2014). In Sweden little research has focused on the involvement of the private sector and how they adapt buildings to rising sea levels. This is a problem, because private property owners and developers have the responsibility to secure their buildings to the rising sea level (André, 2013).

**Netherlands**

The Netherlands is often referred to as the specialist in water management, but the role of the private actors in the transformation of flooding vulnerable urban waterfronts is not always that clear. It is widely known that housing associations can play an important role in the urban area development (Franzen et al., 2011), as owner of one half of the housing stock. If the housing corporations are not implementing climate adaptation measures, they can jeopardize the future value of their housing stock (Roders & Straub, 2015). Because the waterboards are responsible for the flood risk management and freshwater supplies in the Netherlands, few private actors (and public actors) are aware of the problems caused by rising sea levels and increased precipitation (Lu & Stead, 2013).

The waterfront developments in Dordrecht are selected* for the case study in the Netherlands. The urban waterfront, Stadswerven will be transformed into residential, commercial, cultural and public functions, due to its location outside the dikes it is vulnerable to flooding (Herk et al., 2011). This will be an interesting case in the Netherlands, because it is not protected by the dikes and therefore the development will face new challenges for the municipality of Dordrecht and the private property developers, who have to deal with the rising sea level in their development. Private property developers buy land, which they develop and then sell to a purchaser. For the development of the land, is private capital needed and this makes the development sensitive for economic cycles of growth and recession (Congreve, 2012). Private property developers are mainly driven by profit-making objectives, (Haque & Asami, 2014) which makes them more short term oriented. While adaptation strategies are long term oriented, with the aim of managing a problem, floods, that have not yet occurred.

*See appendix 2 for selection.
In the IPCC report is stated that; There is a minority of academic literature that provides information on the implementation of adaptation plans, in contrast with the large accumulation of literature that discusses concepts, strategies, and plans of adaptation (IPCC, 2014a, p. 877). So the problem that can be identified in the development of flooding vulnerable urban waterfronts is a lack of knowledge on how adaptation strategies can be implemented and the involvement of the private sector therein. The private property developers are a key actor in the private sector, because they are the ones who can implement the adaptation measures and ensure that the demands of the institutions and owners/users are met. But to what extent and what their incentives are for adapting the buildings in urban waterfronts is not known, while their actions are so essential for the development of a safe waterfront.
1.3 RESEARCH GOAL

The involvement of public and private actors in flood prone urban waterfronts is important. Together with institutions, are private property developers responsible for implementing adaptation measures that guarantees the safety of the current and future inhabitants. The aim of this research is to find out to what extent private property developers are aware of the risks of flooding and what their incentives are for implementing adaptation measures in order to reduce the risk of flooding.

The waterfront developments in Gothenburg and Dordrecht are in the planning and design phase, so the focus of the research will be on the extent to which private property developers are aware of the problems of the rising sea level and increased precipitation, as well as if and how they plan to adapt the buildings in urban waterfronts to the increased threats of flooding. The demands and requirements of institutions and owners/users for the area and buildings will be an important aspect in determining the incentives for private property developers towards the adaptation of urban waterfronts. In the Netherlands multiple waterfronts have already been developed were the risk for flooding was limited, thanks to the dikes, dams and other interventions that protects the Netherlands from the water. Dordrecht is an interesting case because it is located outside the dikes and without the protection from the waterboards and Rijkswaterstaat. So the aim of the study is to find out to what extent the Gothenburg and Dordrechtse municipalities and involved private property developers are aware of the risk of flooding and to what extent the involved private property developers are planning on adapting the buildings to the changing climate. By comparing these two waterfront developments lessons and insights on the perspectives and incentives for private property developers to adapt buildings to the changing climate can be gained.

The underlying goal of this research is to create a equilibrium in the waterfronts between the land and the water, where current and future inhabitants can live safely. Through adaptation, the threats of flooding can be managed, adaptation strategies are long-term strategies and the effects of an adaptation may not be visible at this point. But if no adaptations are done, the economic and social cost in case of flood events will be significant. Therefore urban waterfronts have to adapt to the changing climate and private property developers have a key role in implementing these adaptation measures and their incentives for implementing adapt measures are crucial for the success of urban waterfronts. How these goals are accomplished will be presented in chapter 2; the Research Design and Methodology. But first the two cases; Sweden and the Netherlands will be explained in the following section.
1.4 CASE STUDIES

In Sweden water is a new challenge, while the Netherlands have been living with water for centuries. The development of Frihammen is the starting point of this research and the experiences of the Dutch water management and the unique situation in Dordrecht will be the comparative case. In both cases will the involvement and incentives for private property developers to adapt the urban waterfronts to the risks and threats of flooding be examined.

Sweden

According to Granberg and Elander is Sweden ‘a pioneer in environmental governance’ (Granberg & Elander, 2007, p. 538). In 2007 Sweden publicized a report; Climate Change and Vulnerability Commission, which stimulated the development of adaptation policies and where the risks of the changing climate were identified. But as already discussed a problem with this adaptation strategies is a lack of engagement by stakeholders, who have other priorities (Klein & Juhola, 2014). In Sweden the roles are divided as following; the municipalities are responsible for implementing national climate policy targets, through physical planning. The county administrative boards are responsible for the overall coordination and supervision of local authorities and the central government act as a source of information, funding and provider of the regulatory framework. The central government is not often involved in the implementation of climate adaptation (Johansson & Mobjörk, 2009), which means that each municipality bears much of the responsibility for implementing the adaptation strategies that can manage the negative impacts of the changing climate.

The Netherlands

Climate change is an important policy issue in the Netherlands, where 60 % of the country lies below sea level and 70 % of the gross national product is earned in these flood-prone areas (Stead & Taşan-Kok, 2013, p. 213). This makes flooding a considerable threat for the Netherlands and has resulted in an old Dutch water management tradition where waterways, earthworks and water barriers have been constructed to protect the Netherlands from water disasters. Some examples are; polders, canals, dikes, dams, locks, windmills and sluices (Stead & Taşan-Kok, 2013).

The Delta program is responsible for the flood risk management and freshwater supplies in the Netherlands and their water policy aims at avoiding any disasters with an adaptive and flexible approach. Recent research from the Delta Committee, has estimated a possible regional sea level rise in the Netherlands of 1,3 m in 2100 and 4 m in 2200. The decision to build in low-lying flood prone areas is based on a cost-benefit analysis, where present and future costs are included (Verbeek et al., 2010). In 2000 a new planning strategy was developed; ‘Ruimte voor de rivier’ (Room for the River), were the emphasis is to offer the water more space. Besides this plan, a new planning strategy is developed, where the regional and local governments are developing adaptation strategies for the water (Lu & Stead, 2013).

Recent initiatives in Dordrecht include the risk of flooding in the development of existing and new urban areas, this project is called the Urban Flood Management Dordrecht. The goal of this project is to improve the flood resilience of the city, by including multiple actors from different levels; national to local and street level. To ensure that the risk of flooding is included in the spatial planning, that there is enough awareness of the flood-risk and that there are developments of practical strategies to cope with and communicate the risk (Zevenbergen, et al., 2008, p. 86). The waterfront developments in Dordrecht are interesting to study because they provide insights on Dutch water management and the incentives private property developers have for developing in flood-prone areas.
Sweden as a pioneer in environmental governance and the Netherlands as a specialist in water management are two interesting countries to compare. The similarities and differences can provide both countries with new insights on waterfront developments and the involvement of institutions and private property developers in the adaptation of flood-prone areas.

Figure 4: Gothenburg and Dordrecht (own illustration).
Developments in flood prone urban waterfronts

(Image: Quan, 2013)
2. RESEARCH DESIGN AND METHODOLOGY

The lack of knowledge on the involvement and incentives for private property developers in the development of flood prone areas was presented in the previous chapter. In this chapter the research strategies and methods will be discussed. Starting with the objectives and the conceptual model followed by the research questions, strategy and design. The planning for the upcoming months will briefly be presented and finally the validity of the chosen methods and generalization of the research will be reflected upon.

2.1 RESEARCH OBJECTIVES

Urban waterfronts are confronted with the threats of flooding, due to the changing climate. Until now the focus has mainly been on mitigation, but the negative impacts of the climate can no longer be avoided. Therefore adapting the areas to these threats is of great importance. On a global, European and national level adaptation strategies have been developed, but many countries face challenges in moving from the development of adaptation strategies and plans to implementation (IPCC, 2014a, p. 873).

For the development and implementation of an adaptation strategy, cities and urban waterfronts are dependent on the decisions and requirements made by the institutions, the actions of private property developers and the preferences of owners. Based on exploratory interviews, which can be found in appendix 3, and a literature review, a conceptual model is created. In the model four fields can be observed; the urban context and the market conditions, the institutions, the private property developers and the owners/users. These fields are connected to each other and have an influence on the actions private property developers takes. Directly linked to the actions of private property developers are the demands and requirements of institutions and preferences of owners/users. The urban context and market conditions also indirectly influence the decisions and actions of private property developers.

![Conceptual model](image)

Figure 5: Conceptual model (own ill.).

Developments in flood prone urban waterfronts
Adaptation measures are implemented on a local level, because this is where the impacts of the changing climate are observed and managed. Each urban context has its own risks and vulnerabilities, making each location diverse (Granberg & Elander, 2007). Depending on the urban context, an area can be more vulnerable for flooding, due to elements such as high building density, buildings near the water and a low ground level. The market conditions have an impact on the developments as well, when the demand for housing is high, ground prices can go up and more investments in cities and urban waterfronts can be made. In case of a low demand, developments in hazard areas will be less desirable, because of the high costs necessary to ensure that the area is safe from flooding, while few owners and investors have the money to buy the expensive land.

Institutions guide and steer the developments, and are responsible for including adaptation measures in the urban planning. How the local actors address the risk of flooding will depend on the institutional capacity in a specific local setting (Granberg & Elander, 2007). On which level this responsibility lies depends on the country, city and their regulations. Institutions; municipalities can also act as a public developer, by making use of the private law to purchase its own land for development, which is an active land policy (Franzen et al., 2011).

Private property developers are responsible for the property developments of an area and therefore they can implement the adaption measures. Before an adaptation is implemented, several steps can be identified that leads to the implementation of the adaptation measures. Starting with the awareness of the problem, before you are aware of the problem you cannot work on a solution, so are the developers aware of the risks of the rising sea level and increased precipitation. The second step is the willingness to change, just because we can adapt does not mean we will (Ford & King, 2015, p. 506), as developer you have to be willing to choose between options that include adaptations. The third step is the ability to implement an option that reduces the risk of flooding. According to the IPCC report a successful implementation of adaptation actions depends on the availability of information, access to technology and funding (IPCC, 2014a, p. 844).

The owners and users of the buildings are also important actors in the adaptation process. They are the ones how buy and live in buildings near the water and the ones who are exposed to the risks of flooding. Their demand for housing near the water ensures the development and transformation of waterfronts. If their demand change, the developers have to respond to this.

The main objective is to identify the attitude of private property developers towards the risks and threats of flooding and the incentives for the implementation of adaptation measures in low lying urban waterfrotns, in relation to the demands and requirements of institutions and owners/users in Gothenburg and Dordrecht.
2.2 RESEARCH QUESTIONS

To understand the incentives for private property developers to adapt the buildings in flood prone waterfronts in Frihamnen and Stadswerven, insights on their attitude towards the risk and threats of flooding and their involvement in the implementation of adaptation measures in Frihamnen and Stadswerven are required. This results in the following main research questions;

A. What influences the behavior of the private property developers in Gothenburg and Dordrecht to adapt urban waterfronts?
   1. What is the urban context in Frihamnen and Stadswerven?
   2. What market conditions influence the developments in Frihamnen and Stadswerven?
   3. What institutions and policies are steering the development of the urban waterfronts?
   4. How is adaptation included in the regulations and urban planning documents?
   5. How are owners and users influencing the decisions of the private property developers?
   6. Are owners and users aware of the risk of flooding?
   7. Are adapted buildings worth more? (Why or why not?)

B. To what extent are the private property developers in Gothenburg and Dordrecht implementing adaptation measures?
   1. Are the private property developers aware of the risk of flooding?
   2. Are the private property developers willing to adapt?
   3. Are the private property developers able to implement an adaptation? (Funding, information and technology)
   4. Are the private property developers implementing adaptation?
   5. Why are the private property developers taking a certain position towards adaptation?
   6. Who do the private property developers consider responsible for the adaptation?
   7. Can the adaptation measures provide the private property developers with a higher profit? (Why or why not?)

C. What can the waterfront developments in Frihamnen and Stadswerven learn from each other?
   1. What are the main incentives for the private property developers in Frihamnen to adapt the urban waterfronts?
   2. What are the main incentives for the private property developers in Stadswerven to adapt the urban waterfronts?
   3. Why may one waterfront be more successful than another in influencing the private property developers to implement adaptation measures?
   4. What can Gothenburg and Dordrecht learn from each others waterfront developments and involvement of private property developers?

Through these three parts a complete overview of the incentives for private property developers to adapt the buildings to the threats of flooding in two waterfronts is aimed to be identified. When comparing two different waterfront developments it is important to take the different urban contexts, market conditions and institutions/ policy documents into account, because these aspects have an impact on the behavior and actions of the developers.
Figure 7: Research approach (own ill.)

Developments in flood prone urban waterfronts
The research approach is illustrated in figure 7. The research started with my interest in urban waterfronts and the risks of flooding in these areas due to the changing climate. An exploratory literature review led to the problem definition and the research questions. Through further literature reviews and exploratory interviews the problem and research questions became explicit, which enabled the definition of the research design and methodology. This formed the basis for the theoretical framework and conceptual model. The framework enables a comparison between the two waterfront developments and takes the continuous desk research into account for the conclusion and recommendation.

The conceptual model is guiding for the case studies. In each waterfront development the four fields; urban context and market conditions, institutions, involved private property developers and owners/users will be examined. For each field, an appropriate research method to gain an understanding of their influences on the perspectives of developers to adapt public and private goods is selected. In figure 8, an overview of the research steps in the conceptual model is shown;

1. **Desk research** on the urban context and market conditions in Gothenburg and Dordrecht.
   a. An examination of the urban context and changes to the urban context due to the changing climate.
   b. An examination of the market conditions and growth of the city.

2. **Desk research** and interviews with the institutions in Gothenburg and Dordrecht.
   a. An examination on the governments policies and programs in Gothenburg and Dordrecht.
   b. An examination of the laws and regulations in Gothenburg and Dordrecht.
   c. An interview with the institutions and urban planners of Gothenburg and Dordrecht.

3. **Interviews** with the involved private property developers in Gothenburg and Dordrecht.
   a. An analysis of the existing documents of the involved private property developers.
   b. Examining the awareness, willingness and ability of developers to adapt public and private goods in urban waterfronts.
   c. Examining the incentives that influences developers to adapt public and private goods.
   (Requirements from the institutions / policy documents and owners/users.)
4. Survey on the preferences and demands of owners/users.
   a. Examining the awareness of owners/users for the risk of flooding.
   b. Examining the preferences and demand of owners/users when choosing a house. (What is important for them; safety, view, aesthetics etc.)

The findings from the four fields in the waterfront developments will provide insights on the incentives for the private property developers to adapt the buildings in Frihamnen and Stadswerven to the threats of flooding, this is in itself already useful information for the further development of the waterfronts. By comparing the two case studies similarities and dissimilarities can be discovered, which can provide Gothenburg and Dordrecht with lessons for future waterfront developments. In figure 9, a conceptual overview of the comparison of Frihamnen and Stadswerven is shown.

The findings include:
- The involvement of the private property developers adapting the buildings.
- The influences of the urban context and market conditions on the attitude/behavior of the private property developers.
- The influences of the institutions and owners/users on the attitude/behavior of the developers.
- The incentives for the private property developers to adapt the buildings.

Figure 9: Comparison of Frihamnen and Stadswerven (own ill.).

Important in this comparison is the why. Why is one private property developer adapting the buildings or why is one waterfront development more successful in influencing a private property developer to adapt the buildings. If the why; the incentives for private property developers, can be found, the underlying reasons of their behavior is known and this makes it possible to steer private property developers towards the implementation of adaptation measures.
2.3 RESEARCH STRATEGY AND DESIGN

The research strategy is qualitative, to be able to understand the behavior of private property developers towards the risk of flooding and their incentives for the implementation of adaptation measures. The awareness and willingness of private property developers to adapt the buildings is of importance for the research, this asks for their perception and can only be found with a qualitative research. The perceptions and requirements of institutions, owners and users is also important for the research, because their demands have an influence on the actions of the developers. Through an inductive approach, the relationship between theory and research is emphasized (Bryman, 2012).

The research design, provides the framework for the collection and analysis of the data. In this study, the research design is comparative. The aim of the research process is to understand the behavior of private property developers and the incentives in a specific social context. The choice of a comparative research design was made in order to discover similarities and/or differences in two waterfront developments and the involvement of developers in adapting the area. By comparing two waterfronts an understanding of the incentives for the private property developers and the influences of the urban context, market conditions, institutions and owners/users can be gained. This will provide useful insights for future waterfront developments and possibilities to involve private property developers in the adaptation process (Bryman, 2012).

2.4 RESEARCH METHOD

The research method is the technique for collecting data. The data will be collected through desk research, semi-structured interviews and a survey. These techniques are chosen to be able to find the incentives for private property developers to adapt the urban waterfronts. The desk research will provide overall information on the urban context, market conditions government policies/programs, laws and regulation in Gothenburg and Dordrecht. More in-depth information will be obtained through semi-structured interviews with institutions in Gothenburg and Dordrecht. Through the semi-structured interviews with the private property developers their behavior in adapting urban waterfronts can be obtained. A semi-structured interview enables the interviewer to respond to the answers of the interviewee and gain more insight in the behavior and decisions of the private property developers. The survey will be used to acquire information on the demand and preferences of the owner and users of a waterfront. A digital self-completion questionnaire will be used to collect data for the survey. The benefits of a survey are the convenience for the respondent and the large quantities of questionnaires that can be answered and spread to a large group of respondents (Bryman, 2012).
2.5 CASE STUDY

The two case studies; Frihamnen and Stadswerven were presented in chapter 1. A case study entails a detailed and intensive analysis of a single case. In a comparative research, two cases are selected for a detailed and intensive analysis. To gain a thorough understanding of the behavior of the developers in the waterfronts, documents will be studied and semi-structured interviews will be conducted in both cases.

Document analysis
The first step in the case studies, is the analysis of the existing documents on urban planning, government policies/programs, laws and regulations, the urban context and market conditions. These documents will provide the input for the semi-structured interviews and self-completion questionnaire. In chapter 4, the document analysis starts with an examination of European climate policies, policy documents and urban planning in Sweden and Gothenburg and policy documents and urban planning in the Netherlands and Dordrecht, as well as their view on mitigation and adaptation.

Semi-structured interviews
The interviews can be divided into two groups. Interviews that provide insight on the demand side; the public actors; the municipalities and the private actors side; the private property developers, which provides insight on the private property developers’ behavior and actions towards the risk of flooding and the adaptation of waterfronts. In the tables below is an overview of the selected organization for the interviews in Gothenburg and Dordrecht. The private property developers in Frihamnen were chosen in 2014 through a land allocation. These private property developers will partly be responsible for the first developments in Frihamnen and therefore they are selected for the case study in Frihamnen.

<table>
<thead>
<tr>
<th>Gothenburg · Public</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stadsbyggnadskontoret Göteborg</td>
<td>Responsible for the development of the masterplan of Gothenburg, building permits, maps and aerial photos.</td>
</tr>
<tr>
<td>älvsstranden utveckling AB</td>
<td>Responsible for the realization of the Vision plan for älvsstaden and the development of älvsstaden.</td>
</tr>
<tr>
<td>Park och naturförvaltningen Göteborg</td>
<td>Manages and develops existing and new urban parks and natural environments</td>
</tr>
<tr>
<td>Kretslopp och vatten Göteborg</td>
<td>Working on safe, efficient and environmentally sound water supply and sewage collection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developers in Frihamnen</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botrygg Göteborg AB</td>
<td>Developer of rental and ownerships dwellings.</td>
</tr>
<tr>
<td>Magnolia Bostad AB</td>
<td>Focus on the sustainability of the area and developer of rental dwellings.</td>
</tr>
<tr>
<td>Rikshem AB</td>
<td>Developer of rental dwellings near the water.</td>
</tr>
<tr>
<td>JR Kvartersfastigheter</td>
<td>Specialist in complex city developments</td>
</tr>
<tr>
<td>NCC AB</td>
<td>Focus on offices in combination with dwellings</td>
</tr>
<tr>
<td>Framtiden</td>
<td>Developer of mainly rental dwellings</td>
</tr>
</tbody>
</table>

Table 1: Overview organizations for the interviews in Gothenburg, Frihamnen.
Table 2: Overview organizations for the interviews in Dordrecht, Stadswerven.

**Self-completion questionnaire**
To gain a understanding of the requirements of the owners/users in urban waterfronts. Future residents of the waterfronts in Frihamnen and Stadswerven will be questioned through a digital self-completion questionnaire, if the future residents are unknown, residents of surrounding waterfronts will be questioned. In Gothenburg the surrounding waterfronts are Eriksberg and Lindholmen.

**Case selection**
The cases studies are selected to provide insights on the perspectives of the private property developers to adapt the buildings in urban waterfronts. As already mentioned four fields are identified and in each field actors who influence the incentives for the private property developers to adapt the buildings are selected.
2.6 RESEARCH PLANNING

The research will be conducted between January 2015 and January 2016. The study started with defining the topic, formulating research questions and a first literature review. Gothenburg was already selected in the beginning of the research as well as the Netherlands, but the selection of Dordrecht was done through a further literature study on different waterfront developments in the Netherlands. The exploratory interviews and extended literature reviews assisted with the formulation of the final research problem and goal, theoretical framework and conceptual model. To gain more insight on the case studies, the desk research has already started. This is the first part of the study.

The second part continues with the desk research on the four fields; urban context and market conditions, institutions, private property developers and owners/users. A survey to gain insight in the demands of the owners/users will be done and several interviews will be conducted with involved institutions and private property developers in Gothenburg and Dordrecht. The findings from the survey and interviews will be processed and linked back to the conceptual model. Eventually the results and answers to the research questions will be formulated and discussed, which completes the research. The content of the final report is presented in appendix 4.
2.7 VALIDITY AND GENERALIZABILITY

When collecting the data, through documents, interviews and self-completion questionnaires several biases may occur which influences the validity and generalizability of the research.

Data collection
It is tempting to assume that documents reveal the reality of a topic, but when analyzing the data, the writers motivation to write the article has to be taken into account. A document may show one perspective, making the reality of the document biased. Therefore multiple sources will be examined to ensure that the data provides the whole reality. A second bias can emerge when analyzing the documents, as reader you may interpret documents in a certain manner, which is not from the perspective of the author (Bryman, 2012). In the collection of data through semi-structured interviews biases can also occur. As interviewer you may steer the interviewee with their answers, to prevent this, the same questions need to be ask to all the interviewees, preferably all the interviews will be done in English to ensure the comparability of the findings in Sweden and the Netherlands. The most challenging aspect of the semi-structured interviews with private property developers, may be their unwillingness to share information, because they are driven by profit-making objectives. When analyzing the collected data uncertainties regarding the data may occur, by recording the interviews uncertainties can be checked and confirmed.

With self-completion questionnaires the biases caused by the interviewer will be eliminated, because there is no interviewer. In addition to avoid biases from the English language, the questions will be asked in the native language, Swedish and Dutch. The absence of the interviewer to help the respondent if they have difficulties with a question, can lead to incorrect answers or unfinished questionnaires, in order to eliminate this risk the questions have to be clear and unambiguous. The absence of the interviewer also makes it impossible to ask a follow-up question which can provide further insights. Other disadvantages of self-completion questionnaires are the risks of a low response rate, missing relevant data and difficulties for certain respondents to answer. These risks have to be taken into account when analyzing the data from the self-completion questionnaires (Bryman, 2012).

Validity
The validity concerns the integrity of the conclusion that is generated from a piece of research. A distinction is made between external and internal. The internal validity concerns the question whether a finding that incorporates a casual relationship between two or more variables is reliable (Bryman, 2012, p. 711). In this research a relationship between the demands of institutions, owner/users and the urban context and market conditions with the attitude of the developers towards adapting urban waterfronts is aimed to be found. But the relationship between these variables may not be reliable.

Generalizability
Generalizability concerns the external validity of the research findings. The external validity concerns the questions of whether the results of a study can be generalized beyond the specific research context in which it was conducted (Bryman, 2012, p. 711). It may not be possible to compare the findings from the two waterfronts, because the results are dependent on the specific research context; urban context, market conditions and institutions. Generalizing the results from the two waterfronts with other waterfronts can also be a problem if the findings are only applicable to the waterfronts in Gothenburg and Dordrecht.
2.8 KEY DEFINITIONS

Many of the definitions are quoted from the IPCC report 2014, since their input has been supportive for the theoretical framework.

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Are defined as a general plan of action for addressing the impacts of climate change, including climate variability and extremes (IPCC, 2014b, p. 1758).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive capacity</td>
<td>Is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (Parry et al., 2007, p. 21)</td>
</tr>
<tr>
<td>Disasters</td>
<td>Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2014b, p. 1763).</td>
</tr>
<tr>
<td>Climate change</td>
<td>Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2014b, p. 1760).</td>
</tr>
<tr>
<td>Developers</td>
<td>Developers buy the land and carries out most or all of the building work before a contract is signed with the purchaser (Congreve, 2012, p. 408).</td>
</tr>
<tr>
<td>Governance</td>
<td>The governance activity involves participants in discussing and defining their ambitions to create socially construed knowledge and highlight the ambitions and roles of the stakeholders regarding the development project and policy in general (Van Herk et al., 2011, p. 548).</td>
</tr>
<tr>
<td>Institutions</td>
<td>Institutions are rules and norms held in common by social actors that guide, constrain, and shape human interaction. Institutions can be formal, such as laws and policies, or informal, such as norms and conventions. Organizations—such as parliaments, regulatory agencies, private firms, and community bodies—develop and act in response to institutional frameworks and the incentives they frame. Institutions can guide, constrain, and shape human interaction through direct control, through incentives, and through processes of socialization (IPCC, 2014b, p. 1769).</td>
</tr>
<tr>
<td>Mitigation climate change</td>
<td>A human intervention to reduce the sources or enhance the sinks of greenhouse gases. (IPCC, 2014b, p. 1763).</td>
</tr>
<tr>
<td>Mitigation of disaster risk</td>
<td>The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability (IPCC, 2014b, p. 1769).</td>
</tr>
<tr>
<td>Private sector</td>
<td>The private sector consist of multiple participants; private project developers, investors, builders, urban designers, architects, estate agents and end-users (Franzen et al., 2011).</td>
</tr>
<tr>
<td>Public good</td>
<td>A good that is both non-excludable and non-rivalrous in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others (IPCC, 2014b, p. 1771).</td>
</tr>
<tr>
<td>Public sector</td>
<td>The public sector consists of governments on a national, regional and local level (Franzen et al., 2011).</td>
</tr>
<tr>
<td>Policy makers</td>
<td>The policy makers, are the ones making the policy documents in governments (IPCC, 2014b)</td>
</tr>
<tr>
<td>Resilience</td>
<td>The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014b, p. 1772).</td>
</tr>
</tbody>
</table>
Risk

The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts (IPCC, 2014b, p. 1772).

Sea level change

Sea level can change, both globally and locally due to (1) changes in the shape of the ocean basins, (2) a change in ocean volume as a result of a change in the mass of water in the ocean, and (3) changes in ocean volume as a result of changes in ocean water density (IPCC, 2014b, p. 1772).

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987, p. 43).

Vulnerability

Is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate vulnerability and extremes (Parry et al., 2007, p. 21).

Urban waterfront

By urban waterfront is meant the water’s edge in cities and towns of all sizes. The water may be a river, lake, ocean, bay, creek or canal (Sairinen, 2006, p. 121).
Developments in flood prone urban waterfronts

(Image: Deltawerken, 2004)
3. THEORETICAL FRAMEWORK

In this chapter the gained findings from the literature review will be presented. The topics can be divided into five categories; urban planning, institutions, adaptation, resilience and the private sector. The connections between the topics is shown in Appendix 5. These topics support the conceptual model and the gained knowledge is essential for the research.

3.1 URBAN PLANNING

Cities can be seen as complex systems, with multiple components. On a high level these components can be divided into two spheres; the physical and the social. The physical component consists of physical resources and processes. The social component consists of people, institutions and activities (Dezouza & Flanery, 2013). The economical benefits in cities, encourages business and people to move to cities and to be able to house this growth old harbors and industry areas are transformed into urban waterfronts with multiple uses; commercial activities, housing, tourism and recreation (Huang & Kao, 2014). Through the urbanization is the amount of intact ecologically land reduced, as well as changed (IPCC, 2014a).

Urban fabric

The physical features, the urban fabric, is connected to the urban ecosystem which is characterized by precipitation, wind, temperature, air quality, humidity, radiation, soil, water bodies, flora, fauna, noise, waste and waste water. Secondly it is connected to the urban society and culture, regarding the social cohesion, social inequality, public participation, values and the diversity of people. Finally it is connected to the urban economy and urban governance, which have features of agriculture vs. non-agricultural incomes; subsistence vs. money economy; urban livelihood practices; resource availability; public expectations; and public reliance on institutions and social security systems (Wamsler et al., 2013, p. 71). To be able to understand the urban disasters, the physical features, have to be linked to the risk factors.
First the urban fabric influences the characteristics and the occurrence of hazards. The urban fabric of cities can influence the urban climate, with for example urban flash flood. As well as creating new hazards, like landslides and high emissions, which indirectly creates new hazards like a rising sea level and increased precipitation. To be able to house the growing population in cities, the urban fabric is expanding into hazard prone areas, for example the expansion into flood prone waterfronts. Secondly the vulnerability is location specific, which can be enhanced by the urban fabric. In cities people, buildings, services, infrastructure, economic and political centers are concentrated, which makes cities more vulnerable for the influences of hazards. The urban fabric can also destroy the existing natural hazard protection, like flood walls and floodplains. Finally the urban fabric can also have a negative impact on the response and recovery mechanisms of a city, due to the the many people in a city how needs help, lack of space to shelter the affected people and difficulties to access and transport the affected people in a densely built environment. So the disasters in cities are connected to the urban fabric which also has an impact on the risks (Wamsler et al., 2013).

Waterfronts transformation
Old economic centers near water ways and harbors are growing due to several economical reasons. First companies can benefit from clustering their production and business, due to efficiency in the production process. Second, economic developed areas have high employment opportunities which attracts households. Third, coastal zones provide households with environmental facilities, which they value; like the view of the sea and the activities in, on and near the water. So the economic benefits of coastal cities are promoting the growth of flood-prone areas. People who are not aware of the risks of flooding are encouraging the growth of flood-prone areas; urban waterfronts (Filatova et al., 2011). Urbanization itself can be understood as consequence of a number of socio-economic drivers that attract people to settle in high-risk urban areas (Fünfgeld, 2010, p. 157).

In the Netherlands the government is responsible for minimizing the risk of flooding, the flood protections are financed through taxes, which the whole society pays for, making the whole society responsible for the flood protection. The Dutch policy makers determines the safety standards, which are related to the probabilities of flooding based on the guidelines from the DeltaCommissie. The number of people living and the economic value in an area influences the safety standards, putting the government under pressure to minimize the probability of flooding in these areas. Due to the reduced risk of flooding, more people and businesses are attracted to settle and invest here (Filatova et al., 2011).

The economic clusters in Dutch coastal zone is attracting business and households to seek jobs here, which then pushes the governments to increase the safety even more. This is a self-reinforcing cycle, that has a negative effect on the flood risk: the safer it becomes to live somewhere, the more economic agents would like to live and work there, the higher the total flood risk becomes and the more the state should invest to increase overall safety standards (Filatova et al., 2011 p. 165).

The individuals moving and investing in coastal zone are not personally bearing the risks of flooding, it is the Dutch government who has the collective responsibility to reduce the risk of flooding. A problem with this system is when the cost-benefit analysis turns out to be negative, so the costs for technical protections measures are higher than the benefits of avoiding the risk, at this point the government may not be willing to invest in the protection measures anymore. The spatial patterns are controlled by the spatial planning, governed by the government, but the housing prices are the outcomes of market allocation and competitive uses of the land, where the choices of individuals play a main role.
So coastal zones are expanding on waterfronts, which are close to the most economically developed areas and have the coastal amenities. But these areas are vulnerable for flooding, however few citizens are aware of these risks. In the Netherlands where half of the area is below sea level, citizens have very low coastal flood risk awareness and hardly carry out any preparedness measures (Filatova et al., 2011 p. 167).

**Flooding**

The rising sea level, combined with more and intense storms and an increased amount of precipitation can lead to coastal and river floods, which effects the population, properties, vegetation and ecosystems in low-lying waterfronts (IPCC, 2014a).

Depending on the geographic location different types of floods can be occur.

- **Coastal flood;** storm surges are generated due to a low air pressure and tropical storms can push the ocean water onto land. The sea waves are also reasons for coastal flooding, extreme waves like tsunami’s, can be created by a earthquake or volcanoes in the oceans. The ocean water level is dropping and rising with the tide, which can affect coastal houses and facilities when there is a high tide.
- **River flood;** most flooding occur along a river, when the season changes; in the spring is the winter snow melting causing the rivers to overflow, due to the quick fill of river basins and slower run-off. For miles the river can extend onto the land.
- **Flash flood;** in areas with steep slopes, collected rain water flows downhill too quickly causing the water level in river beds to raise.
- **Urban flood;** in cities where most of the ground is paved, rainfall will not be absorbed in to the ground resulting in a water run-off on the streets. The main reason of urban flooding is a lack of drainage in cities, which can affect more people and properties due to the high building density in cities (Irannezhad, 2009).

**Effects of flooding**

Flooding can cause primary, secondary and tertiary effects:

- **Primary hazards are directly connected to a flood event;** humans can die, large objects (rocks, cars, houses) can be damaged or moved, the water can affect the erosion amount of soil, which destabilizes bridges and building foundations, human built structures like furnitures can be damaged by the water, crops, livestocks, pets can be damaged or die and floods can carry garbages, debris and toxic pollutions, which can cause secondary effects.
- **Secondary effects are occurring due to the primary effects;** the drinking water can get polluted which can cause diseases and health hazards, power plants and gas stations can be damaged and the transportation system can be disrupted.
- **Tertiary effects, are long term effects;** rivers can be changes, new channels can be developed, agriculture productivity can be affected, jobs can be lost and some jobs can be created, insurance rates can be increased and wildlife and habitats can be destroyed (Nelson, 2007).

**Urban and spatial planning**

The urban planning can manage the growing demand for land, ensuring a sustainable and equal land development and take the increasing scarcity of livable land into account for future developments. The urban planning can also play an important role in reducing extreme flood events, by including adaptation plans in the urban planning cities can be created, which continues to exist with the changing climate and are able to withstand extreme weather events without jeopardizing the safety of its inhabitants (Hurlimann et al., 2014 & Djordjevic et al., 2011).
The changing climate will influence the future spatial patterns, the growth and the developments taking place in cities (Djordjevic et al., 2011). This requires the spatial planning to take the changing climate into account and add the adaptation plans to the spatial planning (Wamsler et al., 2013). But this remains difficult, because of the multiple challenges spatial planners are facing, like context-dependent environmental and socio-economic challenges, which requires scientific and political attention. Especially in developing countries there are challenges which have a higher priority in the short-term, like poverty, hunger and the availability of drink water resources. However, the extreme weather events, caused by the changing climate call for new and innovative frameworks where both mitigation and adaptations measures are included. The spatial planning could provide this framework, to ensure that mitigation and adaptation measures are implemented at a local and regional level (Biesbroek et al., 2009).

Each region is unique and characterized by a combination of socio-economic and bio-geophysical processes, making it impossible to develop one spatial planning approach which can be used in all areas. The trade-offs between mitigation and adaptation, should also be taken into account when developing the spatial plan (Biesbroek et al., 2009). Certain interventions can be aimed at mitigation; avoiding the negative impacts of the changing climate, while these interventions are making the implementation of adaptation strategies, that manages the impacts of the changing climate difficult (examples will be further explained in chapter 3.3).

**Land-use plan and environmental permit**

The land-use plan is part of Article 3.1 of the Spatial Planning Act and requires each municipality in the Netherlands to have a land-use plan for the land. In the land-use plan are certain development parameters determined; the building density, the maximum height of the buildings and the type of land use (housing or retail). The environmental permit is connected to the land-use plan; the environmental permit will be refused if the proposed developments are in conflict with the land-use plan. Through the land-use plan can the municipality’s ideas and demands on the urban area development be strengthen (Franzen et al., 2011). The environmental permit can be seen as the link between the planning and construction phase, the permit ensures that the building plans agree with the Building Decree, that the planned building work is corresponding with the municipal building regulations and municipal land-use plan (Franzen et al., 2011).

**Planning policies**

Urban policy makers are realizing that a mix of short-term actions are needed to support the long-term strategies of mitigation and adaptation. These strategies have to be mainstreamed into existing policies, to ensure a more efficient and effective use of financial and human resources, instead of formulating these strategies as separate climate policies. The increased mass media attention for the changing climate has influenced the perception of the society and ensured that mitigation and adaptation is placed higher on the political agenda (Biesbroek et al., 2009).

The effectiveness of mitigation strategies can be monitored easier than for adaptation strategies. Through measuring the GHG emission in a country, this can be compared to the targets of the Kyoto Protocol, to determine the effectiveness of the policies. But for adaptation it is more complex to measure the success rate of an adaptive measure, because there are no predefined targets or quantified objectives. Insights in the costs and benefits of an adaptation are lacking, which is making it difficult for institutions to determine who is responsible for the adaptive measures. The different policy approaches of mitigation and adaptation can also have an influence on the effectiveness of a
strategy. The top-down approach of mitigation strategies are assumed to be easier to implement, than the bottom-up approaches of adaptive strategies, due to the fact that bottom-up approaches involves multiple stakeholders from a local context with conflicting interests and opinions on the implementation of adaptive strategies (Biesbroek et al., 2009).

**Private property developers**

Private property developers buy land, carry out most or all of the building work and then sell the building to a purchaser. For the development of these houses, private capital is needed, which makes this industry vulnerable for economic cycles of growth and recession. The phases of a new development consists of; the selection of a location and the purchasing of the land. The choice for a certain land will be influenced by the zoning requirements and the planning context of that area. The second phase includes the initial design and formal approvals form the land-use planning process and building regulations. The building regulations are related to the construction of the building and the land-use plan takes the broader issues into account. When the approval for the design has been gained, the construction phases starts. After the construction the building is sold to a purchaser, who takes over the responsibility of the building. The fact that the private property developers are not the end owner of the building and are driven by profit-making objectives, they will be less interested in investing in buildings with low maintenance costs and adaptation measures. However, if the developer would receive a higher price for a building that costs less to operate and maintain and is adapted to the changing climate, it would become interesting for a developer to invest in solutions that reduces the operation and maintenance costs and adaptation measures (Congreve, 2012 & Haque & Asami, 2014).

![Figure 13: Development phases of developers (own ill.)](image)

‘Developers determine the size, density, timing and spatial distribution of development. Thus they are the most important agent in the development process, involved in financing, planning, building and shaping the urban environment’ (Maruani & Amit-Cohen, 2011, p. 887). Planning institutions have the power to approve or disapprove plans, but as stated above, the developers are the ones shaping the urban environments. This ensures that developers have an important role in implementing adaptation actions in the built environment.

**Public developers**

Planning institutions can besides approving and disapproving plans, also be actively involved in the land development. In the Netherlands it is common that the municipality develops the land and set up development companies. Municipalities can also participate as a partner (public private partnerships) in the development, or have a managing role in the urban area development (Franzen et al., 2011). In this case the municipalities take the responsibility to prepare the land before the development and part of the preparation can be securing the land against flooding. On a higher level, central governments, can be involved in the urban area development, through policy principles and financing (Franzen et al., 2011).
Forms of housing developments
A distinction can be made between four forms of housing developments in developed countries:
- Direct government housing providers; municipalities or the federal level.
- Limited-profit housing providers; cooperatives and social housing associations.
- Commercial housing providers, who are focusing on large rental housing estates and condominiums or on single-family houses.

The limited-profit housing providers differ in countries and the development can depend on public funding or on private financing. In the Netherlands the limited-profit housing is owned and managed by housing associations. They act on a commercial basis, but the profit they make has to be reinvested in the housing. They are independent from the government, but they have two safety bodies where they have to answer to; the Guarantee Fund for Social Housing and the Central Housing Fund. In Sweden the municipalities are responsible for providing adequate housing, which is often an independent nonprofit housing company within the municipalities. The municipal housing companies combine commercial aims with social responsibilities, and may only engage in a business activity if it is conducted with providing municipal amenities or services for the residents of the municipality (Amann & Mundt, 2012, p. 418). The differences of the provision of adequate housing for target groups in the Netherlands and Sweden makes it difficult to compare this form of housing owners; housing associations and municipal housing companies. Therefore the commercial developers/private property developers are selected for this research.

Open green spaces
Around 67% of the land in cities is made of hard surfaces and only 16% are green areas. Green areas / infrastructures have multiple benefits for the residents' health and wellbeing, as well as it holds solutions for the climate changes, more green space can reduce the storm water run-off in cities (Matthews et al., 2015). So open spaces can provide both aesthetic and recreation benefits for residents while minimizing the impact of development on the local ecosystem and surface water quality (Bowman & Thompson, 2009 p. 97). According to Bowman and Thompson, consumers are willing to pay a premium for the open space and houses with more open spaces can lead to higher prices on the market (Bowman & Thompson, 2009). But there are some challenges when implementing green infrastructures; it is difficult to determine who should bear the financial responsibility when it is a public good (in chapter 3 the investments in public and private goods will be further explained).
3.2 INSTITUTIONS

Institutions have the ability to mobilize leadership and resources, to develop legal and regulatory frameworks for adaptation and to plan for long-term horizons. They can provide the political and administrative structure that can either enable or restrict adaptation (Ford & King, 2015, p. 510).

Institutions

The city governments can be enabled, bounded and constrained by national, subnational or supranational laws, policies and fundings for their implementation of adaptation measures (IPCC, 2014a). But city governments also look to the central governments to set the adaptation agenda, to clarify legal liability, and to avoid committing responsibility and resources to managing risks that can be addressed more efficiently at provincial or national level (Fünfgeld, 2010, p.158). So, institutions can provide guiding, incentives or constraints for the distribution of climate risk, promote adaptation through incentive structures, foster the adaptive capacity in a development and establish protocols for making and acting upon decisions (IPCC, 2014a).

Institutional measures for adaptation

There are three main measures for institutions to stimulate adaptation and improve the safety in hazard-prone areas; firstly through economic instruments such as taxes, subsidies and insurance arrangements. Secondly by means of laws, regulations and planning measures, by protecting hazard prone areas, building codes and re-zoning climate vulnerable areas. Finally government policies and programs can be developed to stimulate adaptation (IPCC, 2014a).

National and local level

National governments have an important role in integrating adaptations into climate policies across government scales and to steer the long-term horizons of adaptations. But these long-term horizons of adaptation is not always a popular choice for governments, who prefer short-term goals and quick fixes (Laukkonen et al., 2009). To avoid trade-offs, it is essential to coordinate the adaptation strategies between the different departments and involved stakeholders (Ford & King, 2015). Local adaptations are increasingly coupled with global policy and connected with other institutions and actors in different scales. According to a research by Amaru & Chhetri local institutions are leaving a gap in the adaptive responses on a local level and ignoring important actors in the adaptation process (Amaru & Chetri, 2013).
From government to governance

The shift from government to governance, implies an involvement of multiple public and private stakeholders discussing and defining their ambitions. This shift is making the development process and integration of climate policy at a local level more complex (Biesbroek et al., 2009 & Van Herk, 2014). Important for the urban climate risk governance is the integration of scientific knowledge into the decision making, an exchange of information between scientists, policymakers and those at riks has to be stimulated to ensure that detailed climate risks assessments and vulnerabilities are incorporated in the urban master plans (IPCC, 2014a).

Vertical top-down approaches have often undermined the local institutions that enable adaptive capacity. But at a local level are there conflicting values which creates challenges for the development and realization of acceptable adaptation options. To overcome these challenges coordination and collaboration between the communities and levels of government is needed (Hurlimann et al., 2014).

A framework that can support collaborative planning, development planning and decision making is the Learning & Action Alliance (LAA). The aim of the LAA, is that a group of individuals or organizations who have a shared interest in innovation and want to learn from each other will integrated the action in the process. In flooding vulnerable ares, the action refers to the integration of flood risk management in the urban development planning. In the Netherlands two examples of the integration of the flood risk management in the urban planning are the programs ‘living with water’ and ‘room for the river’ (Van Herk, 2014)

Levels of governance for adaptation

On an European level, is the development of national adaptation strategies promoted, since the last IPCC report. The European Union started with adaptation planning, through information sharing, the Climate-ADAPT platform and legislations. Twelve European countries have created a National Adaptation Strategie; Austria, Belgium, Denmark, Finland, France, Germany, Hungary, the Netherlands, Norway, Portugal, Spain, and UK. Finland already had a national adaptation strategy. The EU Floods Directive, is mapping the risk of flooding and improving the civil protection responses and early warning systems (IPCC, 2014a).

On a national level, are the national governments coordinating the governments on a subnational and local level. This coordination includes the distribution of information regarding the risk of flooding, strengthening the actions of the state and local governments and facilitating the coordination of the budgets and financing of an adaptation action (IPCC 2014a).

Governments at all levels play important roles in advancing adaptation and in enhancing the adaptive capacity and resilience of diverse stakeholder groups (IPCC, 2014a, p. 876). Because national governments decide the funding priorities, develop regulations, promote institutional structures and
provide policy direction for the state and local governments, national governments have the potential to directly influence the adaptive capacity and reduce the risk and vulnerability of areas and populations. Through the development of regulations, related to zoning, storm water management and building codes, can the national governments steer the development and stimulate the inclusion of adaptation strategies in the development (IPCC, 2014a).

On a local level, the local governments have an important role in translating the goals, policies, actions and investments set by the national and international governments. As well as taking the incentives of local communities, civil societies and non-government organizations (NGO’s) into account. Climate changes are visible on a local level, ensuring that an adaptation is context dependent. Therefore are the local governments essential in addressing the challenges of adaptation strategies and the implementation of the adaptation strategies. Difficulties in the development of the adaptation plans, are the uncertainties about the future climate changes and impacts thereof, which the local governments have to take into. While they are constrained by limited funding, technical expertise, institutional mechanisms and a lack of information and leadership. Through mainstreaming the adaptation plans into the urban planning, land use management and regulatory frameworks, local governments would have more success to implement an adaptation in an hazard prone area (IPCC, 2014a).

Cost-benefit analysis institutions
For the adaptation of coastal areas, is it difficult to rely on the cost-benefit analysis, because of the uncertainties the coastal areas are facing. The developments in coastal zones involve options which have a long investment time scale; 30 years or longer. The long-term options for the developments, demands certain information on the future of an area. But the changing climate and future levels of GHG emissions, have an impact on the outcomes and the future context of coastal areas. Making adaptation investments in coastal areas; waterfronts sensitive for several options. For the selection of an option, the analysis of institutions are important, because they can decide between options while taking the interlinkages between public and private actors and existing polices and conflicting interest into account and choosing the best option for implementation (IPCC, 2014a).

Institutional barriers in climate adaptation
A lack on the uptake of adaptation strategies and plans in cities and countries can be caused by institutional barriers. Policies can have limited overarching policy frameworks that supports adaptation on a local level and some policies may encourage developments in flood risk zones and focussing on short-term goals, and therefore constraining the development of long-term adaptation strategies (Carter, 2011). The multiple issues, governments have to deal with, can also lead to prioritizing short-term tangible issues, instead of the adaptation plans (IPCC, 2014a).

Unclear roles and responsibilities between actors at different levels and fields can slow down or even prevent climate adaptations. Nowadays, there are few national requirements or guidelines helping the local governments with an climate adaptation approach. Through regulations and policies the local governments could receive some support for the implementation of local climate adaptations actions. But some authors believe that to much emphasis on national guidance, could constrain local initiatives and create a local dependency of the national government, which would slow down the development of adaptation actions. Therefore a top-down approach should be combined with a bottom-up approach, where national actors set a proactive agenda regarding the climate adaptation strategies and support the local implementation of adaptation plans (IPCC, 2014a).
3.3 ADAPTATION

Adaptations are long-term processes, which involves learning and adjusting to the changing climate in a continuous and flexible process (IPCC, 2014a). In low-lying waterfronts, the adaptations are focused on flood adaptations, where the aim is to reduce the vulnerability of present and future low-lying waterfords by minimizing direct and indirect impacts of flooding. According to the Darwinian view, groups which do not have adequate methods of coping with environmental stress will not be able to compete for scarce resources and will fail to continue (Smit & Wandel, 2006 p. 283)

Adaptation process

According to Moser & Ekstrom, the adaptation process consists of three stages; understanding, planning and managing an adaptation. In each stage, different subprocess can be identified. The first stage, understanding, consist of; defining the problem, gathering and using the information and (re)defining the problem. The second stage, planning, consists of developing options, assessing an option and selecting an option. The final stage, managing, consists of implementing an option, monitoring an option and evaluating (Moser & Ekstrom, 2010).

Urban adaptation

Adapting cities to the changing climate is of great importance, because urban areas have a high concentration of population and infrastructure, which play an important role in economic, political and social processes (Brikmann et al., 2010). Cities and megacities are the drivers and the results of global changes. As a result, urban areas have a high density of population and socio-economic value, which makes cities vulnerable for the threats of the changing climate. In the International Commission on Climate Change and Development, they conclude that cities and city dwellers have received too little attention in discussion of climate change impacts and adaptation (Commission on Climate Change and Development, 2009, p. 98). Most of the adaptation actions have been in rural areas, while urban areas have a growing share of the world’s population.
Urban areas have specific characteristics compared to rural areas, which have be taken into account when urban adaptation strategies are developed;

- Urban areas have a different scale in population size, density and area of build-up environment then rural areas. The spatial concentration of population, infrastructure and other assets in cities makes them more vulnerable for the negative effects of the changing climate. The high concentration is also entailing opportunities for the efficiency and implementation of certain adaptation measures, like dyke systems.
- Cities are interlinked with multiple processes and flows, which play an important role in large-scale economic and social systems. In case of a climate related disasters, the damages would go beyond the boundaries of a city.
- Diseases can spread easier within and between cities, and thereby affecting large population groups.
- The built environment in cities, is characterized by a high persistence. Which ensures a longer period for the buildings and infrastructure to be changed connected with higher costs (Birkmann et al., 2010).

In urban areas has the focus been on mitigation rather than on adaptation, several mitigation strategies in cities can be recognized, on is the promotion of the short distances within cities, which contributes to the reduction of CO2 emissions in cities. But the compact and multi-functional cities are ensuring that people and economy are concentrated and a high building density, with little green open spaces are exacerbating the threats of the changing climate in cities and making it difficult for cities to adapt, for example the high proportion of nonporous surfaces are increasing the risk of flooding in urban areas (Brikmann et al., 2010 & Carter, 2011).

![Figure 17: Impacts of mitigation in cities (own ill.)](image)

Municipal and higher-level adaptation plans have to take the uncertainties of the changing climate and related risks and threats into account. Policy makers can encourage the adaptation, through regulations, subsides and direct interventions (IPCC, 2014a). But a crucial element in the adaptation process is the bottom-up approach, because of the diversity of local areas (Carter, 2011). A distinction can be made between these two levels of adaptation; the public and joint adaptation is a so called planned adaptation and the private and individual adaptation is a so called autonomous adaptation. A planned adaptation is applicable for the management of a public good and for ensuring the safety of inhabitants of a flood prone waterfront. An autonomous adaptation occurs when an individual acts within the given rules and which leads to a more climate-resilient dwelling or area (Filatova, 2013).
The planned adaptation, based on publicly-funded flood defenses and spatial planning are facing three challenges; the adaptation costs are increasing, there is a growing land scarcity and inefficient use of space, individuals have a low risk awareness and the adaptive management needs a flexible investments (Filatova, 2013).

Economics of adaptation
There are different kinds of adaptation measures, some measures include physical interventions; with investments in the maintenance costs of an implemented measure and the investments in new measures. Before an adaptation investment is made, a cost-benefit analyses is conducted, where the timing of an action is of importance, sometimes it can be beneficial to delay a decision until there is more information available. While some adaptations involve a change in behavior and lifestyle (IPCC, 2014a)

The Intergovernmental Panel on Climate Change (IPCC) describes adaptation costs as the costs of planning, preparing for, facilitating and implementing adaptation measures, including transition costs (Parry et al., 2007, p.76). But this description is difficult to operationalize, because a development alone is also costing money and it is difficult to separated the costs for the adaptation from the total cost of the development. Upfront in a project the threats of the changing climate will be unsure, making it difficult to define the type and amount of adaptation that is needed. A country can choose to fully adapt and therefore being able to cope with the climate change, do nothing and suffer from the impacts of the climate change or adapt to a level that the benefits of adaptation are equal to the costs (Narain, 2011).

Adaptation endeavor
Not all adaptations will be implemented, a conceptual way at looking at this is through an endeavor. The first circle represents the adaptations that are needed, these adaptations actions would be required to avoid any negative effects from the changing climate. Through mitigation the negative effects of the changing climate can be reduced. The second circle concepts of the adaptation actions that are possible with the available technical and physical limits. This circle can be expanded through research and developments. The third circle represents the adaptation actions that are desirable considered limited resources and competing priorities, some adaptation actions are technical possible but they are too expensive. This circle can be expanded through economic growth, which can increase the resources that can be used for adaptation. The final circle represents the adaptation actions that will be done, market failures, practical, political or institutional constraints have to be taken into account for the implementation of the desirable actions (IPCC, 2014a).

Figure 18: Adaptation endeavor (IPCC, 2014a).
Adaptive capacity and readiness

Adaptive capacity is the ability to adapt, however this does not mean that an adaptation is implemented. Even when the adaptive capacity is high, disaster losses and limited adaptation planning can be observed, for example with the hurricane of Katrina in New Orleans. Adaptive capacity is hypothetical and does not capture the implementation of decision making and governance processes which determine the likelihood of capacity translating into actual adaptive actions (Ford & King, 2015, p. 507). Therefore only focusing on the adaptive capacity is not enough to ensure that the adaptation is successful. Between the adaptive capacity and the adaption, multiple barriers can emerge. Barriers are obstacles that can be overcome with coordinated effort and shifts in resources, land uses and institutions (Moser & Ekstrom, 2010).

The adaptive capacity is context-specific and will vary from country to country, from community to community, among social groups and individuals and over time (Smit & Wandel, 2006). Conditions that influence the capacity to adapt are; economic resources, technology, information and skills, infrastructure, institutions and equity (Ford & King, 2015, p. 507). A distinction between short term ability to survive is called coping ability and adaptive capacity is used for long term and more sustainable adjustments. A growth in economic and improvement of technology and institutions can leas to an increased adaptive capacity (Smit & Wandel, 2006).

Uncertainties with the changing climate and the nature of problems can cause adaptations to be postponed, avoided or prevented from being implemented, this indicates a limited adaptation readiness. Adaptive readiness refers to the ability of a country's private and public sectors to absorb investment resources and apply them effectively towards adaptation (Ford & King, 2015, p. 508).

Adaptation measures

Including adaptation (and also mitigation) measures in the built environment is crucial, when infrastructures and planning structures, like roads, parks and buildings, can last at least 50 -150 years. Despite the challenges to include adaptation strategies in the urban development, it can also generate opportunities for cities to create more attractive built landscapes, which take the natural areas into account and creating quality spaces with a high value, where people and business want to spend time. Although high upfront costs have to be made to realize this, large net benefits can be gained over the long-term (Laukkonen et al., 2009). The lack of multi year funding plans for adaptation strategies, is limiting the ability to implement climate adaptation measures. Due to short-term budgets, long-term processes, like adaptation strategies are prevented (Ford & King, 2015).

To reduce the risks of the changing climate four types of adaptation measures can be identified:
- Reducing the current and future hazard exposure;
- Reducing the current and future vulnerability of a location;
- Improving mechanisms and structures to respond to disasters;
- Improving mechanisms and structures to recover from disasters (Wamsler & Brink, 2014 p. 11).

Some measures are a combination of mitigation and adaptation strategies, an example are green roofs. Green roofs reduce the urban heat island phenomenon, which helps to mitigate the changing climate by reducing the carbon and providing a cooler indoor climate which ensures that there is less artificial cooling needed. As well as it helps a city to adapt to an increasingly warm climate and slow down the water flows after heavy rains.
Context independent measures

Measures can be independent from a certain context, examples are; vegetation to reduce temperatures and to slow down water flows, increasing the height of electricity installations in flood-prone areas, on houses marking the flood levels and the harvest and storage of rainwater in periods of water scarcity. Grey measures, which are hard measures aiming at reducing the vulnerability of buildings and infrastructures for the impacts of hazards. In cities the water management can be improved by several grey measures like the construction, improvement or maintenance of dikes, sewerage and drainage systems. In developed communities, are green and blue infrastructures getting a higher importance, where the aim is at working with the natural processes instead of against them. Examples are avoiding hard surfaces where the water can not be absorbed, preserving wetlands for the defense against flooding, creating natural ecosystems which can function as a buffer for vulnerable water bodies and using vegetation on roofs and walls to reduce the run-off water and absorb heat (green and blue infrastructures will be further explained in paragraph 3.4). A finally measure to avoid hazards, is to prevent further developments in hazard prone areas (Wamsler et al., 2013).

Barriers in the adaptation process

In the adaptation process multiple barriers can emerge, which can delay or prevent the implementation of interventions. Adger et al classified five types of barriers in climate adaptation; the first one are the ecological and physical limits, the second one are the technological barriers, the third one are the financial barriers, the fourth one are the informational and cognitive barriers and the fifth one are the social and cultural barriers (Adger et al., 2005). With proactive adaptation planning the barriers can be identified and addressed.

Moser and Ekstrom have also identified multiple barriers which can occur in the adaptation process, but they have divided them into the earlier mentioned three stages. In the first stage, the understanding phase, barriers can occur in detecting the problem, gathering and using the information and for defining the problem. In table 1 an overview of the barriers in the understanding phase is shown (Moser & Ekstrom, 2010).

<table>
<thead>
<tr>
<th>Detect problem</th>
<th>Existence of a signal</th>
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<tbody>
<tr>
<td></td>
<td>Detection of a signal</td>
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<td></td>
<td>Threshold of concern</td>
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<td></td>
<td>Threshold of response need and feasibility</td>
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<tr>
<th>Gather/ use of information</th>
<th>Interest and focus</th>
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<td></td>
<td>Availability</td>
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<td></td>
<td>Relevance</td>
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<td></td>
<td>Credibility and trust</td>
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<td></td>
<td>Legitimacy</td>
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<tr>
<td></td>
<td>Receptivity to information</td>
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<td></td>
<td>Willingness and ability to use</td>
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<th>(Re)define problem</th>
<th>Threshold of concern</th>
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<td></td>
<td>Threshold of response need</td>
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<td></td>
<td>Threshold of response feasibility</td>
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<td></td>
<td>Level of agreement</td>
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Table 3: Barriers in the understanding phase (Moser & Ekstrom, 2010)

In the second stage, the planing phase, barriers can occur in developing options, assessing the options and selecting an option. In table 2 an overview of the barriers in the planning phase is shown.
In the third stage, the managing phase, barriers can occur in implementing options, monitoring outcomes and the environment and in evaluating the effectiveness of an option. In table 3 an overview of the barriers in the managing phase is shown.

Table 4: Barriers in the planning phase (Moser & Ekstrom, 2010)

Vulnerability

The vulnerability of a city to the changing climate is associated with city residents, infrastructure and the built environment. Vulnerability is therefore context related and will differ at the local scales. The risk is connected to the climate changing hazards as floods, heat waves and storms and high winds, the vulnerability and adaptive capacity. By reducing the vulnerability and improving the building adaptive capacity, the risk can be reduced (Carter et al., 2015).
Adaptation private and public goods

A distinction can be made between private and public goods. Private goods are goods where the benefits of the good is for a private actor. Public goods are goods where the benefits are for the public. Private actors can invest in an adaptation action where the benefits are directly for the adaptor. Examples of private actors’ adaptations are insulating homes, buying sandbags or moving out from a flood prone area. Private actors can also invest in public goods, where the benefits of an adaptation is not for an individual or private actor, but for the public. These benefits are non-excludable, which means that anyone living in or near the area where an adaptation has been implemented can benefit from the adaptation (Tompkins & Eakin, 2012).

Figure 19: Private adaptations in private and public goods (own ill.).

In flood control policies there is a need for private actors to invest in public goods. In rural areas there are some examples of private actors investing in adaptation actions for the public good; private farmers and other landowners are encouraged to enhance the capacity for flood storage on their private lands to reduce the public expenses of flood disasters. But the private adaptation investments in public goods are not always an obvious choice. First the benefits of a public good may be visible on different spatial scales and at temporal moments making it difficult to distribute the rights and ownerships, costs and benefits. Second for some private actors there may not be a immediate need for adapting a public good, it can be beneficial to wait for other private actors to implement the adaptations. Third, the private interests are not always corresponding to the public interest (Tompkins & Eakin, 2012).

Ecosystem-based Adaptation (EBA)

The Ecosystem-based Adaptation (EBA) is a new emerging concept. The sea level rise is an urgent challenge and has to be taken into account in the coastal planning. In coastal areas, spontaneous adaptation will not be enough to cope with the potential impacts of the rising sea level. By incorporating a Integrated Coastal Zone Management (ICZM) into the planning of coastal areas, the impacts of the rising sea level could be minimized and an integration can be generated. According to Sierra-Cornea & Cantera Kintz are EBA a public responsibility rather than a private responsibility, because coastal zones are common spaces. But EBA is an anthropocentric approach in which ecosystem services are conserved or restored to reduce the vulnerability of people and society to the threats of the changing climate and this involves national, regional governments, local communities, as well as the private sectors and NGO’s (Sierra-Cornea & Cantera Kintz, 2015).

Gap between adaptation research and action in Nordic countries

According to Klein and Juhola, the Nordic countries, Sweden, Denmark, Norway, Finland and Iceland have a gap between their adaptation research and their actions. The environmental policymaking in the Nordic countries is referred to as the ‘pace-setters’ for environmental policy within the European Union, but within these countries, there is a gap between the adaptation research and the
implementation of these adaptations by policy and decision makers. Five bottlenecks that are causing this gap is identified by Klein and Juhola; (Klein & Juhola, 2014, p. 106)

- Theoretical concepts and constructs developed and applied in adaptation research do not relate to the decision ‘reality’ of stakeholders.
- Uncertainty surrounding the potential impacts of climate change makes stakeholders inclined to wait and see rather than act.
- There is a mismatch between the local scale on which many stakeholders operate and the smaller-scale climate information provided by model.
- There is a mismatch between stakeholders’ primary concern to manage current climate variability, and the medium- to long-term perspective of much adaptation research.
- Adaptation research often ignores the fact that adaptation is not the only priority for many stakeholders.

Adoption vs adaptation

Adoption is defined as a change in practice or the technology that is used whereas adaptation is defined as the response of economic agents and societies to major environment changes and/or political and economic shocks (Zilberman et al., 2012, p. 28). According to Zilberman et al. are individuals making an adoption decision based on economic decision-making rules, heterogeneity of potential adopters and dynamic process, which all three affect change over time. Adaptation on a micro level can include the selection among discrete strategies, like adoption of technologies and migration. Adaptation on a macro level can be measured through commonly behavior, caused by a change of policy at local, regional, national or international level. Zilberman defines adaptation as changes in public and private decision making and resource allocation in expecting or responding to the prospect or reality of large-scale and long-lasting changes (Zilberman et al., 2012, p. 34).

The benefits of adaptation are calculated as the differences between the immediate effects of external changes and the long-run effects after the economy reaches the new equilibrium (Zilberman et al., 2012, p. 35). Because the impacts of climate change are uncertain, actors implementing proactive adaptations are facing uncertainties, missing information and lack of experience. Economists observe two responses to climate risk; mitigation efforts to reduce the risk and insurance that manage the risks. So a financial instrument can in this case be a way of adapting, but there are several challenges for the implementation of this; first it is difficult to quantify the risk. Second insurance and adaptation activities are independent, the ability to insurance can reduce the engagement in practice adaptation activities. Third insurance can encourage risk-taking behavior. Fourth, financial effective tools in spreading the risk, are not necessarily reducing the direct impacts of an event (Zilberman et al., 2012).

Public awareness for adaptation

The public awareness of the importance of adaptation is essential for affecting the adaptation readiness (Ford & King, 2015). The behavior of an individual can change in the form of spatial adaptation. Individuals may move to areas where they are safe from flooding, resulting in fewer and cheaper developments in high flood risk areas. Houses are long-lived assets and therefore the adaptation should be anticipatory rather than reactive (Filatova, 2013).
3.4 RESILIENCE

The more resilient a system, the larger the stress it can absorb without shifting into an alternate regime or collapsing (Weichselgartner & Kelman, 2014, p. 3). Mitigation and adaptation activities are central to urban resilience strategies. Resilience was introduced in 1960, where the perspective emerged from the ecology (Folke, 2006).

Perspectives of resilience

According to Folke, 2006, resilience can be divided into three perspectives, the engineering resilience, the ecological / ecosystem resilience and social resilience and the social ecological resilience. In table 6 an overview of the characteristics of the perspectives is shown. Previously work has mainly focused on the capacity of a system to absorb shocks and still function, but important aspects of resilience is the capacity for renewal and possibilities to create new opportunities for innovation in a system.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Engineering resilience</td>
<td>Return time, Efficiency, Recovery</td>
</tr>
<tr>
<td>Ecological / ecosystem resilience</td>
<td>Buffer capacity, Ability to absorb, Withstand shock and maintain function</td>
</tr>
<tr>
<td>Social ecological resilience</td>
<td>Interplay disturbance, Self-organization, Sustaining and developing</td>
</tr>
</tbody>
</table>

Table 6: Three perspectives of resilience (Folke, 2006 & Lloyd et al., 2013 & Flood & Schechtman, 2014).

A system that includes the societal, the humans, and the ecological, the biophysical is the social-ecological system (Gallopin, 2006). In figure 20 the interconnection between the social and ecological subsystems is shown. Social-ecological resilience includes the amount of disturbance a system can absorb and remain its function, the degree of self-organization of the system and the degree of learning and adaptation of the system (Folke, 2006). In social-ecological resilience the humans play a key role, therefore their willingness to adapt will influence the resilience of a system.

Figure 20: Social-ecological resilience (Lloyd et al., 2013).
Resilience of a community to bounce back after a coastal storm can be strengthened by hard infrastructure defenses, like dikes, but this has a negative impact on the ecological resilience, because it disrupts the nature (Flood & Schechtman, 2014). The focus of this research is on waterfronts and Becker et al. defines seaport resilience as a resilience that can face a storm event and continue to meet the regions demands; facilitating trade as a conduit for the exchange of resources, materials, and finished products; facilitating business success and profit to firms; an engine for local, state, and/or national economic growth and stability; and a public good that minimizes environmental harm and contributes to residents’ quality of life (Becker et al., 2014, p. 49). Resilience of the port of a city, can be considered as a public good, because a public good is non-excludable and non-rivalrous, which means that one individual cannot be effectively excluded from the benefits of a resilient port or reduce the benefits from an others.

Elements of urban resilience

Urban resilience can be divided into three key elements. The first one are the systems, cities can be conceptualized into a system. Cities are linked to multiple systems, like the regional food production, national electricity distribution and international investment patterns. These systems are crucial for the well being of the humans in the affected area. Three characteristics of a resilient system are; flexibility and diversity, redundancy and modularity and safe failure. The second element are the agents, which include individuals, households, private and public sectors. Their interests will differ and change based on strategy, experience and learning. Agents are depended on the urban systems, and some agents are responsible for the management of the urban systems. The capacity of an agent to ensure its well-being, depends on its adaptive capacity. In the adaptive capacity of an organization and households, is the role of the local governments crucial. They are responsible for the planning, prevention and response services, for example the land use plan, building control and permits and emergency services, which are essential for urban resilience and climate adaptation. The third element of urban resilience are the institutions, that structures the human behavior by social rules. Governance is an important factor that influence the resilience of an area, by decision-making processes that ensures safety for the vulnerable groups (Tyler & Moench, 2012).

According to Tyler and Moench, building urban climate resilience means;
- Strengthening systems to reduce their fragility in the face of climate impacts and to reduce the risk of cascading failures;
- Building the capacities of social agents to anticipate and develop adaptive responses, to access and maintain supportive urban systems; and
- Addressing the institutional factors that constrain effective responses to system fragility or undermine the ability of agents to take action (Tyler & Moench, 2012, p. 319).

The link of the institutions with the individuals in a systems is important, because the decisions made by the local policies can have a large impact on the vulnerability of certain individuals and their accessibility to crucial systems, like clean drinking water (Tyler & Moench, 2012).

Climate-resilience developments

Climate-resilient pathways are developments that combine adaptation and mitigation with effective institutions to realize the goal of sustainable development (IPCC, 2014a, p. 842). There are two main categories of climate-resilient pathways, which aims at achieving a sustainable development; the actions to reduce the climate change and the impacts thereof, through mitigation and adaptation; and the actions to ensure that the strategies and choices of risk management are identified and implemented as an integrated part.
Through stimulating consumption patterns that ensures social and economic developments while reducing the use of natural resources and maintaining the ecosystem, sustainable developments can contribute in the development of climate resilience. In the development of climate resilient pathways, the vulnerabilities of the changing climate, interventions to reduce the related risks and actions that are consist with the goals of sustainable development have to be include (IPCC, 2014a).

**Negative impacts of mitigation on local resilience**

The benefits of mitigation are more visible on a global level, but the importance of mitigation for a sustainable development are generally known. First of all, it reduces the frequency and magnitude of climate change. This reduces the effects of extreme weather and climate events. Secondly the reduction of GHG emissions through technological and institutional changes interact with climate resilient development pathways. From recent research, the effectiveness of implementing mitigation and adaptation strategies in combination with other interventions and in a broader context of sustainability and resilience is proven (IPCC, 2014a).

But mitigation can have a negative impact on implications for adaptation. For example, the concentration of buildings to reduce the distances and therefore reducing the GHG- gasses, is beneficial for mitigation but not for adaptation, because the high density of buildings in cities makes it difficult to implement options for water retention and infiltration. The many landowners and capital-intensive high rise buildings can also make it difficult to implement adaptation plans, due to the different interests and opinions of the involved actors (Jabareen, 2013).

![Figure 21: Negative impacts of mitigation on adaptation (own ill.)](image)

**Green and blue urban infrastructure**

Resilience to extreme weather events, like flooding, can be improved by implementing grey adaptation measures and / or green and blue measures. Grey measures are mono-functional interventions like underground drainpipes and pumping stations, these interventions are effective, but their capacity is limited. To increase the urban resilience green and blue adaptation measures is a solution. They make use of natural processes, are self-adaptive and can produce co-benefits. The green and blue infrastructures can not be seen separate, because the green infrastructure depends on the availability of water from the the bleu infrastructure (Voskamp & Van de Ven, 2015).

The adaptation measures for resilience to extreme weather events can focus on four capacities to increase the vulnerability of a city. The coping capacity, which focusses on minimizing economic and social damages when a disturbances occur. The recovery capacity, which focusses on recovering from a disturbance. The threshold capacity, which focus on preventing damages with a threshold...
resistance to disturbances. The adaptive capacity, which is the underlining process of adaptation and which focusses on the long term process (Voskamp & Van de Ven, 2015).

Examples of bleu-green measures are (Voskamp & Van de Ven, 2015, p. 161);
- Storage & harvesting measures, facilitating water retention in the soil, storage or rainfall interception.
- Attenuation measures, slowing down runoff during a rainfall event after the storage capacity of the measure has been exceeded.
- Infiltration measures, enabling groundwater recharge.
- Cooling measures, providing evapotranspiration.

The implementation of blue-green measures is difficult when the location is complex and owned by multiple actors, which is often the case in cities. Private actors are less willing to implement blue-green measures, because they would bear the costs for the development and implementation of the measurements, while the municipalities or waterboards would receive the benefits. The high density in cities is also making the implementation of blue-green measures difficult, because land available for those measurement is limited and of high value (Voskamp & Van de Ven, 2015). So the implementation of blue-green measures to improve the resilience in a city is not always a obvious decision and depends heavily on the willingness of private landowners to invest in these bleu-green measures.

**Capacities of resilience**

The resilience capacity can be focussed on four different capacities;
- Coping capacity: resilience to handle disturbances when they take place, by minimizing economic and social damages.
- Recovery capacity: the capacity to recover from disturbances after it has taken place.
- Threshold capacity: prevent damages by building a threshold resistance to disturbances.
- Adaptive capacity: the process of adaptation should be a continuous lang term process (Voskamp & Van de Ven, 2015, p. 161).

**Conflicting goals for a sustainable development**

For the realization of a sustainable development three conflicting goals exists. The first one is the property conflict, which arises from competing claims on the use of a property for private or public goods. A second conflict is the resource conflict, which occurs when there are competing claims on natural resources and the preservation of natural resources to reproduce. The third conflict is the development conflict, which arises when there is a competing need to improve the living conditions of poor people though economic growth while protecting the environment (Godschalk, 2004).

![Conflict triangle (Godschalk, 2004).](image-url)
3.5 PRIVATE SECTOR

The role of the private sector in disaster and emergency responses is increasing, even though government agencies are responsible for the protection of citizens and their properties, they cannot and will not do this alone (Egan, 2009). According to Agrawala, the success of an adaptation depends heavily on the decisions made in the private sector (Agrawala, 2011). Therefore the objectives of the private sector are important for this research.

Economical aspects

Without transformative change in urban development planning, private sector investments in adaptation will remain limited (IPCC, 2014, p. 952). Before the private sector will make investments in urban adaptation strategies, they will need to see the financial justifications and benefits of adapting the urban environments. As mentioned in the first paragraph of this chapter, the economic cluster in cities are making private investments in cities attractive, because of the concentration of business activities and the demands of citizens. Therefore the households could stimulate the private sector to investments in adaptation, as well as being part of these investments (IPCC, 2014a).

So the private sector has an important role in delivering adaptation, especially the private financial sector, who can provide risk management options which includes insurances and finance large developments. But insurance companies and banks are facing problems with an accurate pricing of risks and the loss of capital after an extreme weather event, which is affecting the markets within and outside Europe. Thus, banks can be affected through the physical impacts of the changing climate on their assets and investments. As well as the changing demands regarding sustainability, mitigation and adaptation can banks be affected. Very few banks have adopted climate strategies that also addresses adaptation (IPCC, 2014a).

In the IPCC report of 2014, are three general ways in which the private sector can become involved in adaptation described;

- Internal risk management; private actors have to protect their own interests and ensure a continuity of supply and markets.
- The private sector has to be recognized as a stakeholder, which needs to participate in public and civil society initiatives and who allows them to make a contribution in reducing the climate risk. But sometimes are the private sector engagement and investments in contrast with the interest and priorities of the government and civil societies.
- Climate adaptation can provide a range of new opportunities for business and communities (IPCC, 2014a).

Taxes and insurances in waterfront

The inhabitants of riversides and coastal areas are taking their advantages from the local amenities of flood defenses, where all taxpayers pay for. Through higher tax rates in areas where there is a higher chance of flooding, will stimulate developments in safer areas. As well as increasing the tax rates in areas where the risk of flooding is increasing, can discourage further urban developments in these areas. But it is important that the taxes are consistent among the municipalities to avoid negative neighborhood externalities and the encouragement of developments in municipalities where the taxes are low but not safe, would not be fair for municipalities who are adapting the taxes to the threats of flooding (Filatova, 2013).
Insurances aims at eliminating economically-unwarranted use of flood-prone areas without prohibiting uses with merit. Insurances distributes the risk across the time and space for climate vulnerable locations, which otherwise would be too risky to develop. If risks are correctly priced, premiums insurance allows location in hazard-prone areas for those who are ready to bear risks without increasing a burden on taxpayers (Filatova, 2013, p. 232). Increasing the prices of insurances is a first step in risk reduction measures, but it does not automatically imply that an action will be taken (IPCC, 2014a).

Flood insurances could be a perfect risk-communication device, because people have difficulties understanding the risks and threats of flooding if they may occur once in the 500 years, while a monthly insurance payment would give the people a clearer message about the risk of flooding. Insures and governments could work together in increasing the individual flood risk awareness. If the flood insurances would adapt to the increasing risks of flooding in an area, individuals would feel an increased responsibility for the location in flood-prone zone and in making their dwellings flooding-proof (Filatova, 2013).

Public and private partnerships
The last decades the collaboration between public, private and civil society actors has become more popular. Partnerships have the ability to resolve the issues of funding large scale projects, sharing the risk of a development and provide the resources and skills for the projects. On a regional level, partnerships have been formed to increase awareness, build capacity, coordinate policy and promote learning for urban responses to climate adaptation (Harman et al., 2015, p. 76). But a challenge remains in transforming the learned lessons and success of an adaptation aimed at a certain climate change and observe a cause and effect relation, which is making the investments and collaboration in mitigation strategies more tangible (Harman et al., 2015).

Increasing the flood risks awareness
To be able to decrease the risk flooding in coastal zones, the individual coastal flood risk awareness has to be increased. Four ways to increase the risk awareness of individuals are identified:

- Personal experience of disaster; individuals who have ever experienced flooding themselves, are more likely to have a higher flood risk awareness. When individuals have an increased flood risk awareness, this can influence and change the spatial patterns and land prices in flooding vulnerable areas.

- Risk communication; the European water management aims at proactive measures, which can only be achieved if individuals are aware of the risk. As already mentioned the awareness of a risk can change the use of land, as well as it can make people more willing to accept proactive actions of the government. When there is an increased risk awareness among individuals, developers are more likely to integrate the risk of flooding in their choice for a location.

- Insurance against flooding; the purposes of flood insurances is to guarantee premiums proportional to the risk of individuals in flooding vulnerable areas. Insurances can serve as a measure to communicate the risk, when the prices for the insurances in flooding vulnerable areas is related to the risks, individuals would notes the risks of flooding in the price they pay for the insurances.

- Building on higher elevation levels; by construction new developments on higher grounds, the direct damages in case of flooding decreases and it serves as a flood communication tool, that remains people of the possibilities of flooding (Filatova et al., 2011).
4. CASE STUDIES

4.1 EUROPE

The changing climate is a problem for several European countries, but different demographic and economic trends makes the European countries diverse. However similarities can also be identified, the health and social welfare of the population in all the European countries have been improved. The European population has increased in most countries, primarily due to the net immigration and the European population is aging, which has an impact on the economic and social state of the countries (IPCC, 2014a).

Mitigation and adaptation
In European countries mitigation and adaptation policies are developed and stimulated by the European Union (EU), due to the changing climate. The EU member states have an overall EU mitigation policy as well as an individual mitigation policy. On an international, national and local level adaptation policies have been developed, although limited research on the implementation of these policies exists. Due to the changing climate, the average temperatures are rising and this is mainly the case in Northern Europe, where the winters are getting warmer and warmer. Europe will also face an increase in extreme weather events, like heat waves, droughts and heavy precipitation. The global mean sea level is increasing, which is causing extreme sea level events to occur in Europe. Coastal flooding is a key challenge for several European cities, infrastructures and port facilities. According to the IPCC the number of people being affected by a coastal flooding in Europe can vary between the 775.000 and 5.5 million people per year in 2080 (IPCC, 2014a) (see appendix 6 for an overview of recent flood events).

The costs in Europe is estimated to be between the 2.6 and 3.5 billion per year in 2100, for coastal adaptation. For the protection from river flood, the costs will reach the 1.7 billion per year in 2020, to 3.4 billion per year in 2050 and 7.9 billion per year in 2080. In Sweden the costs for adaptation, information, campaigns and research will extend to 2.4 billion between 2010 and 2100. In the Netherlands the costs for protection from coastal and river flooding will vary between the 1.2 and 1.6 billion per year until 2050 and between the 0.9 and 1.5 billion between 2050 and 2100 (IPCC, 2014a).

European legislations
The European Union flood risk regulations and policies have a considerable impact on the national flood policies and strategies. Implementation of Directive 2007/60/EC on the assessment and management of flood risks increases policy interactions between the domains of water and spatial planning (Roth & Winnubst, 2014, p. 233). Due to this policy, the European countries were obliged to assess and map the risk of flooding and develop a flood risk management plan for 2015. So the European policies have created new opportunities to integrate the flood risk management in the spatial planning, but the success will depend on the national framings and institutions. In the next paragraphs the adaptation strategies and institutions in Sweden and the Netherlands will be presented.
4.2 SWEDEN

In Sweden the temperatures are expected to increase more than the global average, by 2080 the Swedish average temperature will rise by 3-5 degrees Celsius. The precipitation will increase as well, especially during autumn, winter and spring. Causing high water flows and more frequent flooding. In southern Sweden the sea level can rise up to 0.8 meters, while in the northern parts of Sweden the land elevation will weary the sea level rise. Especially western and south-western parts of Sweden will face more daily flooding, due to the changing climate (Johansson & Mobjörk, 2009).

Adaptation in Nordic countries

Nordic countries are putting adaptation high on their domestic political agendas, including Sweden. On a national level there are policies and measurements on adaptation and the implementation of this, but it is mainly on a local and regional level that the actions to adapt are made. In 2007 Sweden published the final report of the Climate Change an Vulnerability Commission, which stimulated the development of adaptation policy. This policy is based on stakeholder engagement, consensus and negotiation and it includes the risks of climate change and the vulnerability of nature, people and socio-economic activities in Sweden. The municipalities and county administrative board bears the responsibility for the initiation of adaptation, which is supported by finance of the government (Klein & Juhola, 2014). But already in 1967, Sweden launched the Environmental Protection Act, which made Sweden the first country with an Act on environmental legislations (Granberg & Elande, 2007).

Bottlenecks of adaptation in Sweden

However, a research in two Swedish municipalities revealed a gap between the once with information on adaptation and the once implementing the adaptations. There was a misunderstanding between the local planners and the national authorities on the worst-case scenarios (Klein & Juhola, 2014). Some of the municipalities are lacking in planning documents for the rising sea level and two-third of the municipalities do not discuss the expected sea level rise in 2100 (Von Oelreich et al., 2013).

Several bottlenecks were identified in the Nordic countries that caused the gap between the adaptation research and the actions. One of this bottlenecks is the fact that adaptation is not the only priority for many stakeholders and that adaptation has to compete with many other concerns (Klein & Juhola, 2014, p.106). A study in Swedish municipalities showed that the economic and aesthetic value could conflict with the need for adaptation. For example investments in flood-prone areas was allowed to improve the economic development of an area, despite the risk for flooding (Klein & Juhola, 2014).

Swedish institutions

There are 290 local authorities in Sweden and they each have the responsibility of implementing national climate policy targets, through physical planning. They are also responsible for reducing the vulnerability in cases of extreme events. Local authorities have two important regulatory instruments:

- Planning and Building Act. In this act is demanded that environmental and crisis aspects are taken into consideration when a decision is made concerning land and water planning.
- Act on local authorities and county councils measures before and during extraordinary events (Johanssnn & Mobjörk 2009, p. 16). The aim of the act is reduce the vulnerability and to increases the capability to handle a crisis.

The county administrative boards have the responsibilities to oversee the work of local authorities concerning the risk and vulnerability of an area. They have the overall coordination and supervision of Developments in flood prone urban waterfronts
local authorities. Several county administrative boards have given recommendations on how the risk of flooding should be included in the physical planning; the recommendation is that no buildings should be located below the 100-year flood level, with the exception of simple buildings such as garages and outhouses (Johansson & Mobjörk, 2009, p. 23). Not all local authorities are incorporating these recommendations, the most active authorities are the ones that have been affected by flooding and erosion and the local authorities that are having an active planning. In the next chapter more information on the physical planning and risk management of Gothenburg will be given.

Figure 23: Responsibilities of the Swedish institutions (Johansson & Mobjörk, 2009).

The central government act as a source of information, funding and provider of the regulatory framework. They are not often involved in the implementation of climate adaptation. According to the Commission on Climate and Vulnerability, the role of local authorities must be strengthen, the analyses of risks and vulnerabilities and how to reduce societies vulnerability to climate change must be included. Also the country administrative boards should take more responsibilities, by establishing a climate delegation where local authorities, industries, governments and organizations are participating (Johansson & Mobjörk, 2009).

Sweden has mainly been focusing on mitigation of climate change, by reducing greenhouse gas emissions. Lately, climate adaptation has become an important issue, but each actor is responsible for the amount of work needed for climate adaptation. Johansson and Mobjörk conclude that the central government should take a stronger position in establishing the framework, as well as controlling the local authorities’ work related to climate adaptation. Especially the small authorities need more (financial) support from a higher authority (Johansson & Mobjörk, 2009).

According to André, there is little research which is focussing on the private sector and on how they are involved in adapting their buildings to the rising sea level. More research has been done on the public sector and on how Swedish municipalities are working on climate adaptation. This is a problem, when also the private property owners have the responsibility to secure their own buildings to the rising sea level (André, 2013).
Mitigation and adaptation in Sweden

Mitigation at the local level is guided by the national environmental objective of reduced climate formulated in the Swedish climate strategy (Granberg & Elander, 2007, 543). Within the municipalities there were a frequent involvement of the private actors in climate mitigation. These developments were driven by the states grants on climate mitigation. A municipality that is focusing on climate mitigation is Växjö, already before the Kyoto Protocol, they introduced a climate policy on mitigation. In the Agenda 21 of Växjö, they urge the need for an open dialogue between local citizens and decisions-makers (Granberg & Elander, 2007).

In contrast to mitigation, Sweden does not have a comprehensive national strategy steering the local actors’ efforts to adapt. This is mainly caused by the diverse local situation, which is making it difficult to have one comprehensive strategy. Each location has its own risks and vulnerabilities and how the local actors addresses the risk will depend on the institutional capacity in a specific local setting. According to a report published by the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish municipalities are not taking the effects of the changing climate enough into account in their physical planning. For example; housing is allowed on areas too close to areas vulnerable for flooding (Granberg & Elander, 2007).

Granberg and Elander conclude that Swedish municipalities are prioritizing mitigation above adaptation, which is strange when mitigation mainly has an effect when it occurs on a national and international level, were the GHG emissions reduction has more of an impact. While measures of adaptation are crucial on a local level, to prevent potential flooding, using the physical planning (Granberg & Elander, 2007). Also Glaas et al. states that few Swedish municipalities have developed an adaptation plan or prioritized vulnerability management (Glaas et al., 2010).

Municipal adaptation measures in Sweden

If there are any adaptation measures they are mainly oriented at physical measures, which aims at reducing the hazard and vulnerability of river and coastal flooding areas. Examples of physical measures that protects settlements from the rising sea levels are building dams, walls, embankments and other permanent structures which interrupts with the water flows and can safeguard the coastline. By establishing a minimum height above sea level for the development of new buildings, physical measures are made to reduce the vulnerability as well as preparing the buildings to potential flooding (Wamsler & Brink, 2014).

Environmental measures aims at managing the runoff of water by directly reducing it where it falls or by delaying the water flow. Examples of environmental measures are green roofs, rain gardens and the use of open and local stormwater systems. Another measurement to protect cities from floods and the rising sea level, is the planned flooding, where certain areas are allowed to temporarily get flooded to protect the city (Wamsler & Brink, 2014).

Figure 24: Adaptation measures (Wamsler & Brink, 2014).
A third adaptation alternative is the socio-economic oriented measures, which aims at preparing for response. By providing the public with information and raising the awareness. However, a problem with providing information on the changing risk, is that houses in flood vulnerable areas can become unsellable, while insurances may not cover the damages caused by flooding. To avoid determining what is safe and not, some municipalities are not providing maps of flood-prone areas to the residents (Wamsler & Brink, 2014).

**Interaction between the adaptation approaches at the different levels**

As already mentioned the municipalities are responsible for the adaptation on a local level. These measurements are mainly physical, and there is little social and environmental inclusion. Instead of focusing on strategies were people are living with floods, people are provided with false sense of security and flooding is build away. The lack in top-down guidance for adaptation strategies, has made municipalities turn to private consultants for information. The fact that water flows makes municipalities dependent on each other, currently their cooperation is often voluntary but they see the need for their cooperation to be institutionalized at a regional level. Meanwhile, several municipalities are waiting for other municipalities to take actions, and thereby avoiding their own responsibilities. There is also a lack in citizens involvement on a local level, were almost non knowledge and adaptive capacity of the citizens is used (Wamsler & Brink, 2014).

![Figure 25: Interactions between adaptation on three levels (Wamsler & Brink, 2014).](image-url)
4.3 GOTHENBURG

Gothenburg, is the second largest city in Sweden, with 530,000 inhabitants. It is located on the west-coast along the North Sea and at the mouth of Göta älv and is an example of a coastal city that is expanding on flooding vulnerable areas to accommodate the growing population. The low-lying areas along Göta älv, are expected to house 24,000 households in 2035. While the North sea is expected to rise 0.74 meter in 2100 and in extreme cases it could even rise to 2.36 meter due to intense westerly or southwesterly winds (Rullander, 2014).

Figure 26: Overview Gothenburg and neighborhoods (Göteborg Stad Stadsbyggnadskontoret, 2014).

Urban context
The Gothenburg area is 450 km² large and has a population density of 1,200 persons per km² (Sörensen & Rana, 2013). Gothenburg is relatively low-lying and has a high proportion of clay soil. The river, Göta älv runs through Gothenburg, and is connected to Sweden’s largest lake, Lake Vänern, which flows into the North Sea (Keskitalo, 2010). The rise of the land in Sweden can prevent some of the effects of the rising sea level. In the northern of Sweden, the land is rising with 7 to 8 mm per year and in the south the land is sinking between -0.1 to -0.2 mm per year. In Gothenburg the land is rising 3 mm per year, but this is not enough to outpace the rising sea level of an average of 1.8 - 5.9 mm per year (Bui, 2011).

Market conditions
The Swedish export and import, goes through the port in Gothenburg and makes it the largest and best equipped port in Scandinavia. Some well known industries like SKF, VOLVO and Hasselblad and companies like Saab, Ericsson, Astra Zeneca, Skanska, NCC and Nobel Biocare are located in Gothenburg. The population in the Gothenburg’s region is expected to reach 1.5 million inhabitants by 2020, and to be able to accommodate this growth 120,000 homes and 80,000 jobs will be needed. If Gothenburg is not able to react to the growing demand of housing in the city, it may loss...
its’ citizens and economic position (Business region Göteborg, 2009). The local labour market in Gothenburg employs around 700,000 people and is 20% of Sweden’s industry workforce.

In Gothenburg there is a transformation from a labour to a knowledge-based economy, which means that the amount of workers in the manufacturing will decline while the service economy will grow. The urban transformation and the growing demand for housing, will stimulate the process of gentrification and the transformation of rental apartments into owner-occupied flats is a common occurrence in the Swedish housing market. The continuous growth of Gothenburg puts a constant pressure on the local government to build more residences and to improve the infrastructure (Borggren & Ström, 2014).

Institutions in Gothenburg

In 2004 the Extreme Weather Project in Gothenburg was founded by the municipal executive board of Gothenburg, with the aim to improve the knowledge of the effects of climate change and support proactive vulnerability management (Glaas et al., 2010, p. 531). Compared to other municipalities, the Extreme Weather Group in Gothenburg has been quite comprehensive. In table 7, are some of the institutions in Gothenburg.

<table>
<thead>
<tr>
<th>Stadsbyggnadskontoret Göteborg</th>
<th>Physical planning office Gothenburg</th>
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<tbody>
<tr>
<td>Fastighetskontoret Göteborg</td>
<td>Real estate office Gothenburg</td>
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<td>Trafikkontoret Göteborg</td>
<td>Traffic office Gothenburg</td>
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<tr>
<td>Park och natur kontoret Göteborg</td>
<td>Park and nature office Gothenburg</td>
</tr>
<tr>
<td>Miljöförvaltningen</td>
<td>Environment</td>
</tr>
<tr>
<td>Kretslopp och vatten</td>
<td>Water and sanitation company</td>
</tr>
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</table>

Table 7: Involved actors in Gothenburg.

Regulations in Gothenburg

According to the 2010 Planning and Building Act (Law 2010:900); all municipalities are required to adopt a master plan which serves to guide decisions about land use and development of the built environment within the municipal territory (Nilsson et al., 2012, 757). The Commission on Climate and Vulnerability has made it mandatory for municipalities to consider the risk of accidents, flooding and erosion in planning and localizing building. In the new Planning and Building Act that took effect in 2011, the Swedish Parliament decided to include the environmental and climate concerns into the act (Nilsson et al., 2012)

In the Civil Protection Act (Law 2003:778), municipalities are obligated to work on a plan of action and have a law guiding the crisis management during extreme events (Law 2006:544). However, the focus in the civil protection act, made by the Swedish Civil Contingencies Agency, is not on long-term climate change, but more on preparedness and responses to accidents. (Nilsson et al., 2012)

Frihamnen

The city center in Gothenburg is growing and the areas on the northern and southern side will be connected to the center. Frihamnen is located in the northern of Gothenburg and used to be an old harbor, which will be transformed into a livable, attractive green and sustainable area with multiple functions; residential, commercial, offices and tourism. In the program of Frihamnen there will be

Developments in flood prone urban waterfronts
around 9,000 apartments, 15,000 workplaces and 7 schools. Through two bridges; a walk and bicycle bridge and the new Hisingsbron for cars and other traffic, Frihamnen will be connected to the city center. In figure 27 an overview of the area is shown (Göteborg Stad Stadsbyggnadskontoret, 2014).

In Frihamnen there will be close relationship between the river; Göta älv, through possibilities to live, walk and sit near the water. This will create an added value for the neighborhood and the city. But the proximity to the water is not only an asset it will also be a challenge, because some ground in Frihamnen lies at only +1.4 meter, while the current guidelines demands a +2.8 meter ground level to be able to cope with the rising sea level. Therefore some protection against the rising sea level is required. Some examples of protection are mentioned in the report; a low wall or sluice gates in Frihamnen or at the river mouth, but these options need to be further studied (Göteborg Stad Stadsbyggnadskontoret, 2014).

The involved actors and their function in the development of Frihamnen are already presented in Chapter 2. In 2014 was the program for Frihamnen made, in 2015 will the detail plan be made and in 2016 will the construction start and in 2020/2021 will the first part of the development be finished (Göteborg Stad Stadsbyggnadskontoret, 2014).

Älvstaden

Älvstaden is located in central Gothenburg on both sides of Göta älv and is the area that will be transformed into a vibrant and attractive city center. In appendix 7 is an overview of the neighborhoods of Älvstaden is shown. Älvstranden utveckling AB is responsible for the realization of the Visions for Älvstaden, the cooperation with other actors for the realization of an ecologically, socially and economically sustainable urban area. The Visions for Älvstaden was developed in 2012, and Frihamnen is the first neighborhood that will be transformed (Älvstaden Gothenburg Stad, 2015).
4.4 THE NETHERLANDS

The Netherlands is a low-lying country which will face many challenges with the changing climate and the rising sea-level. According to KNMI and the Delta Commission, the sea level is expected to rise between 0.20 and 0.40 meter by 2050 and to 1.30 m by 2100. Combined with longer periods of increased precipitation, low-lying urban areas will face an increased risk for flooding. With 60 percent of the the Netherlands lying below the sea level, the changing climate is important policy issues in the Netherlands (Stead & Tasan-Kok, 2013).

Dutch water management
Activities to minimize and prevent flooding have been part of the planning agenda since planning began (Stead & Tasan-Kok, 2013, p. 214). The Dutch water and land management is very old and for centuries the Dutch have been constructing waterways, earthworks and barriers to protect themselves against the water. But there have been some events, where the systems could not withstand the water, for example the flood disaster in 1953, where the dikes in the south-western of the Netherlands were unable to protect the country against a combination of a high spring tide and a north-westerly storm. This led to the foundation of the Delta Commission, who became responsible for reducing the threats from sea. In 1993 and 1995 high water levels in the Maas and Rhine rivers located in the southern and central part of the Netherlands forced thousands of people to evacuate (Stead & Tasan-Kok, 2013).

Dutch urban planning
The Dutch urban planning is controlled by the government. Through integrated instruments, national spatial policies are distributed top-down to the municipalities. But in recent years the control of the government has been reduced, which left housing to market conditions. The government changed its role and is not longer the developer and financier of a project, but provides the normative framework of planning and building regulations. The lack of central direction has hampered the adaptation of new climate proofing policies (Verbeek et al., 2010).

Rijkswaterstaat
The Rijkswaterstaat is the executive agency of the Ministerie of Infrastructure and Environment (a ministry of the national government in the Netherlands) and they are working on a safe, livable and accessible Netherlands. Together with waterboards, provinces and municipalities, the Rijkswaterstaat is protecting the Netherlands from flooding. The waterboards are responsible for the regional water management, management of flood defenses and wastewater treatment in a certain area. Nowadays there are 24 waterboards compared to 3500 in 1850, which are united in the Association of Waterboards (Kuijken, 2015). Several programs have been developed to secure the Netherlands from floods; the Delta Program, Room for the River and The National Water Plan These programs will be explained below.

Delta Programma
The Delta Program is a national program, where the national government, provinces, municipalities and waterboards are working together in protecting the current and future generations from flooding. The Delta Program 2015, consists of national delta decisions and preferred strategies for subareas, which provides them with a compass for the implementation of interventions until 2050 (Kuijken, 2015). The Delta Program is under the direction of the Delta Commissioner.
The five Delta decisions are (Kuijken, 2015);

- Water safety: a new approach for protecting people and the economy from floods
- Freshwater: a new approach for limiting water scarcity and optimize the use of freshwater for the economy and utility functions
- Spatial adaptation: a new and more focused approach on the water robust and climate proof (re) development of urban areas.
- Rijn-Maasdelta: structured decisions on the water safety in Rijn-Maasdelta
- Ijsselmeergebied: structured decisions on the water safety in Ijsselmeergebied.

The four starting points for the preferred strategies in the subareas are (Kuijken, 2015);

- The Delta decisions forms the framework.
- Anticipate rather than react.
- Combine short and long term.
- Connect the water challenges with other spatial ambitions to find a sustainable solution.

Measure matrix of the Delta Program, is a program which focuses on the designing dwellings that are less vulnerable for the negative effects of the changing climate. The prevention of water damages can be based on the dry-proof method, where measures are taken to prevent the water form entering the dwelling. For example by placing watertight barriers in front of the windows and doors. Or on the wet-proof method, which allows the water to enter the dwellings, but materials are used which are not affected by the water (Robers & Straub, 2015).

Room for the River

Room for the River (RR) is a new policy, where the focus of the strategy is on ‘living with water’. It aims at creating space for the rivers. The policy is developed by the Rijkswaterstaat, waterboards, provinces and municipalities. The RR aims at an integration between water and land and is moving away from the hard boundaries between water and land. Several areas along the Rhine, Waal, Meuse, Ijssel and Lek are contributing to the flood safety by increasing river flow and discharge capacity and enhancing the spatial quality and stimulating regional economic developments (Roth & Winnubst, 2014, p. 234).

The Room for the River plan in a spatial water solution, the shift from infrastructural to spatial flood risk management have some impacts on the risk and protections of citizens, property values and the
daily life and economic activities. The spatial solutions requires new forms of negotiation and cooperation between stakeholders (Roth & Winnubst, 2014, p. 243).

**The National Water Plan**

The National waterplan provides the guidelines, principles and direction of the national water policy in the period 2016-2021, with a preview to 2050. The ambition of this document is to make authorities, companies and citizen more aware of the risks and threats of the surrounding water (Waterstaat, 2008). In this document a multi-layer safety approach is introduced. The first layer aims at preventing flooding, the second layer aims at reducing the consequences of flooding by adapting the spatial layout and the third layer aims at enhancing the emergency responses in case of a flooding. Preventing has been the main priority in the Netherlands, but the risk of a flooding can not be excluded, therefore the second and third layer were developed (Van Herk, 2014).

**Inner and outer dikes areas**

In the Netherlands a distinction is made between inner dikes areas and outer dikes areas. The inner dikes areas are protected by the Rijkswaterstaat and waterboards, who govern the safety of the residents against flooding. In the outer dikes areas there are no legal standards for the protection against water and the Rijkswaterstaat and waterboards are not responsible for the safety of these residents. These areas are primarily intended for the dispose and storage of water. In outer dikes areas along the coast and rivers the government have formulated guidelines, which the municipalities and provinces have to take into account for the development and design of the area (Waterstaat, 2008). The owners and users of outer dikes areas are responsible for the risks of damage by the water and the implementation of measures to reduce the effects of the water. Because the residents and users of outer dikes areas bears these responsibilities it is important that they are aware of the risks. ‘Specifiek beleid voor het bouwen buitendijks ontbreekt doorgaans’, ‘Specific policies for building outside the dike are missing’ (Waterveiligheid buitendijks, 2012, p. 4)

**Dutch social housing**

The Dutch housing associations own and maintain one third of the total housing stock in the Netherlands. Therefore they could play an important role in implementing the adaptation measures in the Dutch housing stock. Robers and Straub have identified five reasons why the housing associations should implement climate change adaptation measures. First it would contribute to their social task, housing associations are expected to use their resources and commercial profits to achieve societal aims closely linked to the common interest. Secondly, implementing adaptation measures can be interpreted as a legal obligation, requiring them to provide their tenants with quality housing now and in the future. Thirdly, by adapting the dwellings, the value of their housing stock can be improved. Fourth, the impacts of climate change are expected to come a serious threat to a country’s creditworthiness. Fifth, the maintenance costs of the dwellings can increase if they are not adapted to the changing climate. Thus for housing associations who own and maintain dwellings,
implementing adaptation measures could have social and financial benefits. But there are a lot of uncertainties with the changing climate, which makes the adaptation planning and implementation complicated (Robers & Straub, 2015, p. 169).

**Mitigation and adaptation in the Netherlands**

In 2006 a National Spatial Strategy was approved, which shows the government’s vision for the spatial development in the Netherlands until 2020. In this document the impacts of flooding and water shortage are included and from an important principle for the spatial development. The importance of the changing climate on the spatial planning is addressed in The 2007 Program on Climate Adaptation and Spatial Planning. Adaptation is largely a spatial issue and the main challenge for the spatial planning will be the climate proofing in the Netherlands. Besides adaptation, mitigation is also an important issue in the program. while mitigation relies on a global approach with global effect, adaptation is predominantly local or regional in scale (Stead & Tasan-Kok, 2013, p. 217).

**Dutch finance systems for flood protection**

The Waterboards collects taxes to finance the maintenance of dikes and assures the water quality. This system is not uniform across in the country and is not reflecting the individual benefits of the flood protection. The 24 waterboards are independent authorities, who can decided their own taxation systems. Some waterboards charge ‘dike-tax’; for the households who live near the dyke and benefit the most from a proper maintenance of the dyke. Other households are not charged with tax on water defenses, because their properties are located on high grounds. The water defense tax is very low, only 0.15% per each 2.500 € of property value, which is insignificant compared to other housing costs.

The subsidy, flood defense measures that are exclusively funded by the government serve as a perverse subsidy and pushes development into high risk zones. Insurances from river and costal flooding was introduced in November 2012, and from a research from Botzen and van den Bergh was shown that households are willing to pay for certain insurance arrangements. Before 2012, was heavy rainfall insurances offered (Botzen & van den Bergh, 2009).

The program Room for the River aims at setting back serval river dikes and making more space for controlled flooding. When the plans of the Room for the River program do not match the current land use, for example agricultural and residential use, the government buys the land of the individual landowners or offers them a replacement plot some where else (Botzen & van den Bergh, 2009).
4.5 DORDRECHT

The population of Dordrecht consists of around 120,000 inhabitants. It is located in the south west of the Netherlands, below Rotterdam. Dordrecht has an old historical inner city, which is characterized by multiple functions and the most important center of the region. It owns its identity to the connection with the surrounding water and has been dealing with high water levels for centuries. Stadswerven is located closely to the inner center of Dordrecht and well connected to the main infrastructure of the city, therefore it has a potential to give the inner center a new urban impulse (Masterplan Stadswerven, 2009).

Urban context
Dordrecht is located on an island and has a surface of 90 km². It is surrounded by the old Merwede river and the Old Maas in the north, the new Merwede in the south and the Dordtsche Kil in the west. The polder is protected by a 37 km long primary dike-ring, in the areas outside the dike there is a tidal differences of 80 cm (Kelder et al., 2013 & Gersonius et al., 2011).

Market conditions
The economical value of the current building stock in Dordrecht is approximately 15 billion euros. Dordrecht is part of a logistic intersection and the transport on water is important for the local and regional economy (Kelder et al., 2013). It is the most important centrum for the region (Masterplan Stadswerven, 2009).

Regulations
The municipalities in the Netherlands have three specific responsibilities concerning water:
- Collection and transport of wastewater
- Rainwater run-off; Section 3.5 of the Water Act, regulates the municipal duty to care for the efficient collection and processing of rainwater run-off (Jong & Hobma, 2012, p. 5).
Groundwater; Section 3.6 of the Water Act, regulates the municipal duty to care for groundwater (Jong & Hobma, 2012, p. 5).

Section 3.1 Spatial planning act reads: The Municipal Council shall adopt one or more local land use plans for the entire territory of the municipality, in which, in the interests of proper spatial planning, the use of the land included in the plan shall be designated and rules laid down with a view to such use (Jong & Hobma, 2012, p. 7).

According to the Spatial planning act the following aspects are relevant for the spatial plan:
- Water storage areas (in for example parks)
- Forms of roofs, density of buildings in the area (for example in the form of more green and water functions)
- A multifunctional rain water storages (Jong & Hobma, 2012).

Stadswerven
Dordrecht is growing and to be able to house this growth, a former shipyard on the edge of the historical city center in Dordrecht; Stadswerven, will be transformed into a residential area with 1600 buildings and a range of commercial, cultural and public facilities. The area that will be developed is 0.3 km² and it is surrounded by water; river the Merwede, a smaller river the Wantij and a very small river the Vlij. Stadswerven is located outside the dikes and has an average ground height of +3.0 meter NAP (Van Herk et al., 2011).

The development process started in 2001, when the municipality started to acquire the land and developed the urban masterplan for De Stadswerven. In 2005 was the urban masterplan approved by the city council. To be able to met the requirements of flood regulations, the ground level had to be raised to +4.0 meter NAP. Due to tensions between the private developers and the municipality the redevelopment of Stadswerven got delayed and suspended in 2007 (Van Herk et al., 2011). In 2009
was a new masterplan for Stadswerven developed, which is now steering for the development. In 2010 the Dutch government developed a multi layer safety pilot project for the island of Dordrecht, to improve flood safety in an area oriented development process.

Stadswerven is surrounded by water and the added value of water will be exploited, through options to live near and on the water as well as the creation of high valued public spaces. The neighborhood has to become an area in the city which is attractive and distinctive for the local, urban and regional scale (Masterplan Stadswerven, 2009).

**Urban flood management**

In 2005 to 2008 was the Urban Flood Management (UFM) Dordrecht created. This project is part of an international collaboration between, Dordrecht, London and Hamburg. The aim of UFM is to develop an integrated flood risk management approach for flood prone areas. Stadswerven is an outer dike area, which means that the high water levels has to be taken into account in the urban development (Van Herk et al., 2014). UFM Dordrecht consists of a consortium of public, private, local and national organizations (Stone et al., 2008);

<table>
<thead>
<tr>
<th>Involved actors in UFM Dordrecht</th>
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<tbody>
<tr>
<td>De gemeente Dordrecht</td>
</tr>
<tr>
<td>Waterschap Hollandse Delta</td>
</tr>
<tr>
<td>Rijkswaterstaat</td>
</tr>
<tr>
<td>Ministeris van Verkeer en Waterstaat</td>
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<tr>
<td>Provincie Zuid-Holland</td>
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<td>Dura Vermeer</td>
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<td>Deltares</td>
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<td>Progrez</td>
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<td>UNESCO-IHE</td>
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</table>

Table 8: Involved actors in UFM Dordrecht.
Developments in flood prone urban waterfronts

(Image: own photo, September 2014)
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Developments in flood prone urban waterfronts


Developments in flood prone urban waterfronts
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Masterplan Stadswerven (2009) Nieuwe stedelijkheid voor Dordrecht


Developments in flood prone urban waterfronts


Steenbergen, J. J. M., & Van Bemmelen, R. J. (2011). Land. if you don’t have it, create it. the case of ijburg, amsterdam. Irrigation and Drainage, 60(51), 4-10.


United Nations International Strategy for Disaster Reduction (2012), How to Make Cities Developments in flood prone urban waterfro


Appendix 1

PERSONAL MOTIVATION

My interest in the built environment arose when I was six and was drawing floor plans of my dream houses. All the houses and buildings I visited, I used to image and create a better floor plan or division of the buildings and at that point I wanted to be an architect. During my studies of Architecture, I realized that it is not the designing of buildings and areas that keeps me up at night, but the reasoning, logic and idea behind it.

Before we have the buildings, neighborhoods and cities we see, admire and live in, there are a lot of pieces of the puzzle that has to fall on the right place. Being part of a development that changes peoples lives and lasts for centuries is something which amaze me. My interest in waterfronts emerged when I was in Gothenburg last semester and did a project on the involvement of stakeholders and their actions against flooding in the city center of Gothenburg. The main findings from this research surprised me; the study showed that many of the involved actors were aware of the problem but did not feel the responsibility to implement actions and bear the financial responsibility therefore. There was also a desire of a national waterboard, which could bear the overall responsibility and guide the implementation of flood interventions.

Living near water is a quality and one day I see myself living there as well, but it has to be safe and to ensure this safety we have to start adapting the urban waterfronts to the changing climate. I believe that this is the responsibility of multiple actors and individuals. Institutions and private property developers are a key actor in the development and adaptation process, understanding their behavior and incentives to adapt urban waterfronts could lead to the development of urban waterfronts that are safe and appreciated by the current and future inhabitants. Gaining that insight would not only be interesting for Gothenburg and Dordrecht, it would also be very instructive and interesting for me.

Developments in flood prone urban waterfronts
### SELECTION OF CASE IN THE NETHERLANDS

<table>
<thead>
<tr>
<th>City</th>
<th>Advantages of the case</th>
<th>Disadvantages of the case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>Rotterdam has a high amount of urban assets that are exposed to coastal flooding and river flooding. Due to Rotterdam city's critical location, it has become a pioneer in climate change and spatial planning. Rotterdam's municipality have policy documents that deals with urban resilience, climate change, adaptation and mitigation. (Stead &amp; Taşan-Kok, 2013)</td>
<td>The urban waterfronts in Rotterdam are not located outside the dykes, like Gothenburg, which makes it difficult to compare. (the context is not the same) Rijnhaven with floating houses seemed like an interesting case, but the tender failed, because the submitted plans did not meet the requirements. (Peter van Veelen)</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>Waterfront developments in IJburg. Where there are examples of multiple land use; shops, schools, restaurant, housing and recreation. The area will house 45.000 inhabitants and jobs for 12.000 people (Steenbergen &amp; Van Bemmelen, 2011).</td>
<td>But IJburg has a system of sluices, dykes and embankments to protect IJburg from the IJmeer and rising sea levels (Steenbergen &amp; Van Bemmelen, 2011). Therefore IJburg is not as vulnerable for flooding as Gothenburg. (the context is not the same.)</td>
</tr>
<tr>
<td>Dordrecht</td>
<td>Area is located outside the dykes, which makes it vulnerable for the rising sea level. Stadswerven is in being developed at this moment and will be a mixed urban waterfront, which is close to the water.</td>
<td>Stadswerven is a little bit further in the development process, but this does not have to be a disadvantage.</td>
</tr>
<tr>
<td>Katwijk</td>
<td>In Katwijk a combination is made of a flood defense and a parking garage. Both interventions are placed in a dike, which made the development of the dike much more expensive (9 million euro more), but it is also generating money on the long run. The investors of the dike are; the Rijkswaterstaat, the province, water board, municipality, residents and tourists. They are also the ones who are gaining the profit on the long term (Heijden, 2013). This development is an example of a waterfront development where the developers were involved in the adaptation.</td>
<td>The Katwijk case is on a very small scale and can not really be compared with Gothenburg. Therefore this case is not selected for the comparative case study.</td>
</tr>
</tbody>
</table>
APPENDIX 3

MEETING RUBEN VERBENA DURAVERMEER

From the meeting with Ruben Verbena from DuraVermeer, the financial aspects of banks, insurance companies and valuation companies and the relation to urban area development was revealed.

Based on this meeting the figure below was made.

This model shows the relation between and investment and the access to capital to invest in a building and capital to compensate for the damage of a building in case of a flooding. In this process the valuation companies are playing an important role, because they are the ones who value the buildings, and thereby determining the capital banks and insurance companies can provide owners and users with.
Peter van Veelen enhanced the conceptual model with adding that the urban context and market conditions are very important for the development of urban waterfonts.

The market conditions influence the demand for ground and thereby the price of the land. Low lying waterfronts with risk for flooding, must be safe before developments can be made. If the municipalities would secure the area before selling the ground, different interventions are needed. These interventions, like raising the ground level and building dike cost money and makes the land price higher. In case of a bad economy, there will be little demand for expensive land. So in this case the municipality can choose to sell the land for a low price, but without any interventions to it, which means that the developer and investors will have to take the responsibility in adapting the land to the rising sea level.

The urban context is also important for the involvement of developers. If a low lying urban waterfront is secured by dams and sluices, a developer will not feel any responsibility in adapting the area to the rising sea level, because this is already regulated on a higher level.

So the market conditions and urban context influence the decisions municipalities and developers are making in low lying urban waterfonts, and has to be taken into account when two areas are being compared.
## APPENDIX 4

**CONTENT FINAL REPORT**

### ABSTRACT

5

### TABLE OF CONTENT

7

#### 1. INTRODUCTION

9

1.1 Background  
9  
1.2 Problem definition  
12  
1.3 Research goal  
15  
1.4 Case studies  
16

#### 2. RESEARCH DESIGN AND METHODOLOGY

19

2.1 Research objectives  
19  
2.2 Research questions  
21  
2.3 Research strategy and design  
25  
2.4 Research method  
25  
2.5 Case study  
26  
2.6 Research planning  
28  
2.7 Validity and generalizability  
29  
2.8 Key definitions  
30

#### 3. THEORETICAL FRAMEWORK

33

3.1 Urban planning  
33  
3.2 Institutions  
39  
3.3 Adaptation  
42  
3.4 Resilience  
50  
3.5 Private sector  
54

#### 4. CASE STUDIES

57

4.1 Europe  
57  
4.2 Sweden  
58  
4.3 Gothenburg  
62  
4.4 The Netherlands  
65  
4.5 Dordrecht  
69

#### 5. CASE STUDY FINDINGS

73

5.1 Findings Gothenburg  
73  
5.1.1 Findings urban context and market conditions  
73  
5.1.2 Findings institutions  
74  
5.1.3 Findings private property developers  
75  
5.1.4 Findings owners and users  
76  
5.2 Findings Dordrecht  
77  
5.2.1 Findings urban context and market conditions  
78  
5.2.2 Findings institutions  
79  
5.2.3 Findings private property developers  
80  
5.2.4 Findings owners and users  
81  
5.3 Findings connected to conceptual model  
82

#### 6. CONCLUSIONS

83

6.1 Introduction  
83  
6.2 Influences urban context and market conditions  
84  
6.3 Demands institutions  
85

Developments in flood prone urban waterfronts
6.4 Preferences owners and users 86
6.5 Behavior private property developers 87
6.6 Incentives for developers to adapt urban waterfronts 88
6.7 Summary conclusions 89

7. RECOMMENDATIONS 91
7.1 Recommendations private property developers 91
7.2 Recommendations institutions 92
7.3 Recommendations Gothenburg 93
7.4 Recommendations Dordrecht 94
7.5 Recommendations for further research 95

8. REFELECTION 97
8.1 Process 97
8.2 Results 99

REFERENCES 101

APPENDIX 107
APPENDIX 5

CONNECTION OF TOPICS IN THE THEORETICAL FRAMEWORK
APPENDIX 6

FLOODING NEWS FROM DUTCH NEWSPAPER; VOLSKRANT

Dodental overstromingen Texas stijgt naar 24
Aanhoudende regen heeft in de Amerikaanse staat Texas voor nog meer overstromingen gezorgd. De afgelopen week zijn zeker 24 mensen door het noodwe ... 31 mei 2015, door redactie — BUITENLAND

Zeker 52 doden door overstromingen China
In China zijn minstens 52 mensen omgekomen door hevige overstromingen. Eerder spraken de autoriteiten nog van 57 dodelijke slachtoffers. De overst ... 24 mei 2015, door redactie — CHINA

Evacuaties na recordhoeveelheid regen in Frankrijk
In de Franse regio Haute-Savoie is zo veel regen gevallen, dat zeker honderd mensen zaterdag moesten worden geëvacueerd. Volgens Franse media viel ... 2 mei 2015, door Redactie — BUITENLAND

Meer doden en vermisten na overstromingen Chili
Het dodental door de overstromingen in het noorden van Chili is opgelopen tot 25. Reddingswerkers waarschuwen dat dit aantal nog verder kan stijgen ... 5 april 2015, door Redactie — BUITENLAND

Opnieuw verzekering tegen overstromingsschade
Huishoudens kunnen zich binnenkort weer verzekeren tegen overstromingsschade. Het verzekeringssbedrijf Neerlandse komt opnieuw met een polis die ... 23 maart 2015, door Redactie — ECONOME

Evacuaties in Spanje na overstromingen
Meer dan duizend mensen zijn geëvacueerd uit de dorpen Boquineni en Pradilla, in het noorden van Spanje, omdat de rivier de Ebro buiten haar oeve ... 1 maart 2015, door Redactie — BUITENLAND

(source: Online Volkskrant visited on 4 June 2015)
APPENDIX 7

NEIGHBORHOODS IN ÄLVSTADEN

(Vision älvstaden, 2012)