# An analysis of institutional capacity for climate change adaptation in the Copenhagen area



II







# Title page

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# Abstract

The report is based on the question 'How do different municipalities in HOFOR develop their own plan to implement climate change adaptation?' Therefore focus will be on to find out what approaches that municipalities follow for climate change adaptation and how they relate these approaches with national adaptation strategy. Moreover the project will identify how municipalities work with other municipalities and how they divide their tasks among them regarding climate change adaptation. Besides, the project will identify how different municipalities cooperate with HOFOR and finally it will investigate how different municipalities engage people and other stakeholders in climate change adaptation. The report is based on multiple case studies where each municipality working with HOFOR is an individual case. The report is an exploratory one. The analysis is based on the interviews of representative persons from different municipalities, HOFOR, Avedøre Wastewater and an water expert, municipality plans and strategies and theories of sustainable urban water management, community resilience and social assessment, institutional theory and governance, power and collaborative planning.

The report shows different approaches for climate change adaption. It shows that though municipalities choose traditional pipe based approach for increasing capacity of sewerage, there is an ongoing shift from traditional pipe based approach local solutions with more green areas for handling rainwater. But this ongoing shift is not dominant yet. For this new paradigm, municipalities need to build their institutional capacity by collaborative planning approach and by resilient approach. I hereby, conclude that municipalities are collaborating with utilities for climate change adaptation very explicitly while till now citizen participation is included in the process of public hearing. Municipalities face some communication challenges to work with citizens. There are other barriers that hinder adaptation tasks for example: technical barrier, lack of manpower, lack of time, financial barrier and legislative barrier. Though some municipalities have already engaged citizens in some demonstration projects for example in Brøndby and in Rødovre citizens took part in the road renovation project. But the examples of such case are very few. Moreover, municipalities rely more on technical know-how.

### Preface

The report has been written in connection with the master's thesis within the Urban Planning and Management Program under the department of Development and Planning, Aalborg University in Aalborg. The research period for this report was conducted from 1 February to 13 June 2013.

For the references the Harvard method has been used, e.g. (Larsen 2009), if there are references with the same name and year then there is a letter added on the year, e.g. (Larsen 2009a). The full list of the references can be found at the end of the report. Appendices can be found in the end of the report.

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I hope you will enjoy the reading!

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## List of Acronyms

CCA	Climate Change Adaptation		
DKK	Danish Kroner		
DTU	Technical University of Denmark		
FAR	First Assessment Report		
HOFOR	Hovedstadsområdets Forsyningsselskab		
IPCC	Intergovernmental Panel on Climate Change		
KL	Kommunernes Landsforening		
LAR	Lokal Afledning af Regnvand		
NAS	National Adaptation Strategies		
NGO	Non Governmental Organization		
OECD	Organization for Economic Co-operation and Development		
SUDS	Sustainable Urban Drainage Systems		
UNEP	United Nations Environment Program		
UNFCCC	United Nations Framework Convention on Climate Change		

### 1. Introduction

IPCC fourth assessment report describes that in recent years there will be sea level rise, increased storms, drought, flooding and other climate related impacts (Intergovernmental Panel on Climate Change 2007) which are a real threat to urban environment. Climate change has a wide range of impacts. Therefore, most of the cities have concentration on reducing green house gas emissions and making city as a zero-carbon city. But it's a long term process while climate change is happening now. So, cities are prioritizing more on adaptation measures by taking initiatives on local handling of rainwater (LAR) solutions and making more green and blue areas around the city. By these way cities become more sustainable and resilient to live in. Like many other countries Denmark has prepared National strategy for climate change adaptation in 2008 for making a more resilient and adaptive society. It is now a law of Denmark to include climate change adaptation in the local plans. By 2013 municipalities of Denmark have to prepare climate change adaptation plan according with the agreement with the municipalities and the government. Some municipalities have already prepared climate change adaptation plan while some are preparing the plan though there are some technical, financial, regulatory and institutional constraints. All kinds of people in all sectors of society need to take the challenge to adapt climate change. Public and private authorities, companies, businesses, citizens are needed to involve in the adaptation measures. Climate change adaptation plan is needed to integrate with municipality's other plan like municipality plan, wastewater plan, water plan etc. Utility companies have a big role in climate change adaptation because in most of the cases they handle wastewater. HOFOR is a utility company in Denmark that provides different utility services to the citizens and is a forum of eight municipalities in Copenhagen. The municipalities that owned HOFOR are: Albertslund, Brøndby, Dragør, Herlev, Hvidovre, København, Rødovre and Vallensbæk municipalities. But Brøndby and Vallensbæk municipalities did not join HOFOR for waste water services instead they joined Avedøre wastewater services for wasterwater treatment. Both HOFOR and Avedøre wastewater service have a role in climate change adaptation. The combined sewerage system in Copenhagen area cannot take the pressure when there is heavy rainfall and it exceeds the capacity. Therefore, water cannot pass and there is a huge possibility of flooding in the surface. The solution could be to make the underground pipe bigger which is very costly instead there could be another solution to store rainwater on the surface and use them in an effective way so that it will not give pressure to the sewer system. Here LAR solutions are the best way to utilize rainwater by making rainwater garden, ponds, lakes, playgrounds, green roofs, infiltration trenches, tunnels etc. Some of the municipalities have already applied LAR solutions and it gave a good result. It is more pleasant to look at green and blue areas instead of looking the concretes.

Climate change adaptation plan gives an opportunity to improve the city's physical environment thus help in improving the quality of life of the citizens. Copenhagen has already prepared climate change adaptation plan that recommends using city's green and blue areas for adaptation which include private gardens, backyards, allotments, public parks, areas of natural interest, green sports fields, lakes, rivers and streams, cemeteries and green transport links. According to the plan, these initiatives will make the city of Copenhagen a pleasant city to live in. The plan recommends three initiatives for using green and blue infrastructures for climate change adaptation. These include: to preserve and care for the city's existing green areas, to supplement the city with more green and blue surfaces and to create coherent green networks in the city (City of Copenhagen 2011).

The study will identify climate change adaptation approaches of different municipalities in Copenhagen area. Therefore the main research question is:

How do different municipalities within HOFOR develop their own plan to implement climate change adaptation?

The study will find out how eight municipalities that work with HOFOR develop their own plan to implement climate change adaptation. Therefore, the main research question is divided into four sub questions.

Sub research question 1: What approaches do municipalities follow for climate change adaptation and how do they relate those with national adaptation strategy?

It is known that Denmark has already prepared national adaptation strategy where it is mentioned that municipalities have to take initiatives for climate change adaptation. But it is not possible to implement adaptation plan without the cooperation of citizens, private sectors, businesses, city planners, construction sectors and others. According to the law municipalities have to prepare climate change adaptation. The study will show how the municipalities are developing their climate change adaptation plan, which approaches they are following and which steps they are now at. Mainly the approaches municipalities will follow are divided into two paradigms in this project. One is traditional pipe based paradigm which includes making the sewer bigger and to increase the capacity of sewerage system and another paradigm is to separate sewerage system by handling rainwater locally through using city's green structures. Therefore the study will find out if the municipalities are following the pipe based approach or they are shifting to the new approach for adaptation. The study will also identify municipalities have technical deficiency, financial constraints and regulative barriers that hinders the plan.

Sub research question 2: How do municipalities collaborate with other municipalities and how do they share responsibility across boundaries in regards to climate change adaptation?

The study will find out how municipalities cooperate with each other and work across borders in climate change adaptation. Some municipalities have already prepared climate change adaptation plans for example Copenhagen and some did not. So the other municipalities those did not prepare the plan yet can cooperate with other municipality to see how they prepared the plan and can get inspiration from them. The study mainly focuses on storm water events. Rainwater passes through one municipality to other municipality as it knows no boundaries. So, cooperation is necessary here for taking initiatives otherwise one initiative could be good for one municipality but could harm another. Therefore it is important to find out if there are any conflicts in the cooperation. Besides, the study will find out the responsibilities of the municipalities for climate change adaptation and which barriers they face. Besides, the study will find out the resources of the municipalities and how they increase their adaptive capacity to make the cities more resilient to climate change.

Sub research question 3: How do they relate to HOFOR? How responsibilities in climate change adaptation are shared between municipalities and the utility?

HOROR is owned by eight municipalities. The utility companies of these eight municipalities have jointly merged in 2011 in one single organization named HOFOR. HOFOR is a new organization. The study will find out how municipalities work with HOFOR. Besides, it will investigate how they share tasks in climate change adaptation and if they follow any regulations or face any barriers while working with HOFOR. The study will also find out the capacity of HOFOR and municipalities. Besides, Avedøre wastewater is working with the wastewater of two municipalities: Brøndby and Vallensbæk. It is important to find out how these HOFOR and Avedøre wastewater work together and they have overlapping tasks. So the study will also find out the conflicting areas of HOFOR and Avedøre wastewater.

Sub research question 4: How do different municipalities engage people and other stakeholders in climate change adaptation?

According to national adaptation strategy, municipalities have to engage all kinds of related stakeholders and citizens. So, the study will find out how different municipalities engage people and other stakeholders in climate change adaptation. The study will also investigate if there is more reliance on technical department's rather than public involvement. Therefore, the study will find out which actors are given priority by the municipalities for climate change adaptation.

Therefore, the main focus of the study will be to find out whether municipalities follow a pipe based approach by increasing the capacity of sewer or they use green and blue areas for climate change adaptation. If they are moving to the new approach with more green solutions for adaptation it is important to build capacity of the municipalities. It is possible to build institutional capacity by collaborative planning approach and resilient approach. Therefore, the study will identify the institutional capacity of the municipalities and what extent they are collaborating with citizens for adaptation. The research is based on the theories on urban water management, community resilience and social assessment, institutional theory and collaborative planning theory. The analysis is based on the interviews from the responsible persons from the municipalities, utility companies and water expert and the plans and strategies which municipalities have already prepared. On the basis of analysis there will be a discussion and reflections chapter where the key findings will be discussed and some reflections will be presented. Besides, in the end there will be a chapter heading conclusions where research questions will be answered.

### 2. Theory

This chapter consists of theoretical approaches which have been used for the study. Firstly, how climate change adaptation is approached in different literature is described. Other theories which are used for this study are sustainable urban water management, community resilience and social assessment, institutional theory and collaborative planning theory. The study deals with climate change adaptation approaches. Therefore it is necessary to know how different literatures and theories define climate change adaptation. Due to the extreme rainwater events and cloudburst the intentions of the urban water professionals are to manage urban water in a more sustainable way. So, by using this theory it is possible to understand how to utilize urban water more sensitively and in a more resilient way. The study will find out the adaptive capacity and internal resources of the municipalities. Therefore, community resilience and social assessment theory is used here in the project. Institutions can enable and constrain opportunities to respond to changes in the environment and good governance can produce good plans and strategies. These theories are used to find out how planning is done in the Danish context. Without having collaboration it is very hard to adapt. Therefore, the study uses the theory of collaborating planning to see how collaboration can help to develop and implement climate change adaptation plan. In Denmark climate change adaptation is considered within spatial planning area where there exists hierarchical orders of functions and a clear boundary between public and private sector. More details of the theories are described in the sections below.

#### 2.1 Climate change adaptation

The intergovernmental Panel on Climate change was created in 1988 with the vision to provide the world a clear scenario of world's changing climate (Intergovernmental Panel on Climate Change 2013). The main task of IPCC was to prepare a comprehensive review and recommendation of climate change, social and economic impact and possible response strategies and elements for climate change. Today IPCC's role is to gather the scientific, technical and socio economic information for climate change in a comprehensive and transparent way and also to see the potential impacts for adaptation and mitigation. The first IPCC assessment report was published in 1990 showing the importance of climate change in a political platform to tackle the relevant impacts of climate change. The second IPCC assessment report was published in 1995 considering Kyoto protocol and third and fourth assessment report was published in 2001 and 2007 (Intergovernmental Panel on Climate Change 2013). Biesbrock et al. (2010) argue that the assessment reports of IPCC till now focused on climate change mitigation strategies where adaptation strategies were ignored (Biesbroek et al. 2010). But in their fourth assessment report IPCC includes the importance of adaptation measures. According to IPCC, adaptation is the adjustment in natural and human systems to actual or expected effects of climate change that causes harms or creates beneficial opportunities (Intergovernmental Panel on Climate Change 2007). Adger et al (2009) mention that countries are adopting climate change policies slowly despite climate change adaptation has been an agenda in the global discourse (Adger et al. 2009) and even though Kyoto Protocol's (1997) second article prioritizes to ensure adaptation strategies in different sectors (United Nations Framework on Climate Change 2013). Adaptation practices have several dimensions. It can be local, regional and national level, by sector wise like (water resources, agriculture, tourism, public health and so on), by type of action (physical, technological, investment, regulatory, market), by actor (national or local government, international donors, private sector, NGOs, local communities and individuals), by climatic zone (dry land, floodplains, mountains, arctic and so on) etc (Intergovernmental Panel on Climate Change 2007).

Different literature suggests that there is an important role for public policy in facilitating adaptation to climate change including reducing vulnerability of people and infrastructure, providing

information on risks for private and public investments and decision making, and protecting public goods such as habitats, species and culturally important resources (Intergovernmental Panel on Climate Change 2013). Agrawala (2005) clarifies the term 'mainstreaming' which refers to the integration of climate change vulnerabilities or adaptation into some aspects of related government policy such as water management, disaster preparedness and emergency planning or land use planning (Agrawala 2005). By implementing mainstreaming initiatives, it is expected that climate change adaptation will be integrated with other well-known planning like sustainable land use planning (Intergovernmental Panel on Climate Change 2007). Most of the adaptation planning literature emphasizes the role of governments and the barriers that hinder the implementation of adaptation actions. There are five major constraints that are identified by Agrawala and van Aalst (2005) for climate change adaptation. These are: (a) relevance of climate information for development-related decisions; (b) uncertainty of climate information; (c) compartmentalization with governments; (d) segmentation and other barriers within development-cooperation agencies; and (e) trade-offs between climate and development objectives (Agrawala & van Aalst 2005) (Intergovernmental Panel on Climate Change 2007).

Lund et al (2012) suggest that adaptation focuses on physical measures and institutional changes (Lund et al. 2012). But due to the institutional changes the division of responsibilities between institutions becomes blurry in case of climate change adaptation. Therefore, new organizations get the responsibility to prepare climate change adaptation strategy to avoid conflicts between government institutions (Biesbroek 2010).

The above discussion gives an overview of how climate change adaptation is included in planning arena. It also shows the importance of climate change adaptation. Climate change adaptation is a new task of planning. So, municipalities face some barriers due to the institutional changes. In Denmark municipalities will prepare climate change adaptation plan but it is also the responsibility of the utility company. Therefore, there are some institutional changes which will be discussed in the analysis chapter from the above theoretical perspectives.

#### 2.2 Sustainable urban water management

This section deals with sustainable urban water management where it shows different transitional phases to reach water sensitive city. The main goal of the water professionals is to make city water sensitive so that it can react positively to climate change and poses adaptive capacity. While making the city resilient to climate change it will also increase the living quality of urban areas by improving the infrastructures and by making more green and blue areas. Details of sustainable urban management water management theory are presented below:

Due to the climate change cities are experiencing heavy downpours which later causes floods if water management system is not adequate. Urban water management is a challenge for the water professionals because in urban areas the density is very high. Besides, there are not adequate green and blue areas in the city which can protect cities from flooding. Therefore, sustainable urban water management is necessary to make the city resilient to climate change. An emerging challenge for water professionals is to design for resilience to the impact of climate change which will consider ensuring safe water supply and protecting water environment. Though it is viewed the tremendous success of innovating sustainable technologies in many cities researchers argue on sustainable water management is very slow. Brown et al. (2009) published a paper on "urban water management in cities: historical, current and future regimes" where they present an urban water transition policy development (Brown et al. 2009). This framework characterizes the transition of urban water management practices through the temporal, ideological and technological contexts while passing

through different management paradigms. This framework is also characterized by another concept 'hydro-social contract' which is developed by Lundqvist et al. (2001). This contract includes agreements between communities, governments and business on how water should be managed. This contract is based on cultural perspectives, historical values, institutional frameworks and regulatory measures. Brown et al. (2009) present different stages of urban water management transitions framework where they show cities transitions through when pursuing change to more sustainable futures (Brown et al. 2009).



Figure 1: Urban water management transition framework (Brown et al. 2009)

In the framework the cumulative socio-political drivers represent the normative and regulatory pillars of institutions and service delivery functions represent the cognitive pillar of institution. The first three cities (water supply city, sewered city and drained city) are developed from historical phase. Waterways city is a part of water cycle city. Brown et al. (2009) argues that no city has until today developed as a water sensitive city yet though scientists and researchers have already gained interests to make cities sustainable in the future. Brown et al. (2009) highlight that the hydro social contract for water sensitive city would integrate the normative, cognitive and regulative measures as well as make the city resilient to climate change. This will also provide sustainable lifestyle and will increase the capacity of professionals and practitioners for innovation and sustainable management of city's water resource (Brown et al. 2009).

The sustainable urban management transition framework helps to identify if the city is water sensitive or not. Besides, this framework will be used to find out which approaches municipalities are following now for example, if the municipalities follow traditional pipe based approach or they are shifting to the new paradigm of using green infrastructures to make the city more sustainable.

#### 2.3 Community Resilience and social assessment

This section will discuss theories about resilience approach and social assessment. A resilience approach is important for climate change adaptation as it is a tool to identify community's resources, vulnerabilities and adaptive capacity. By using this tool it will be easier to find out how community's inhererent resources can be used to increase the adaptive capacity. The more details of this theory are discussed below:

Maguire and Cartwright (2008) argue about social resilience, vulnerability and society's adaptive capacity in a paper named 'assessing a community's capacity to manage change: A resilience approach to social assessment. They mentioned that resilience approach is a powerful tool that identifies community's resources and adaptive capacity to overcome challenges. The approach finds out community's inherent capacities to cope with vulnerabilities. In their paper they clearly discussed the relationships between vulnerabilities, adaptive capacity and social resilience (Maguire & Cartwright 2008). They identified vulnerability as the components that weaken a community's ability to respond adaptively to a change. Adaptive capacity in their view is the community's inherent ability to cope with changes and social resilience is the community's ability to respond adaptively to a change. Adaptive capacity is closely related with the term adaptation. Brooks (2003) argues that adaptation is the adjustments in a system's behavior and characteristics to enhance its ability to cope with the external stresses (Maguire & Cartwright 2008). Smit and Wandel (2006) mention that adaptation is the actions that community takes to reduce vulnerabilities and increase resilience while adaptive capacity is the ability to take these actions. Adaptation is measured as a community's actual response to a change while community's adaptive capacity is assessed through the use of indicators like local leadership, communication channels and community's ability to organize (Maguire & Cartwright 2008). Brooks (2003) argues that it is important to explore the factors and processes that enable adaptive capacity to be translated into adaptation. Therefore, resilience is important which enables community to utilize it's resources to transform and response to a change in an adaptive way. A resilient community is able to employ its resources and its adaptive capacities in a proactive and pre-emptive way. Folke (2006) argues that resilience is more than the ability to adapt to a change and it involves transformation, encompassing the capacity for learning, innovation, renewal, reorganization and attaining sustainable state. Paton (2006) argues that social resilience is more that returning to a previous state but includes the capacity to learn and benefit from the new possibilities of changes (Maguire & Cartwright 2008).





The components of resilience conceptual framework are: resilience, vulnerabilities, resources, adaptive capacity, response and external processes. As already discussed resilience is the ability of a community to respond to a change adaptively to be transformed to sustainable state. Resilience is shaped by its vulnerabilities, resources and adaptive capacities. Vulnerabilities are the components that weaken community's ability to respond adaptively to a change. Resources are the strengths and abilities of a community to overcome vulnerabilities and to respond adaptively to change. Brooks (2003) defines adaptive capacity as the ability or capability of a system to modify or change its characteristics or behavior to cope with actual or anticipates stresses. Response has a certain degree of resilience and is driven by its ability to build on its resources and adaptive capacity and to translate these into adaptation. External processes are the political, economic and physical environment that influences a community's response to change including internal vulnerabilities and resources and the way in which this is transformed into adaptive action (Maguire & Cartwright 2008).

Social assessment is a process of collecting, organizing and analyzing information about a community. Taylor et al. (1995) mention that social assessment is conducted using social analysis, evaluation and monitoring through processes of stakeholder engagement. Public involvement and community engagement are integral parts of social assessment. Stenekes et al. (2008) argue that a participatory approach to social assessment is conducted through group negotiation, collaboration and cooperation. Maguire and Cartwright (2008) argue that if the community is involved in the process of change from the very beginning, the level of uncertainty may be reduced and community's resilience to the change can be increased. Moreover, community involvement in the social assessment process promotes community participation with other stakeholder groups. If community members are excluded from the participation process then uncertainty about the change will develop (Maguire & Cartwright 2008).

Stakeholder engagement is more important in a resilience based social assessment where community members are able to provide the best understanding of the communities and its vulnerabilities, resources and adaptive capacities. The underlying principle behind stakeholder engagement is that experts knowledge varies from one discipline to other disciplines and for different interests. Different stakeholder groups can offer important insights and their involvement is essential in each phase of planning (Maguire & Cartwright 2008).

The resilience approach will be used as an analytical tool for this project. From the interviews all the data about resources and vulnerabilities will be gathered. Besides, information about municipalities adaptive capacity will also be collected. The resilience approach will be used to assess adaptive capacity of the municipality for climate change adaptation through identifying communication channels and stakeholder engagement. In the analysis chapter the resilience approach for the municipalities will be presented to get overall scenario of the municipality's adaptive capacity.

#### 2.4 Government, Governance and Institutions

In the following sections institutional theory and capacity building framework will be discussed. Institutions play an important role in climate change adaptation. Institutions enable and constrain actors opportunities to a changing environment. Besides, it deals with how government institutions take the leading role in case of climate change adaptation where expert's knowledge is highly prioritized in the arena of climate change. Moreover, the theory of institutional capacity building will be discussed to find out the institutional capacity's of the municipalities.

According to Scott, institutions define legal, moral and cultural boundaries that support and empower activities of the actors. Institutions function to provide stability and order which is also regarded as a process. Institutions operate at multiple levels from national level to interpersonal level. Institutions have three vital ingredients – regulative, normative and cultural cognitive systems that provide stability and meaning to social behavior that consists of rules and regulations (Scott 2001). The regulative pillar represents rules and regulations through contracts and membership guidelines. Normative pillar consists of norms, values and beliefs of constituents that provide social stability and order. On the other hand, cognitive pillar operates through the individual level of analysis (Bansal & Penner). Brown et al. (2009) argue about new institutionalism in their article on 'Urban water management in cities: historical, current and future regimes' where they mentioned that new institutionalism deal with the processes of institutional change. While Healey (1997) mentions that institutions comprise of both hard and soft infrastructure. By hard infrastructure she means formal organizational structures, departments, formal committees, laws, taxes and subsidies while social relations, informal networks, administrative routines, professional cultures and social worlds are soft institutions (Brown et al 2009).

In the paper delving into the "Institutional Black Box": Revealing the attributes of sustainable urban water regimes, van de Meene and Brown identify the institutional capacity (van de Meene et al 2009). In their paper they identify four spheres as sustainable management regimes: administrative and regulatory sphere, inter- organizational sphere, intra-organizational sphere and human resource sphere.



Figure 3: Management Regime Framework and Capacity Building Initiatives (van de Meene et al. 2009)

Good governance fulfils public interests by focusing on the institutions. Most of the cases, there exists representative democracy in the ruling of government system. In this case government either follows legal obligation or are flexible in the way of ruling which allows developing hierarchical structures (Healey 2006).

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Figure 4: The governmental structure in Denmark. Source (COMMIN n.d.)

Termeer (2012) states that governance institutions are concerned with policy making and implementation. Healey (2006) states that governance is the process for managing collective affairs of the society.

"Governance involves the articulation of rules of behavior with respect to the collective affairs of a political community and of principles for allocating resources among community members" (Healey 2006, 206pp).

Governance activities are diffused through the multiplicity of social relations. But it is a matter of concern how these responsibilities are distributed through public and private sector (Healey 2006). She explains governance as an institutional approach not only focuses on the interactive nature of governance process but also how social networks work with government institutions. Healy (2006) also emphasizes more on the reasoning rather than technical and rational planning processes. She also states that governance is a process that can manage collective affairs through forming rules and regulations.

In Denmark public hearings are mandatory and collaboration is integrated through the hearings (Lund et al. 2012). In most of the cases comprehensive municipal plans are usually established by the time of the hearings. It then becomes an institutional part of the Danish government system (Lund et al. 2012). Furthermore, due to the presence of expert planner, participation of citizens and ordinary people becomes less meaningful as expert planners may be willing not take suggestions, complaints etc. into account and include it in their plans as they are more confident about their plans and decisions. This example shows how public administration in a classical government system is organized. The government system consists of a functional, specialized bureaucracy with departments consisting of professionals with the necessary knowledge to institute the political decisions that they are well-informed and well-implemented based on a high quality of expert knowledge (Ploger 2001). This form of government system refers representative democracy where representatives are elected i.e. politicians who are overseeing the work of officials in the different departments of a government. Their task which is guided by their officials, both administrators and experts, is to articulate the public interests in issues such as climate change adaptation and to develop government action to archive these interests. In this case officials are answerable to the politicians and politicians are answerable to the people (Healey 2006).

Institutional capacity building framework will be used as an analytical tool for the project. The framework consists of four spheres. From the interviews, all the data about these four spheres will be collected and then analyze to find out the institutional capacity of the municipalities where the main purpose will be to identify the human resource skills, municipality's inherent capacity, municipality's collaboration with other stakeholders and finally the administration and legislation on climate change adaptation. This framework will help to identify the institutional capacity of the municipalities.

#### 2.5 Network Power and Collaborative Planning

In the following section collaborative planning theory will be discussed along with how to exercise power in collaborative planning. Besides, it will be discussed how to approach collaborative planning and why collaborative planning is important for climate change adaptation.

Climate change affects a number of policy sectors i.e. finance, health, transportation and planning etc. Therefore, it is needed to consider all the sectors that are directly or indirectly related with climate change. Climate change adaptation is a collaborative approach. It is needed to consider all the aspects from different sectors to make any plan or strategy. Mainly this part will look at collaborative planning approach for planning purpose and discuss why collaborative planning is important for climate change adaptation.

Bayley (2008) argues that government includes different stakeholders in the policy making to make the governance system more transparent. By this way, central government and regulatory agencies make the system disillusionment as there is a scope of greater use of consultation and stakeholder participation in public decisions (Bayley 2008). He also mentions that stakeholders' involvement and such kinds of movements in decision making are seen in Europe and United States. Denmark is also practicing collaborative approach. Copenhagen municipality has developed "urban renewal" project that includes businesses, companies, people, schools, NGOs etc. to understand the needs, values and interests of the citizens residing that area.

Healey (2006) argues that governments use collaborative planning to make policies as improves coordination and legitimacy and address conflicts in a strong way (Healey 2006). She also mentions that public communication is a process where collective affairs are managed and thus becomes a part of policy-driven governance. Pløger (2001) adds here, governance involves rules and behavior to manage these collective affairs and public interests (Ploger 2001).

While talking about how to deal with planning the perception of power comes. David Booher and Judith E. Innes (2002) mentions that power is challenging as planners conceive them as powerless in their paper "Network Power in collaborative Planning". On the other hand, John Forester (1989) argues that what planners do is part and parcel of what form in society (Booher 2002). Forester identifies that information is power and he argues that if planners ignore this they become powerless. Therefore he suggested not ignoring power relations; instead planners need to understand how these relations shape planning processes (Forester 1989). Booher and Innes (2002) find the importance of power in collaborative and communicative approach in planning styles to seek consensus building. Collaborative planning includes face to face discussions of stakeholders to make necessary plans, policies and public issues and planners' everyday exercise power through their communication of planning commissioners, developers and others (Booher 2002).

Forester (1989) identifies about five kinds of planners: technician, incrementalist or pragmatic, liberal-advocate, structuralist and what he himself calls the progressive (Forester 1989). These five types of planners deal with power in different ways which makes practical and political differences. For the purpose of the project only technician and progressive types of planners will be discussed

one is based on hierarchical structure and other is on collaborative approach including participation of governmental and non-governmental actors. Technician is interested in technical information that needs expert knowledge (Forester 1989, Ploger 2001). Lund et al. (2012) mention that in Denmark climate change adaptation is handled in the technical departments in the municipality that make adaptation is a technical issue (Lund et al. 2012). Progressive planner deals with information as they think that information is power that allows public participation (Forester 1989).

Booher and Innes (2002) identify about an alternative form of power that emerges from consensus building and other kinds of collaborative planning (Booher 2002). They call it network power which came from collaboration, consensus building, community partnerships, businesses etc. They also argue that planners can play different roles like: technician, participant, facilitators or advocates in convening stakeholders and in making sure that processes can meet the conditions of network collaboration (Booher 2002).

# 2.5.1 How to Approach Collaborative Planning in climate change adaptation

Termeer et al. (2012) identify six qualities of government institutions: variety, learning, room for autonomous change, leadership, resources and fair governance in their paper titled "Institutions for adaptation to climate change: comparing national adaptation strategies in Europe". Here they argue that stakeholder participation is an important measure to create qualitative governance institution which builds on the six qualities of government institution (Termeer et al., 2012). Even though government institutions have all the basic qualities Termeer et al. (2012) argue that they still have five weaknesses which can cause tensions in the long term. These five weaknesses are: lack of openness towards learning and variety, strong one sided reliance on scientific experts, tension between top-down policy development and bottom up implementation and distrust in the problem solving capacity of civil society and lastly the inequity of reserving funding for long term action (Termeer 2012). Termeer et al. (2012) investigate to what extent historically grown governance institutions can enable society to cope with the new challenges of climate change adaptation. Their investigation is based on case study which concludes that strategies were created behind the closed doors. In some of the cases public hearings were organized where only a few people those who were aware of this process and were interested reacted. In all the cases there was a big reliance on scientific information that was used to gain legitimacy of the strategies (Termeer 2012).

Healey (2006) argues that politicians take care of public affairs in regards to public interest in the form of representative democracy (Healey 2006). She also adds that municipalities started to show interests in integrating public participation in local spatial planning since 1960's which show the evidence to overcome the weakness of representative democracy. The integration of stakeholder involvement in a representative democracy challenges the power shifting from experts and professionals to valuing a broader form of knowledge that Booher and Innes (2002) refers to as Network power in collaborative planning

Booher and Innes (2002) argue that three basic conditions must be fulfilled to emerge network power in a significant way which is: diversity, interdependency and authentic dialogue. Agents like stakeholders, agencies and citizens have different interests and knowledge. Therefore, it is needed to recognize diversity of values, resources, experiences and information for networking. The second condition is that agents recognize their interdependency through each other's actions and thus fulfill their own interests. The third condition is authentic dialogue. It is important that participants in the network have a dialogue in which all are empowered and informed. They also argue that the communication flowing through the network must be both accurate and trusted by participants (Booher and Innes, 2002). Bayley (2008) clarifies participatory processes in a paper "Designing a participatory process for stakeholder involvement in a societal decision." He distinguishes between process and instruments where he identifies information websites, opinion surveys, citizen juries, stakeholder's workshops as instruments. These instruments lead to a process to interact with public and stakeholders leading up to a decision (Bayley 2008).

Collaborative planning is important because of several reasons. Lund et al. (2012) argue that dialogue, networks and collaboration is important across the companies, citizens, businesses, insurance companies and neighboring municipalities (Lund et al. 2012). These are important as they consist of groups which have important local knowledge (Lund et al. 2012, Urwin 2008, Storbjörk 2010). Secondly collaborative planning is important to motivate citizens and business for implementation of adaptation measures properties i.e. local seepage of rainwater and green roofs etc. (Füssel 2007, Lund et al. 2012). Lund et al. also mention that collaboration with research institutions, state agencies and consultants help to gain the most recent knowledge about local climate change effects and uncertainties (Lund et al. 2012). And lastly participation through networks, collaboration with consultants etc. can lead to added value within adaptation measures (Lund et al. 2012, Storbjörk 2010).

The research will find out how different municipalities within HOFOR develop their own plan to implement climate change adaptation. From the research question it is already seen that there exists collaboration with municipalities and utility company HOFOR as they are working together for preparing climate change adaptation plan. Therefore, it is necessary to find out how municipalities are collaborating with Utility Company HOFOR for adaption and how they share their responsibilities regarding climate change adaptation. Besides, collaborative planning theory will be used to identify how municipalities collaborate with other municipalities, citizens and other stakeholders. Detail of the analysis will be found in the analysis and interpretation chapter.

### 3. Methodology

This chapter gives an overview of methods used for the project. In the first section case studies that is appropriate for the project is described. The second part comprises of applied research of the project which describes research questions and applied methods and overall research design of the project. Theoretical approaches used for the project are: literature review on climate change adaptation, sustainable urban water management transitions, resilience approach, institutional theory and collaborative planning theory. The empirical data were collected from the interviews and from the planning documents and strategies. The detailed methods used for the study is described in the below section:

#### 3.1 Case Studies in General

Case study research method is used in several disciplines like sociology, psychology, political science, business, community planning and even in economy to contribute to our knowledge about complex events. Case study research method is a unique and strong research strategy in social science while comparing with other strategies like experiments, surveys, histories and the analysis of archival information (Yin 2009). Case study's unique strength is it's ability to deal with a full variety of evidence like documents, artifacts, interviews and observations. In the book 'Case Study Research, Design and Methods' Yin prefers to use case study as a research strategy when 'how' and 'why' questions are being posed over contemporary set of events and when the investigator has a little control over those events (Yin 2009). Again case study is preferred in examining contemporary set of events that adds two sources of evidence: direct observation of the events being studied and interviews of the persons involved in the events. But many researchers ignore case studies as a research strategy instead they choose experiments or surveys. Yin mentions several reasons for that like case studies take too much time, not follow systematic procedures, biased views to influence the direction of the findings and conclusions, little basis for scientific generalization etc (Yin 2009). On the other hand, Flybjerg identifies some critiques made by his teachers and colleagues in this article "Five Misunderstandings about Case-Study Research". They argue that one cannot generalize from a single case while social science is about generalizing. Some other researchers argue that case studies can be used for pilot project and not for the full-fledged research schemes while others argued that case study is subjective that gives too much scope for the researcher's own interpretations (Flyvbjerg 2006). He argues about these misunderstandings and concluded that case study is a necessary and sufficient method for important research in social science.

#### 3.2 Multiple Case Study

Yin mentions two types of case study in his book 'Case Study Research, Design and Methods': single case study and multiple case study. As the study focuses on the how municipalities in HOFOR develop their own plan for climate change adaptation. There are eight municipalities that are working with HOFOR. Therefore these eight municipalities are eight cases here. The chosen unit of analysis is HOFOR here. Besides, the case study is an embedded one where each single case has one single unit of analysis. But in his book Yin describes some of the positive and negative side of using multiple case studies. He mentions that multiple case studies require extensive resources and time. He argues that it is needed to choose multiple case studies: one is to predict similar type of results for each case and other is to predict contrasting results for the cases. In this project it is expected that the eight cases will have similar type of results but there will arise some dissimilarities also. The study will identify which approaches municipalities follow to develop climate change adaptation plan. Here the answer could be either they rely more on technical matters or they rely on a new approach with green solutions. For this shifting it is needed to identify institutional capacity of the municipalities through collaborative planning and resilient approach. Therefore, the study will investigate how

municipalities are working within the municipalities, across borders, HOFOR, citizens and other stakeholders. The study will identify the barriers and challenges each municipality face and furthermore find out the capacities of the municipalities.

#### 3.3 Research Question and Applied methods

In this section the applied methods employed during the course of the research will be discussed. Firstly the problem area will be described and it will be followed by the research questions and hypothesis and then the research design and analytical framework will be discussed which will include an analytical table linking the research questions to theoretical knowledge and sources of data collection.

#### 3.3.1 **Problem formulation**

Traditionally Denmark focuses more attention on mitigation rather than adaptation on climate change as it has not experienced major climate related disasters before. But in recent years, Denmark has experienced flooding in Copenhagen where in summer 2011 and 2010 due to heavy rainfall. The Danish national adaptation strategy was adopted in March 2008 which includes the vulnerable sectors where climate change is expected. It has included scientific, technical and socioeconomic measures that should be followed by the municipalities. Moreover, it is mandatory in Danish planning law that climate change adaptation should be included in the local plans of all the municipalities. Therefore municipalities have started to develop climate change adaptation plans. Some of the municipalities have already developed adaptation plans while others are developing. But it is needed to examine whether these municipalities are following national adaptation strategy or they are preparing their own plans considering socio-economic, technical and scientific measures of the particular municipality. Climate change adaptation is not an easy task and it is a long term process. The task force needs to consult with technicians as well as residents and also other stakeholders like utility company, insurance company and interested groups. According to the law, utility companies will prepare flood maps which will be included in the climate change adaptation plans. Therefore, there is a need for cooperation with municipalities and utilities. According to Danish water sector law, utility companies handle wastewater while municipalities do projects on the surface. But climate change adaptation tasks include handling both surface areas and underground areas. But the law did not clearly mention the responsibilities of municipalities and utility companies. Therefore, the study will identify how municipalities work with utilities and how do they share their responsibilities. In this project eight municipalities that work with HOFOR service area has been chosen. These municipalities are: Albertslund, Brøndby, Dragør, Herlev, Hvidovre, København, Rødovre and Vallensbæk. There is a scope for investigating the considerable approaches that municipalities will follow for climate change adaptation. Besides, the study will identify whether municipalities follow pipe based approach or they are moving from the traditional pipe based approach to new paradigm by using green areas for local drainage of rainwater. Besides, if the municipalities will use the approach of new paradigm it is needed to build institutional capacity. Therefore, the study will investigate the institutional capacity by analyzing four spheres of managing institutional regimes by considering collaborative planning and resilient approach.

#### 3.3.2 Research Question

The main research question of the study is:

How do different municipalities within HOFOR develop their own plan to implement climate change adaptation?

Sub research question 1: What approaches do municipalities follow for climate change adaptation and how do they relate those with national adaptation strategy?

Sub research question 2: How do municipalities collaborate with other municipalities and how do they share responsibility across boundaries in regards to climate change adaptation?

Sub research question 3: How do they relate to HOFOR? How responsibilities in climate change adaptation are shared between municipalities and the utility?

Sub research question 4: How do different municipalities engage people and other stakeholders in climate change adaptation?

**Error! Reference source not found.** provides an overview of the research questions, theoretical knowledge required and data sources that were used to help conducting research.

Research guestion	Sub research question	Theoretical question	Data sources
How do different municipalities in HOFOR develop their own plan to implement climate change adaptation?		What is in the theory about climate change adaptation planning?	(Intergovernmental Panel on Climate Change 2013), (Intergovernmental Panel on Climate Change 2007), (Biesbroek et al. 2010), (Adger et al. 2009), (United Nations Framework on Climate Change 2013), (Agrawala 2005), (Agrawala & van Aalst 2005), (Lund et al. 2012), (Biesbroek 2010)
		How sustainable urban water management is defined in the theory?	(Brown et al. 2009).
		What is community resilience approach and how it is used in climate change adaptation?	(Maguire & Cartwright 2008)
		How to define institutional capacity?	(Scott 2001), (Brown et al 2009), (van de Meene et al 2009). (Healey 2006), (Lund et al. 2012), (Ploger 2001), (Termeer 2012)
		How to approach collaborative planning?	(Bayley 2008), (Ploger 2001), (Booher 2002), (Forester 1989), (Lund et al. 2012), (Termeer et al., 2012), (Booher and Innes, 2002), (Bayley 2008), (Urwin 2008, Storbjörk 2010)
	What approaches do municipalities follow for climate change adaptation and how do they relate those with		Interviews with Palle D. Sørensen, Center for Park and nature, Copenhagen Municipality

Table 1: Overview of research questions, theoretical knowledge and data sources

national adaptatio	n	Ciercial Claub a Unbase relation of
strategy?	_	Sigrid Giarbo, Urban planner,
How do municipalitie	S	landscape architect,
	r	Albertslund Municipality
municipalities and no	V	
do they shar	e	Hans-Henrik Høg,
responsibility acros	S	forsyningschef, Albertslund
boundaries in regard	S	Forsyning
to climate chang	e	
adaptation?		Morten Beha Pedersen,
		cand.techn.soc, Hvidovre
How do they relate t	0	Municipality
HOFOR? Ho	v	
responsibilities i	n	Lars Kuhnau Hansen, Rødovre
climate chang	e	Municipality
adaptation are share	d	
between municipalitie	S	Sonia Sørensen, Section
and the utility?		leader, planning department
How do differer	t	Rikke Nicolajsen, Avedøre
municipalities engag	e	wastewater services
people and othe	r	
stakeholders in climat	e	Søren Hansen, Avedøre
change adaptation?		wastewater services
		Chiara Fratini, MSc. Env. Eng.,
		Ph.D. fellow, Water expert,
		Center for Design, Innovation
		and Sustainable Transition,
		Aalborg University – CPH
		And municipality documents
		on climate change adaptation
		from websites.

#### 3.4 Research design

Yin mentions about three general purposes in his book ´ Case Study Research´ to lead case study strategy: exploratory case studies, descriptive case studies and explanatory case studies (Yin 2009). The research question of this project is: How do different municipalities within HOFOR develop their own plan to implement climate change adaptation. The goal of this project is to find out the approaches that municipalities will follow for the implementation of climate change adaptation plans and how they are collaborating with different stakeholders for this purpose. Therefore the case study is an exploratory one.

The main goal of this project is to find out how do different municipalities that work with HOFOR follow national adaptation strategies and how do they implement climate change adaptation. To reach the goal it is necessary to find out the approaches that municipalities follow for climate change adaptation and how do different municipalities engage people and other stakeholders in case of climate change adaptation. The project is based on theoretical knowledge of sustainable urban water management, resilience theory, collaborative planning, Danish climate change adaptation strategies, municipality's climate adaptation plan etc. The analysis of this research is based on the interviews

from the respective persons of different municipalities, utility companies and water expert. Based on the theories and interviews research design is prepared.



#### Figure 5: Research design of the project

#### 3.5 Analytical framework

This section presents the analytical framework of the research which will be used as a guideline for further analysis. In the theory chapter literature originating from climate change adaptation, sustainable urban water management, resilience research, institutional theory and institutional capacity building are reviewed. The framework on Sustainable urban water management will also be used as an analytical tool for the research.

The basic approach is to investigate an ongoing change of paradigm as part of the climate adaptation and this includes an institutional capacity building. Based on the literature a tube based and technocratic approach is being described as the dominating approach. First step of the analysis will be to identify whether municipalities follow pipe based approach or develop a new integrated approach for climate change adaptation. Secondly if there occur any paradigm shift from the pipe based approach to the new paradigm. Therefore, it is needed to identify the institutional capacity to discuss how the institutions can perceive these changes. In order to look at these changes, it is needed to find out the capacity building of the institutions which can be done through resilient approach and collaborative planning. The detail of the analytical framework is discussed below.

The study will investigate how do different municipalities in HOFOR develop their own plan to implement climate change adaptation. For this purpose, the research work will identify the approaches municipalities follow, their capacities and challenges they face and their collaboration with other municipalities, utility companies and citizens.

The analysis will be based on interviews of responsible persons for climate change adaptation in different municipalities and utility companies. Besides, there will be another interview with a water expert to find out about the changes in the water sector law and how this affects plans especially climate change adaptation plan and how this affects the responsibilities of the municipalities and utility companies. Only interviews are not the basic data for the analysis. It will also incorporate the plans and strategies which municipalities have already made and theoretical knowledge that are already discussed in the theory chapter.

The sustainable urban management framework tool will be used here as an analytical framework for the project. Due to the extreme rainwater events and cloudbursts urban water professionals want to manage urban water in a more sustainable way. Sustainable urban management framework shows the transitions of urban water management. As discussed in the theory chapter that the framework shows the water transitions from one stage to another stage in a more sustainable way. In the framework six stages of water transitions are presented where the stages are: water supply city, sewered city, drainage city, waterways city, water cycle city and water sensitive city. For the purpose of the analysis this framework will be divided into two paradigms: pipe based approach and new paradigm with green growth. Water supply city, sewered city and drainage city are identified as technocratic paradigm where waterways city, water cycle city and water sensitive city are identified as new paradigm with green growth as these cities prioritizes green urban structures along with water. This analytical framework will help to identify whether municipalities water management system goes in the technocratic paradigm or it transforms to the green growth. Another option could be whether municipality's water management system includes both the paradigms. This is an important tool for the analysis as it will find out the approaches of municipalities whether their approaches are still dominated by a more technocratic and tube based approach and to identify traces of a new approach for urban water management with more green areas.

This new approach does not consider only sustainable water management but also raises the values of the cities. So, citizens can get water in their surroundings for recreational purpose. Besides, this framework will also identify whether the cities are resilient or not. The resilient approach as discussed in the theory chapter not only considers the technical and natural aspects but also a society's adaptive capacity that includes resources and vulnerabilities of the cities but also involves citizens so that they can react effectively against climate change.

The transformations from one paradigm to another paradigm by emphasizing more green and blue structures for water management are not possible without institutional changes. These transformations will change regulative, normative and cultural pillars of the institutions. The normative pillar relates to the growing focuses on the importance on integrated climate change adaptation approaches that include stakeholders, which is a quite different approach to nature and relations within the water handling. The cognitive pillar relates to the dominant knowledge, skills and thinking in climate change adaptation which is more reliance on technical knowledge. Regulations relates to the formal institutional power with aspects such as responsibilities and economical models. Due to the transformations of technocratic paradigms to new paradigms there is a need for changes in the institutions. To change these three pillars of institutions, it is important to look at the

capacity building of the institutions. In this report this is approached through collaborative planning that aims at creating platforms that enable the different actors to meet in common learning processes and thereby increase the capacity.

In the paper delving into the "Institutional Black Box": Revealing the attributes of sustainable urban water regimes, van de Meene and Brown identify the institutional capacity (van de Meene et al. 2009). In their paper they identify four spheres as sustainable management regimes: administrative and regulatory sphere, inter- organizational sphere, intra-organizational sphere and human resource. These four spheres will be used to find out the institutional capacity of the municipalities. The attributes for each sphere are presented in the table below:

 Table 2: Management Regime Framework and Capacity Building Initiatives for Sustainable Urban Water Management capacity (van de Meene & Brown 2009)

Sustainable management regimes	Attributes		
Administrative and regulatory	<ul> <li>Strategic planning and design</li> <li>Tools and instruments</li> <li>Guiding principles</li> <li>Management and implementation</li> </ul>		
Inter-organizational Sphere	<ul> <li>Organizations effectively coordinate activities and engage in regular and open communication, focusing on learning and flexibility, and drawing on experience.</li> <li>Partnership, cooperation, and collaboration</li> <li>A shared vision, interests, sense of ownership and norms of cooperation, and reciprocity</li> <li>Cooperative attitude, willingness, commitment to the relationship, and are willing to share power.</li> <li>Team composition, including leadership, agreements, responsibility, rules for interaction, and opportunities for feedback</li> </ul>		
Intra-organizational Sphere	<ul> <li>Resources</li> <li>Stakeholder and community engagement</li> <li>Organizational structure and administration</li> <li>Leadership</li> <li>Culture</li> </ul>		
Human Resource Sphere	<ul> <li>Knowledge and information</li> <li>Internal qualities</li> <li>Resilience</li> <li>Interest in organization's role</li> <li>Approaches to engagement</li> </ul>		

These theoretical approaches help to build the analytical framework of the research. The overall analytical framework is presented in the below figure:



Figure 6: Analytical framework of the research

The analytical framework discussed above will provide a guideline for the analysis. The cases from all the municipalities are discussed in the next chapter. Data collected from the case studies and from the interviews will be analyzed by following the steps of the analytical framework. First step will be identifying the paradigm of sustainable urban water management and that will be followed by finding out the institutional changes and capacity building for institution by the application of resilience approach and collaborative planning.

#### 3.6 Data collection protocol

For the theory chapter data has been collected from articles, books, plan documents, website which give clear understanding of climate change adaptation strategies and collaboration in the implementation of climate change adaptation, general understanding of climate change adaptation. Plan documents were found on the homepages from Danish Ministries, PLAN09 and from the City of Copenhagen and from other municipalities. The peer-reviewed documents were received from lectures, supervisor, Google Scholar and SCOPUS, and when using homepages as a reference there has been awareness of the homepages reliability. Additionally interviews from the respective persons from the selected municipalities will be conducted.

#### 3.7 Interviews

In this project, ten interviews has been conducted with eleven key persons from responsible persons from different municipalities, HOFOR, Wastewater center Avedøre and one water expert. The interview persons, time of the interview and place and their responsibilities are shown in the below table:

An analysis of institutional capacity for climate change adaptation in the Copenhagen area

#### Table 3: Information about Interviews

Name of the	Contact Person	Responsibility	Interview Date, time
Organization			and place
HOFOR	Sonia Sørensen	Section leader, planning	12-04-2013 (11:00-
		department	12:00)
			Ørestads Boulevard 35
Avedøre wastewater	Rikke Nicolajsen	Head of the Service department	02-05-2013
			(10:30-11:30)
			Kanalholmen 28,
			Hvidovre
Avedøre wastewater	Søren Hansen	Project Manager	02-05-2013
			(10:30-11:30)
			Kanalholmen 28,
			Hvidovre
Albertslund Municipality	Sigrid Glarbo	Urban planner, landscape	16-05-2013
		architect	(02:00-03:00)
			Albertslund City Hall,
			Nordmarks Alle
Albertslund Forsyning	Hans-Henrik Høg	Supply Manager	16-05-2013
			(03:00-03:30)
Droger	largen leneen	Llood Diamping	Vognporten 9
Dragør	Jørgen Jensen	Head, Planning	
Horlov	Lico		Tolonhono intorviow
Hvidovro	Morton Roba	cand toobh soc	20.04.2012 (9:45.0:20)
TIVIDOVIE	Dederson	cand.techn.soc.	Havedstensvei 15
	reaciseit		Hvidovre
Kahenhavn	Palle D. Sørensen	Projectleder Center for	06-05-2013 (2:00-3:00)
Robernavn	Talle D. Solensen	Park & Nature	Islands Brygge 37
Rødovre	Lars Kuhnau Hansen		13-05-2013 (03:00-
			04:00)
	Chiara Fratini	Water Expert	10-05-2013 (11:00-
			12:00)
			AAU-CPH library
			AND OF IT IIVIALY

These people are chosen as they play an important role in climate change adaptation plans and cloudburst plan. The interviews were recorded and then transcribed. After finishing one interview summary from the interview was written by the author. During the interview written notes were also taken. The aim of the interview is to get a better overview about municipality's climate change adaptation approaches and the collaboration between HOFOR, municipalities, citizens and other stakeholders. (see interviews in the appendix)

#### 3.8 Analysis and Interpretation

Analysis and interpretation will be based on the interviews conducted for the project purpose. The findings of the interview will be then compared with the theories and strategies whether it fits or not. In this part, an analytical table will be made showing the analysis questions which will be narrowed down later. Information from the interviews and theories and strategies related this will be presented in the table. The literature review, the empirical knowledge and the case study will give the necessary insight and knowledge for this project to analyze and interpret the approaches municipalities follow for climate change adaptation implementation and their collaboration with the stakeholders. Details of the analysis and interpretation will be described in the particular chapter.

There will be a discussion chapter afterwards which will include discussions of the key findings from analysis and some reflections on that.

#### 3.9 Supervision

The project has been prepared in close cooperation with the supervisor Birgitte Hoffmann and Chiara Fratini. From the very beginning they supported me by guiding with relevant literature to identify the scope of the project. Their cooperation has made the report more valid and reliable. Moreover they reviewed various drafts part of the report all the time of the project period.

#### 3.10 Limitations of the Study

In the beginning it was decided by the authors and supervisors that each responsible person of the municipalities that are working with HOFOR will be interviewed. First of all the responsible person of HOFOR was interviewed. So, now it was important to find the views of the responsible persons from the municipalities. Therefore, the author has contacted with the key persons from the municipalities through mails and direct phone calls. Key person from Copenhagen Municipality, Albertslund Municipality, Hvidovre Municipality, Rødovre Municipality have been interviewed. Brøndby Municipality and Vallensbæk Municipality are working with Wastewater center Avedøre. So two key persons from Wastewater center Avedøre were interviewed to cover these two municipalities. The author has contacted several times with the responsible persons from Dragør Municipality through email and phone calls but it was not possible to interview them as only two of them are handling climate change adaptation tasks and due to the limitation of the time they preferred the author to get information from the website only. And another limitation was while the author contacted with Herlev municipality, the responsible person gave telephone interview only as they do not have climate change adaptation plan yet.

### 4. Case study in Denmark

This chapter deals with climate change adaptation plans in Denmark. Danish Government has prepared national adaptation strategy in 2008. Therefore Danish national adaptation strategy will be described here. Besides which methods and tools are used in climate change adaptation at the national level will also be discussed. The study will investigate how eight different municipalities within HOFOR develop climate change adaptation plan. Therefore, climate adaptation plans and related plans that municipalities have already prepared will be described here. Besides, some general information about utility companies will be presented here. More details will be found in the sections below.

#### 4.1 Climate change adaptation in Denmark

"Danish strategy for adaptation to a changing climate" was introduced in March 2008 under the responsibility of the Ministry of climate and energy that focuses on the necessity for national adaptation to climate change. Danish climate change adaptation strategy includes a description of the vulnerability of some sectors for example: coastal management, construction, energy supply, agriculture and forestry, fisheries, nature management, planning, human health, emergency, rescue service and insurance related aspects where climate change is expected to have significant consequences. Which adaptation measure will be taken into account depends on the consequences of climate change, the probability of their occurrence and costs of prevention (Danish Government 2008).

By making this strategy the government emphasizes the importance of timely adaptation to climate change. The government gives priority on the autonomous adaptation where authorities, businesses and private citizens react to the consequences of climate change within the given legislative, economic and technical framework in a timely manner. Danish strategy is based on the perception that climate change is a long term process with uncertainties (Danish Government 2008). Therefore, government attempts to initiate an information campaign so that climate change is incorporated into planning and development. By these way public authorities, businesses and citizens can consider how and when climate change should be taken into account. Considering these efforts, Danish strategy comprises of three measures. Firstly, they have the initiative to make an information campaign which also includes a web portal operated by an information center. They will also prepare a research strategy which ensures that Danish climate research focuses on the adaptation question to a greater extent by establishing a coordinated body. It will also establish an organizational framework which will include a horizontal coordination forum for adaptation among public authorities (Danish Government 2008).

The strategy identifies a need for information campaign which will be goal oriented. The focus of this information campaign will be to inspire the stakeholders and to involve citizens in climate change adaptation. The focal point of the information campaign will be to establish a web portal which will provide adequate information of climate change adaptation to the Danish society. The portal will provide easy access to the latest knowledge which can be used by authorities, business people, specialists and citizens (Danish Government 2008). The strategy also focuses on making a research strategy which involves research on the consequences of climate change and adaptation relevant research and technological development, including socio-economic research. The government will establish a coordinating unit for research in climate change adaptation which will create better coordination and knowledge sharing of climate change adaptation research (Danish Government 2008). Moreover, a coordination forum will be created to implement the government strategy. The coordination forum will ensure coordination across sectors and authorities. In the Coordination

Forum, all relevant state authorities, one representative from the municipalities, regions and the coordinating unit for research (Danish Government 2008).

Danish adaptation strategy (2008) focuses on the adaptation at the national level but it also encourages other departments to react. After the formation of new government in November 2011 there was a change in the ministry level. Climate change adaptation has gone to the ministry of Environment while climate change mitigation is dealt under the new ministry of climate, energy and building (Danish Government 2008).

In February 2013, Minister for environment has published the Danish Government's action plan for a climate proof Denmark which includes some initiatives to ensure Denmark's resilience towards more serious precipitation. By making this action plan, government will ensure the best possible framework for climate change adaptation in the municipalities along with a common knowledge base and regularly prepare guidelines on climate change impacts. These initiatives will be coordinated across authorities, the business community and general public (Danish Ministry of Environment 2013a). The Danish government has decided to relocate the information centre for climate change adaptation from the ministry of climate and energy to the ministry of environment in November 2011. The information centre is working now under ministry of environment and is incorporates in a new task force for climate change adaptation. The information centre provides and website klimatilpasning.dk which is updated all the time and provide new tools for climate change adaptation (Danish Ministry of Environment 2013a).

Minister for the Environment Ida Auken has launched a citizen campaign in collaboration with some partners which helps citizens to protect their homes against cloudburst. This also offers citizens a free climate change adaptation check of their home where first step is to prevent flooding in private houses. The cloudburst in 2011 damaged about 6.2 bn DKK (Danish Ministry of Environment 2013b). A new tool named "The Resilient House" has been introduced at klimatilpasning.dk which provides interactive experience of different risk and adaptation potential around a virtual house to the user. The main purpose of the tools is to make aware the house owners to prevent flooding in and around their house (Danish Ministry of Environment 2013a).

The minister also mentioned that all of the municipalities have to make a prioritized action plan to protect citizens against flooding by 2013 (Danish Ministry of Environment 2013b). Again a climate change adaptation squad was established in February 2012 to provide necessary guidelines to every municipality to produce the action plan (Danish Ministry of Environment 2013a).

Moreover, Ida Auken introduced a bill in October 2012 which will ensure that wastewater companies will prepare flood maps on the basis of IPCC that will identify problem areas during heavy cloudbursts. The maps will be included in the municipal plan 2013 (Danish Ministry of Environment 2013c). The minister has started an active initiative for adaptation to climate change for example, active climate change adaptation profile that involves citizens, businesses and municipal authorities. The minister has also established a national dialogue forum which will bring together a group of key players to discuss common strategy and policy regarding climate change adaptation. In the climate change adaptation website a new tool, the climatemeter has been launched that can provide information about which methods can be used to map the risks of flooding within ones region or municipality (Danish Ministry of Environment 2013d).

#### 4.2 Spatial Planning in Denmark

In Denmark climate change adaptation is considered in the policy arena within spatial planning (Lund et al 2012). Spatial planning has a long tradition to be organized in a government system that functions with hierarchical orders and tasks and competences are distributed between different

government levels which also shows a clear boundaries between public and private sector (Lund et al 2012). In Denmark elected political councils make spatial policies which are normally served as professional bureaucracy. These political councils are responsible to make comprehensive plans, laws and regulations for spatial development and have power over controlling the execution of plans and regulations. They also mention that government tools are command and control in this context and private actors are passive receivers of plans and regulations and objects for control in a governing system while citizens become lay persons and are less capable of defining what is best for society (Lund et al 2012). In a traditional government system like in Denmark, public administration is organized as a functional, specialized bureaucracy where expert professionals with specialized educations serve different departments to take political decisions. In the real situation it is seen that in spatial planning, planners dominate large technical departments and thus became responsible for public planning in traditional government systems (Lund et al 2012).

The reliance on rational and technical approach has some advantages and disadvantages. It is important to include scientific knowledge for long term planning in terms of professionalism. On the other hand, disadvantages comes from that sector specialization tends to make interdisciplinary collaboration difficult because each sector will develop a unique language and culture that many times will be difficult to spread. Due to the lack of collaboration and inclusion of outside resources, plans made by the expert professionals are insufficient to deal with the complex problems where as climate change is the most prominent example. Lund et al argue that due to the professional bureaucracy Danish municipalities to climate change adaptation is partly explained and also be translated as a barrier to create value in these plans and strategies (Lund et al. 2012). Lund et al. (2012) argue that the lack of collaboration in the creation of plans dealing with complex problems of society can make them insufficient to deal with.

Climate change adaptation is hardly featured in other sectors like agricultural, health and traffic plans instead of these sectors have consequences for climate change as Lund et al. (2012) argue (Lund et al. 2012). Again Adger et al. (2008), Urwin and Jordan (2008) and Biesbroek (2010) argue that adapting to a changing climate is a major challenge at all relevant administrative, temporal and spatial scale (Neil Adger, Arnell & Tompkins 2005, Biesbroek 2010, Urwin 2008). They propose bottom up approaches as these are more appropriate in the multitude of variables, context dependencies and cultural settings. Biesbroek (2010) also states the requirement of involving public and private actors in the problem-solving debate (Biesbroek 2010). Adger et al (2008) argue that climate change adaptation is institutionally constrained as it has also international agreements such as UNFCC. They also explain that individual adaptation actions do not happen on its own they are constrained by institutional processes such as regulatory structures, property rights and social norms associated with rules in use. They argue that the scales of appropriate adaptation goes to lower elements of jurisdiction like municipalities, cities etc within the technological availability, regulatory systems and knowledge of future climate risks.

Healy (2006) defines spatial planning as, sometimes promoting and accommodating economic activity and regulating it to safeguard other values such as the conversation about the environmental or social justice. She further adds that local environment and institutional qualities have a key role in the competitiveness of urban areas in relation to the present globalized ordering of economic life (Healey 2006). Looking at the aspects of where climate change adaptation is placed in Danish context Healey (2006) definition of spatial planning explains why it is handled in spatial planning as it is an environmental issue.

#### 4.3 HOFOR (Hovedstadsområdets Forsyningsselskab)

HOFOR is a fusion of Copenhagen energy and the utility companies of Albertslund, Brøndby, Dragør, Herlev, Hvidovre, Rødovre and Vallensbæk municipalities. HOFOR as a utility company is providing municipalities with water, sanitation, gas and wind turbines. HOFOR supplies water in Albertslund, Brøndby, Dragør, Herlev, Hvidovre, Copenhagen, Rødovre og Vallensbæk and is responsible for the discharge of wastewater and storm water in the same municipalities except Brøndby and Vallensbæk. HOFOR has an organizational commitment for contributing to sustainable urban development through environment friendly power solutions. Cooperation is the cornerstones of HOFOR. HOFOR has cooperation within the municipalities and with the customers (HOFOR 2013).

Cooperation is particularly important for water and waste water, as water routes do not respect municipal boundaries, and because the circuits in the metropolitan area are linked. Therefore, HOFOR's water and wastewater companies merged with water and wastewater companies in Albertslund, Dragør, Herlev, Hvidovre, København and Rødovre and water companies in Brøndby and Vallensbæk whereas Avedøre wastewater A/S controls Brøndby's and Vallensbæk's wastewater.

HOFOR's ambition is to create sustainable cities. It works mainly in the capital region because urban areas grow very fast in the capital region. Therefore, it creates more and new environmental problems which threaten ground water. As it is observed now that climate is changing, Copenhagen region is already facing flooding due to heavy rainfall. Therefore this changing environment requires new durable solutions.

HOFOR creates sustainable cities having following goals and ambitions:

- To protect groundwater against pollution and overuse, such that it has groundwater and thus clean drinking water for 100 years.
- To coordinate climate change adaptation and cloudbursts security so that it can manage water around homes and commercial buildings in a cheapest way.
- To provide a CO2 neutral energy to reach goal to make the city 100% CO2 neutral by 2025. (HOFOR 2013)

HOFOR is Denmark's largest utility company which has more than 4000 kilometers of water and wastewater pipes, 14 water utilities, has 65 rainwater pools and 38 water basins. It supplies drinking water to about one million people. It sends 52 million m3 of water to customers per year. It helps to travel 3500 hectares of forest to protect groundwater. It invests annually over a billion dollars in pipe wires and windmill (HOFOR 2013).

An analysis of institutional capacity for climate change adaptation in the Copenhagen area



Figure 7: Supply area within HOFOR (HOFOR 2013)

#### 4.4 Avedøre Wastewater

Avedøre wastewater has a vision to ensure that all companies with wastewater of importance have a connection permit with conditions for discharge of wastewater. Wastewater center Avedøre is owned by ten municipalities: Albertslund, Ballerup, Brøndby, Glostrup, Herlev, Hvidovre, Høje Taastrup, Ishøj, Rødovre and Vallensbæk (Spildevandscenter 2013a) (See figure). As a large utility, it is important for Avedøre wastewater to be an active player when it comes to developing new knowledge about wastewater technology. Therefore Avedøre wastewater cooperates with HOFOR on activities to develop environment friendly solutions for efficient operation of wastewater treatment plants and sewage supply (Spildevandscenter 2013b). Avedøre wastewater has prepared manuals to manage rainwater. The company prepared manual for handling rainwater in their own ground which gives a common technical basis for the design and construction of facilities for the percolation of rainwater on their own land. Another manual explains how rainwater that falls on the homeowner due to percolation in the garden becomes groundwater. The targeted persons are citizens here. Avedøre wastewater also prepared LAR method guide which gives opportunities for local drainage of rainwater which is prepared in connection with SUDS (Sustainable Urban Drainage Systems) course for planners, Environment Employees, drainage engineers and technical staff from own municipalities and supplies in Avedøre Wastewater's catchment area (Spildevandscenter 2013c).



Figure 8: Municipalities working with Avedøre wastewater (Spildevandscenter 2013a)

#### Lynettefællesskabet I/S 4.5

Lynettefællesskabet is one of the largest utility companies in Denmark which handles wastewater for treatment. The company cleans water in its two treatment plants one is Lynetten and other one is Damhusåen. Wastewater from northeastern basin is treated at Lynetten and the wastewater from the southwestern basin is treated at waste water treatment plant (WWTP) Damhusåen. Every year the company cleans 80-110 million m3 of water from private households, business and industry, and precipitation. The catchments areas from which Lynettefælleskabet receive wastewater are 123 km2 (Lynettefælleskabet 2013). It is owned by the eight municipalities Frederiksberg, Gentofte, Gladsaxe, Herlev, Hvidovre, Copenhagen, Lyngby-Taarbæk and Rødovre. The main focus of Lynettefællesskabet is to create the best environmental solutions for water treatment. Therefore, they are cooperating with both private and public companies. Figure 9: Municipalities working with Lynettefællesskabet



(Lynettefælleskabet 2013)

Lynettefællesskabet has a vision to purify the

wastewater from the eight municipalities they own and dispose wastes from water treatment in accordance with applicable requirements and thus help to create a good water environment around the metropolitan area to the delight of local residents.
# 4.6 Municipality of Albertslund

This section deals with Albertslund Municipality's climate change adaptation plan. There will be a discussion on why this plan is prepared and what the contents of the plan are, what approaches municipalities follow for adaptation and what challenges they face. Detail of the plan description is discussed below.

Albertslund was built in 1960s and 1970s with the vision of a modern life with light, air and active leisure. The city is situated very proximity to water and nature. Albertslund has experienced heavy rainfall in 2007, 2010 and 2011. It seems that in future Albertslund will have to handle more rain. Albertslund has prepared climate change adaptation 2012- strategy and actions which include both strategies and actions that municipalities are going to do to adapt climate change. According to this plan, the municipality of Albertslund sees rainwater as resource. The plan also suggests integrating and using rainwater in the nature projects (Albertslund Kommune 2012).

According to the plan, the most immediate challenge for Albertslund city is increased rainfall. Therefore, the main focus is to handle Albertslund stormwater system in an effective way. The strategy for climate change adaptation plan aims to describe how rainwater management can respond to climate change with minimal risk of damage to property and natural assets. According to the plan, the management of rainwater contains three aspects: maintenance and adjustment of the stormwater system, local infiltration and delay of rainwater. Besides, climate change adaptation in Albertslund contains mapping which shows how rainwater in the system cannot keep up with the current and future heavy rainfall events and extreme rainfall and the water in these event will gather. This mapping is the basis of the further work on climate change adaptation (Albertslund Kommune 2012).

Albertslund is a new city where the landscape is planned with green and blue structures. Rainwater is used here for recreational lakes and canals. Albertslund has separate sewerage system. All the rainwater in the area passes to the three streams Vejle river, Hastings river and Harrestrup Å through municipal stromwater system. Albertslund has two separate sewer systems locating side by side: one for wastewater and one for rainwater. Rainwater system handles all the water that falls on roofs, roads and squares. Albertslund sewer system is relatively new. It was established in 1960's and 1970's when the municipality has a well functioning system (Albertslund Kommune 2012).

In the plan it is mentioned that in Denmark there will be a need to increase the capacity of stormwater by 35% (Albertslund Kommune 2012). The plan also suggests that the city of Albertslund needs to relief stormwater rather than making larger pipes for handling rainwater which is at a time expensive one. Therefore, the plan prioritizes more on green solutions i.e. SUDS which also give an aesthetic view and also a solution for heavy rainfall. These types of solutions are cheaper than conventional sewerage system (Albertslund Kommune 2012).

It was decided to work for green structure through Albertslund neighborhood in the Municipal plan 2009-2021 to ensure better diversification opportunities for plants and animals and a better relationship between the recreational green areas. There are two concepts in the plan for stormwater management: Plan A and Plan B. Plan A is the piped system for deriving rainwater and Plan B is the inclusion of land in terrain that can be flooded in extreme situations where stormwater system or SUDS solutions cannot absorb more rainwater. For extreme rainwater events, the green structure is part of Plan B. Besides municipality's wastewater plan regulates the handling of sewage and rainwater Albertslund and sets service levels to local citizens and businesses. A review of the current waste water from 2003 is established in 2013 where climate change adaptation is enrolled in the plan. The review also includes the management of increased rainwater volume. Again water

supply plan of the municipality describes the overall water supply in Albertslund municipality to achieve sustainable water abstraction. Infiltration of rainwater is an important factor to achieve these goals. By promoting establishment of both public and private facilities for local infiltration of rainwater supported sustainable water abstraction which is necessary in order to ensure a good local water balance. Albertslund Wastewater which is now HOFOR carries a large responsibility to ensure Albertslund a robust stormwater system. Therefore, the municipality has a close cooperation with the company. The company's service is very much on thinking synergies in activities for climate change adaptation (Albertslund Kommune 2012).

Albertslund climate adaptation plan emphasizes on collaboration with other actors to contribute to a better climate and environment because water knows no borders. Therefore, according to the plan, Albertslund is cooperating with Water in Cities (Vand I Byer), demonstration project of permeable pavement, green cities etc. Besides, the plan also focuses on active citizen participation. According to the plan, there is a need for individuals and business to know about the coming climate change and how they can be met. There is therefore a need for information on climate change adaptation and opportunities of the individual citizen and business has to take their own initiatives to adapt in their property, and to guard against torrential rain. Alberstlund wastewater informs these to the citizens. Besides, Agenda center Albertslund has already performs a part of this work. They generally aim to advise and assist citizens, associations and groups in their environmental efforts (Albertslund Kommune 2012).

From the above discussion it is found that, though Alberstslund has relatively new sewerage system with separated rainwater and wastewater, it also faces some challenges to handle rainwater. Therefore, the adaptation plan focuses more on SUDs solutions rather than traditional sewerage solution through making large pipes. By this way the municipality will get an aesthetic view of the city with more green and blue structures. But the municipality also will collaborate with the citizens and other stakeholders to deal with climate change as they have to save their property against heavy rainfall. These findings will help to guide the analysis of interviews and will be used to investigate what the municipality is doing in reality.

# 4.7 Municipality of Brøndby

This section deals with Brøndby Municipality's climate change strategy. There will be discussion on why this plan is prepared and what the contents of the plan are, what approaches municipalities follow for adaptation and what challenges they face. Detail description of the plan is discussed below.

Municipality of Brøndby has prepared climate strategy 2008-2020 which includes both adaptation and mitigation. The municipality does not have a separate climate change adaptation plan yet. But in the climate strategy 2008-2020 the municipality sets some goals for adapting climate change. The plan proposes that before 2010 Brøndby municipality have incorporated climate adaptation in their relevant plans and procedures thus, to casework and new projects is future examples of relevant plans and procedures are wasting water plan, contingency plan, municipal plan, and municipal strategy, building renovation, construction processing and preparation of local plans. According to the plan Brøndby municipality has launched necessary initiatives to ensure climate change adaptation and implement them before 2020 (Brøndby Kommune 2011).

According to the plan the biggest challenges are increasing precipitation in winter and stronger rains in summer and rising sea levels generally and during storms. Therefore the plan prioritizes to make decisions about where water must be guided to in case of emergency situations, and how the future development of the city meets the challenges that lay ahead (Brøndby Kommune 2011). According to the plan, the majority of jobs is found in Technical Management and requires greater or lesser extent cooperation across units. At the same time the plan also suggests that there is a need for coordination across, so that tasks are not mutually against each other (Brøndby Kommune 2011).

Brøndby municipality's climate strategy identifies communication is an important tool in climate work. According to the reason is that it will be used to involve and activate other individuals and groups, and partly because there is knowledge to be communicated as a basis for people to change their actions. But the plan concludes that communication can strengthen municipality's reputation. Therefore, according to the plan, this is crucial to engage with the key people around each initiative, but also to ensure an adequate knowledge level of all those affected. As mentioned in the plan that communication will also be crucial when municipality works on an action against citizens and business. According to the plan municipality uses campaigns and dialogue for this kind of communication (Brøndby Kommune 2011).

The Municipality of Brøndby and Avedøre wastewater is working together to address climate change adaptation. Together they made some demonstration projects in Brøndby and in Avedøre wastewater for handling rainwater. One of the examples of this LAR solution that decouples stromwater from the combined sewer system is implemented in Brøndby. The project was prepared for Danish detached house properties where rainwater that falls on the roofs are simply channeled into the combined sewerage system that creates pressure when there is heavy rainfall along with flooding in the basements. So, to minimize the pressure, LAR solutions are good examples. Brøndby municipality and Avedøre wastewater implemented this demonstration project in Brøndby strand along with 28 garden owners to find out solutions from rainwater events through using their gardens for rainwater. The project also used roads by making infiltration beds so that rainwater can seep into these infiltration beds (Danish Ministry of Environment 2013e).



Figure 10: Rainwater solution in the private garden and infiltration beds along roadside in Lindevang, Brøndby Strand (Danish Ministry of Environment 2013e).

These demonstration projects were prepared through the cooperation of the people for finding out local solutions that is clarifies from the speech of Søren Hansen, Project Manager, Avedøre wastewater services as he said

"We experienced great support for the project right from the start. I think that the extreme rainstorms of recent years have caused people to believe that the stormwater problem is best solved through cooperation. We also saw that the residents already were interested in and knew relatively much about the problems and the solutions to them" (Danish Ministry of Environment 2013e).

Some of the other demonstration projects are also implemented in Brøndby and wastewater center. All these projects are a good example of coordination work of the municipality, utility companies, Avedøre wastewater services, garden owners, road people, engineers and other stakeholders who have interests in the project. These projects teaches that for implementing climate change adaptation it is important to have five important dimensions: cooperate across technical specializations and organizations, work on the basis of common goals, backwards up with action, include local practical knowledge and use combined solutions: "both-and" instead of "either-or" (Danish Ministry of Environment 2013e).

From the above discussion it is found that, Brøndby municipality's climate strategy focuses more on coordination work and thus inspiring LAR solutions. The municipality collaborates with citizens, utility companies and other stakeholders to implement demonstration projects. These findings will help to guide the analysis of interviews and will be used to find out which approach municipality is following now.

#### 4.8 Municipality of Dragør

This section describes Dragør Municipality's climate strategy. There will be a presentation of why this plan is prepared and what the contents of the plan are, what approaches municipalities follow for adaptation and what challenges they face. Detail description of the plan is discussed below.

The Municipality of Dragør has prepared a local climate strategy in 2009 following the heavy rainfall event in 2008. Climate Strategy contains proposals for action, as the individual or municipality can do to help prevent climate change, and suggestions on how they can adjust the local impact. According to the strategy adaptation is about to organize the municipality to climate change, such as more torrential rain, more storms and higher sea levels where as the climate is expected to change over the next 100 years. The reason for making climate strategy is that the municipality is very near to sea and a low area. According to the strategy, when there will be sea level rise or heavy rainfall then Dragør has a high risk of flooding (Dragør Kommune 2009). The below figure shows normal average sea level today and if the municipality will experience flooding it will destroy huge areas of the municipality.



Figure 11: Normal average sea level today and if it occur flood today (Dragør Kommune 2009)

The strategy contains both mitigation and adaptation. The strategy gives guidelines what to do in response to climate change to both the municipality and the citizens. According to the strategy, Dragør municipality will work both in the short and long term to ensure robust planning on all fronts, private and municipal, take account of climate change, both through prevention and adaptation. The strategy also suggests that the municipality will incorporate both prevention and adaptation to climate change into all relevant plans and projects along working with climate across sectors, municipal boundaries and create initiatives involving both private and public. Besides, the strategy emphasizes on informing and involving citizens, institutions and associations on climate and

initiatives. According to the strategy the municipality will consider climate change adaptation by integrating climate protection in future work with the development of the port. Besides, it suggests that municipality will improve public buildings so that they can withstand flooding periods for example, by applying and using suitable materials vulnerable areas - basements, etc. Again, municipality will inform people about actions that the individual homeowner can undertake on their own land in order to avoid water in basements before and during extreme rainfall and prepare contingency plan during extreme rainfall. The strategy also recommends that municipality will investigate and optimize sewage capacity through constructing larger pipes. Besides, according to the strategy, municipality will investigate the capacity of the existing ditches which may act as reservoirs of the drainage of rainwater. The municipality will consider the possibility of using road for decoupling rainwater in case of extreme rainfall as it is mentioned in the strategy. According to the strategy the municipality will develop a plan and possible reserve area for future dike west of Søvang and behind the protected areas along Dragørs southwest-facing coast. Therefore, the municipality will cooperate with Copenhagen and Tarnby municipality. The strategy also suggests that municipality will designate lock holes in the walls where road water can pass in case of extreme rain (Dragør Kommune 2009).

According to the strategy there is an option that says that citizens will inform local authorities in case of flooding in their property. The strategy suggests that the municipality will give guidelines on how individuals can decorate their property in a way to handle rainwater for example by making clean gutters and drains and using rainwater for watering the garden (Dragør Kommune 2009).

Dragør utility company is working with HOFOR along with seven other utility companies of the municipalities of Copenhagen area which are, Hvidovre, Rødovre, Vallensbaek, Albertlund, Herlev, and Brøndby. HOFOR is responsible for the operation of waste water supplies in all municipalities except Brøndby and Vallensbaek. Municipality of Dragør has a common vision in HOFOR which is to create sustainable cities based on climate and environmentally friendly power solutions. HOFOR is working with eight municipalities; therefore, cooperation is one of the cornerstones of the company. This applies to cooperation across municipalities, with the industry and the customers. Through the cooperation across municipality can share their knowledge with other municipalities while working with HOFOR. By this way HOFOR became stronger as there is in-depth knowledge of local conditions (Dragør Kommune 2013).

From the above description it is found that, the approaches municipality will follow for rainwater events are: identifying the capacity of sewer and making larger pipes, identifying the capacity of the existing ditches to use them as reservoirs for rainwater and using road for decoupling of rainwater. Besides, the municipality will provide guidelines to individuals to protect their houses against extreme rain and how they can reuse rainwater. Municipality of Dragør is very proximity to the sea. Therefore, the municipality will consider developing the port so that it can withstand when sea level rises. These findings will help to guide the analysis of interviews and will be used to find out which approaches municipality is following now.

# 4.9 Municipality of Herlev

The Municipality of Herlev did not prepare climate change adaptation plan yet but it is working with Local Agenda 21 since 1996 with the vision to make sustainable city. Municipality of Herlev has prepared Municipal plan 2005-2017 incorporating Agenda 21 strategy. Besides, Municipality has prepared wastewater plan 2010-2019. In following sections there will be a discussion on how Municipality of Helrev handles rainwater.

In 2007 Herlev utility was separated from the municipality and now the utility company is working with HOFOR. HOFOR operates both water and wastewater for Herlev municipality. According to HOFOR there are two kinds of water: sanitary wastewater that is the water from toilets, bath, kitchen and laundry and rain water is the water that flows from roofs, fields and roads. Both kinds of water pass to sewer system. But there is a need to calculate the capacity of the sewer system for handling wastewater. In that case HOFOR suggests that, if there is more rain than individual can divert the water held back on their own land, until there is enough space in the sewerage system. Besides, rainwater can be retained on the site in several ways. Firstly, it can be as percolation fascines to the ground, re-use of rainwater for toilets and laundry or water the garden. Secondly, rainwater from the roof can be used as visual enhancement of the garden. There are many different possibilities for using water in the garden called local drainage of rainwater (LAR). Both Avedøre wastewater and city of Copenhagen has developed method catalogs for SUDS solutions. Establishing fascines are one of the solutions for handling of rainwater. Fascines are voids in the soil where the water is collected in the first place and subsequently percolated. The water is then purified in part, when it seeps into the ground (Herlev Kommune 2013).

A major advantage of rainwater percolate through fascines is that the water trickles down and becomes groundwater which is a very important resource for humans. Homeowners can establish fascines with the permission from the municipality to discharge rainwater. In Herlev drainage of rainwater is regulated in wastewater plan to prevent flooding where property owners only have the right to divert a specified amount of rainwater. This means that one have to handle rainwater on their own land until there is room in sewer water. In some cases individuals have to handle all the rainwater on the site. Besides, municipality inspires citizens to reuse rainwater for toilet and laundry which also save water bills and nature. There are also some legal requirements for using rainwater for toilet flushing and washing machines in homes from December 2009. Herlev municipality has prepared wastewater plan 2010-2019 where an important goal is to increase local preparedness against extreme rain. The plan outlines how the municipality will handle wastewater from homes and businesses and rainwater to be discharged from roads, roofs and other paved areas (Herlev Kommune 2013).

From the above description it is found that, the approaches municipality will follow for rainwater events are: identifying the capacity of sewer, percolation fascines to the ground, re-use of rainwater for toilets and laundry or water the garden and local drainage of rainwater (LAR). In Herlev drainage of rainwater is regulated in wastewater plan to prevent flooding where property owners only have the right to divert a specified amount of rainwater. These findings will help to guide the analysis of interviews and will be used to find out which approaches municipality is following now.

# 4.10 Municipality of Hvidovre

In the below section there will be a description on how Municipality of Hvidovre incorporates climate change adaptation in their different plans. Besides, there will be a description on how rainwater is handled by the municipality and which approaches they follow.

The Municipality of Hvidovre has prepared plan strategy 2011 which includes local council's assessment and strategy development over the next 12 years. Plan strategy gives some proposals regarding settlement, health and movement, service and culture, engineering and urban environment, climate, energy and environment and urban renewal (Hvidovre Kommune 2012). The plan proposes that sustainable municipality must be a role model for citizens and businesses, energy consumption will be CO2 neutral and enterprise policy must be environmentally and climate-friendly. The plan suggests that the focus will be to make the municipality a good place to live, contributing actively to restore nature and the environment both locally and globally. According to the plan, the

long term vision is to make Hvidovre a sustainable city where energy is CO2 neutral, where businesses and citizens aware of the impact their lifestyle to the nature and environment and act accordingly and where rain water is seen as a resource. Sustainability is a theme for all municipal actors according to the plan. Therefore, the vision is made in cooperation with citizens, users and companies in local Agenda 21 Action Plan. The plan considers making buildings more sustainable by focusing on energy consumption. The plan prioritizes to use green roofs, rainwater harvesting for toilet flushing and irrigation of landscaping (Hvidovre Kommune 2012). The plan proposes to utilize climate changes positively with local use of rainwater creating a greener and more beautiful city. Besides, it also prioritizes that urban renewal and urban development projects must consider possibilities for local management of rainwater (Hvidovre Kommune 2012).

In 2008 Hvidovre municipality became part of the Danish Society for Nature Conservation Climate Municipality System to actively make efforts for climate. By thinking sustainability and climate in the daily lives future generation can live in healthy and prosperous world. As a part of climate municipality, the municipality is committed to reducing local CO2 emissions by 2% per year until 2025 which will be a starting to make greener future (Hvidovre Kommune 2013a).

The municipality has prepared municipal plan 2009 which includes along with other issues environment and energy supply. The plan includes also climate change adaptation as climate is changing globally and the effect of climate change is seen in Denmark. In future it is expected that there will come more and heavier rains and storms, sea levels rise. This will also affect Hvidovre in several areas. Hvidovre is located on the coast and has historically been hit by several floods. According to the plan Parts of the coastline are already protected against flooding by levees. (Hvidovre Kommune 2013b).

The Municipality of Hvidovre led much of rainwater into the sewers. In 2007, Hvidovre, and several other municipalities in the country, has experienced some of the effects of climate change. Torrential rains gave flooding and water in basements in areas not previously had problems. According to the municipal plan, the drainage system will be expanded in the next 40 years; the effects of climate change are still straining sewers and provide a greater risk of flooding (Hvidovre Kommune 2013b).

When there is rainfall, most of the rainwater from roofs and paved areas in Hvidovre led to the sewers. Therefore there is a pressure on the sewerage system. The plan suggests adapting to changing rainwater patterns so that it does not overload the sewers. Rainwater can be retained by building more large basins, but also by establishing fascines, ditches, trenches, small wetlands and lakes locally in Hvidovre. The objective of the local council's is to allow most rainwater to be handled locally on the individual property or such common areas in the locality. Heavy rains and too much water in the drain wires means that there may be overflow of mixed rain and sewage to Kalveboderne, Køge Bay and local waterways (Hvidovre Kommune 2013b).

From the above description it is found that, the approaches municipality will follow for rainwater events are: expanding drainage system, building more large basins, establishing fascines, ditches, trenches, small wetlands and lakes locally etc. These findings will help to guide the analysis of interviews and will be used to find out which approach municipality is following now.

# 4.11 Municipality of Copenhagen

Following section describes the approaches that the Municipality of Copenhagen follows for climate change adaptation according to the Municipality's climate adaptation plan and cloudburst plan. Besides, there will be a description on why this plan is prepared, which approaches they will follow, contents of the plan and what challenges they face. Detail description of the plans is discussed below.

#### 4.11.1 Copenhagen climate adaptation plan

Copenhagen climate adaptation plan was published in 2011 where it focuses not only on minimizing the risks of future climate change but also it prioritizes the improvement of the life quality of Copenhageners. Therefore it works for flexible solutions combining other departments of planning like urban planning and design, water planning and management, development of recreational cities etc (City of Copenhagen 2011). Copenhagen is already facing some challenges due to climate change like more and heavier rainfall but along with this challenge Copenhagen will face sea level rising, warmer weather and change in the ground water level in future. Copenhagen Climate Adaptation Plan (2011), focused more on to assess which challenges are greatest and where in Copenhagen municipality. It also incorporates the measures that are necessary to climate change adaptation which will also be beneficial for the inhabitants as it will create more recreational opportunities (City of Copenhagen 2011). The plan was prepared in cooperation with COWI, Deloitte, Rambøll, DMI, KU-LIFE, DHI and GRAS. The plan must be considered in relation to the latest IPCC report and have to be updated according to the IPCC report which is published every four years. Copenhagen climate adaptation plan ensures timely care, no inappropriate investments, investments are recouped as part of a development in green growth, largest possible synergy with other planning measures, flexibility in relation to changes in forecasts of the future climate, climate adaptation measure in themselves offer quality for the citizens and businesses in the city, adaptation is based on technically high level analyses and a general management of climate adaptation in the city takes place (City of Copenhagen 2011).

In the Copenhagen climate adaptation plan (2011) it is mentioned about three levels of climate adaptation. Firstly, City of Copenhagen chooses the initiatives which prevent the damages when the risk of damage is unacceptably high. Such preventive measures include the building of dykes, building higher above sea level and the expansion of the sewer's capacity and local management of rainwater. Secondly, priority will be given to those initiatives which minimize the extent of the damage if it is impossible to prevent the damage such measures are: warning systems for rain, establishing waterproofs cellars and adapting areas where rainwater can be stored. The third level of climate change adaptation is to reduce city's vulnerability which includes equipping cellars to they can cope with flooding and being prepared with pumps (City of Copenhagen 2011).

#### How to secure Copenhagen against rainy weather in the future

In the recent years most people experienced heavier downpours which will continue in the near future in Copenhagen. Copenhagen experienced heavy downpour on 14 August, 2010 which flooded many cellars and streets including Lyngbyvej (City of Copenhagen 2011). Meteorologists expect that precipitation will increase by 25-55% during the winter and will decrease up to 40% in winter (City of Copenhagen 2011). The changes will have considerable significance for Copenhagen as the heavy summer rain will create more extensive floods if no initiatives are taken. For this reason, City of Copenhagen considered three methods to adapt to heavier rainfall in the future. First method includes having larger sewers, underground basins and pumping stations. New drains will be constructed to create extra capacity. Focus will be also laid on separating rain and waste water in the individual dwellings (City of Copenhagen 2011). But due to the excavation work traffic and commercial life will be affected over long period of time. For this reason climate adaptation plan recommends method two in all places where it is feasible which includes managing rainwater locally instead of guiding it into the sewers (City of Copenhagen 2011). According to the plan rainwater should be considered as resource. This can be achieved by managing rainwater locally with the help of green, low-tech solutions which can absorb the rainwater or clean in which are also called SUDS (Sustainable Urban Drainage Systems). If rainwater is managed locally, it will minimize the amount of rainwater in the sewers so that it doesn't become necessary to excavate and lay down large pipes.

This method is also cheaper than method one which can be achieved by investing only DKK 5bn (City of Copenhagen 2011). The city of Copenhagen will adopt this method throughout the whole municipality, not only where municipality gives obvious problems. The third method is to let flooding in the areas where it does least damage for example: car parks, playing fields and parks etc (City of Copenhagen 2011).



Figure 12: Extract of a map showing where flooding can occur when rain which statistically comes once a hits Copenhagen in 2110 (City of Copenhagen 2011)

Copenhagen climate adaptation plan gives an opportunity for green growth also. The plan gives Copenhagen an opportunity to develop the city in a way to make it world's most livable cities. It chooses the solutions that improve city's physical environment, urban spaces, travel and various experiences and also guality of life for Copenhageners (City of Copenhagen 2011). Due to many years of sound planning and urban renewal Copenhagen is a green city. Now the main focus of City of Copenhagen is to improve the city's existing green spaces and blue areas and making links between the city's green and blue areas that includes private gardens, backyards, allotments, public parks, areas of natural interest, green sports fields, lakes, rivers and streams, cemeteries and green transport links. More green and blue initiatives will help to make Copenhagen a pleasant city to live in. City of Copenhagen will adapt climate change by using city's green and blue area by three different ways. Firstly the plan ensures that city's existing green areas will be preserved with care. Secondly, more green and blue surfaces like: trees, green roofs and facades, gardens and underground basins that can contribute to adapting the city to the climate and also refreshing the city at the same time will be established. Thirdly a green network will be created between Copenhageners and their natural surroundings contributing to the local dissipation of rainwater and improving the urban climate (City of Copenhagen 2011).

#### The adaptive capacity of the city of Copenhagen

Copenhagen climate adaptation plan includes four platforms i.e. knowledge and skills, networks and partnerships, public regulation and planning and financing for the adaptive capacity of Copenhagen.

THE ADAPTIVE CAPACITY OF THE CITY OF COPENHAGEN					
Knowledge	Networks	Public regulation	Financing		
and skills	and partnerships	and planning			

Figure 13: The adaptive capacity of the city of Copenhagen (City of Copenhagen 2011)

Copenhagen municipality has been building up knowledge and expertise in climate change adaptation which requires interdisciplinary knowledge and collaboration with research and industry on specific initiatives and selected demonstrative projects (City of Copenhagen 2011). Copenhagen Climate adaptation plan gives an opportunity to utilize existing networks and partners, creating new relationships between scientific, technical and business networks and increase the dialogue across Copenhagen's administrations. The plan also provides the chance to find out the barriers and the opportunities in the legislation and in dialogue with the municipality and other governmental institutions. Moreover, the plan also assesses market potentials and strengths by developing computer models and analyses of business cases. By this way Copenhagen can gain new knowledge and experience by financing in an appropriate manner (City of Copenhagen 2011).

Copenhagen climate adaptation plan includes various types of networks that fulfills the needs and gives opportunities of the international market and creating contact with research and business networks with the right knowledge and motivation. The plan prioritized interdisciplinary demonstration project where emphasis is given to some of the networks the municipality is already engaged in, for example "water in cities" cooperation which is a Danish network between universities, public institutions and private enterprises (City of Copenhagen 2011).

#### 4.11.2 Copenhagen's Cloudburst plan 2012

Copenhagen has experienced heavy rainfall in July 2011 which has opened the eyes of politicians. Politicians are focusing now more on how to prevent and lower damages from such an occurrence. It is not possible to protect the city from cloudburst fully but it is possible to prepare the city against cloudburst. Cloudburst is a term that represents heavy rainfall. According to DMI's definition when there is more than 15 mm precipitation in 30 minutes then it is called cloudburst. But under cloudburst on 2nd July it has experienced 100 mm precipitation in one hour. Copenhagen has prepared cloudburst plan 2012 with the cooperation of Copenhagen municipality and COWI (City of Copenhagen 2012). The plan shows that the initiatives in this plan cost 3.8 billion crowns where the damage from the heavy rainfall in 2011 costs 5-6 billion crowns. Heavy rains damages both surface and groundwater. According to the cloudburst plan, it is easier and cheaper to find solution for the surface water then the ground water whereas, the solutions of the surface water include building more green and blue areas with trees and plants which also give space for recreational purposes of the inhabitants. The plan suggests that this solution will be applied where there is room for it. But where there is little space and where the buildings are dense then the solution will be make climate proof city with using underground tunnels (City of Copenhagen 2012). Cloudburst plan is a long term project. It will take 20 years to implement the plan. Therefore, the focus of the plan will be to find out where the risk of flooding is greatest and where it is easier to find solutions. The plan also proposes that cloudburst is a challenge that cannot be solved by taking only one action like making the sewerage system bigger. There is a need for combined effort to find out the right solutions. It is not possible to make the plan alone only in Copenhagen Municipality. Therefore it is collaborating with Frederiksberg municipality and will work closely with the surrounding municipalities and utilities (City of Copenhagen 2012).

Copenhagen has already prepared climate change adaptation plan. Cloudburst plan describes the methods, priorities and actions recommended for the part of climate adaptation about cloudburst. This plan takes a big step to protect Copenhagen against the violent rain which was experienced in 2010 and 2011. In the cloudburst plan it is described how differently rainwater can be used in the city. The attention will be to utilize this rainwater for green plants, canals and ponds and another solution will be to expand the sewers where it is not possible to use rainwater to recreational green and blue elements in the city. Cloudburst plan is coordinated with Copenhagen Energy (HOFOR and Frederiksberg Municipality and Frederiksberg supply), since all rainwater that falls in Frederiksberg must be guided through Copenhagen to either treatment plants or the sea during a cloudburst (City of Copenhagen 2012).

Cloudburst plan is based on the Copenhagen climate change adaptation plan and included flood maps and risk analysis. The plan will form the basis for the implementation of cloudburst solutions which will be applied in other city. Cloudburst plan describes different methods to make Copenhagen city resistant to the cloudburst. Firstly, most of the precipitation from the cloudburst will be directed to the sea while small part of discharge water will pass to the lakes of the inner city. Secondly, the possibility of delaying the rainwater passage towards the sewers and store rainwater in buffer areas during a cloudburst is crucial of the urgent need to establish special cloudburst solutions. Such solutions can be real cloudburst roads, landscaped canals or tunnels, which is reserved for water from torrential rain and generally increases capacity to lead water away. Thirdly, Copenhagen has an ambition that the city should incorporate more blue and green areas in the future (City of Copenhagen 2012). The drainage of rainfall from cloudburst is an important element of spatial planning in Copenhagen. Therefore, consideration of cloudburst protection incorporated into local plans and development projects, as solutions can help to promote the city's blue and green structures. A blue-green structure in a city is an expression of the relationship between water creeks, canals, green spaces, parks and urban space. Cloudburst Ensuring Copenhagen will contribute most to the city's green and blue structure those carry water away at terrain. The solutions, for example are to reopen the streams, create new channels or lakes and create more green areas, and use roads with elevated curbs to lead cloudburst water there (City of Copenhagen 2012). However, the water volumes to be handled so large that it is not possible to transport all cloudbursts water on the surface of the denser part of the Inner City. In these areas, water is passed to the port through large tube. They must like the subway drilled deep into the ground, do not touch the things that are on earth. Therefore, pointing Cloudburst plan in a solution where Copenhagen must be ensured by combining the solutions, which makes the city more green and blue by divert rain water on the ground, and with tunnel solutions in the areas of city where there is no possibility of surface solutions (City of Copenhagen 2012).

The following figure shows how water will flow in Copenhagen and Frederiksberrg. The routes start where the lines are thinnest and thicken the more water flowing to them. It can be seen how all the flow paths into the sea although in some places is a long way. A water basin is an area where all precipitation will flow the same way by a cloudburst. Basically, the height differences in an area that determines which way the water will flow, but in a city makes the built areas, the water in some places will flow than bit different. The paths, the water will flow, is called flow paths (City of Copenhagen 2012).

An analysis of institutional capacity for climate change adaptation in the Copenhagen area



Figure 14: Water flow paths during cloudburst (City of Copenhagen 2012)

The following figure shows how efforts should be concentrated in Copenhagen's water catchments in three levels based on risk, implementation and synergy with urban planning and construction projects where red areas are given high priority, yellow areas are given middle priority and green areas are given lower priority (City of Copenhagen 2012).

An analysis of institutional capacity for climate change adaptation in the Copenhagen area



Figure 15: Priority areas for water catchments (City of Copenhagen 2012)

It is not possible to implement cloudburst plan alone without incorporating with other plans. Therefore the plan must incorporate municipality's other plans like municipal plans, local plans, wastewater plans, and green blue plans etc (City of Copenhagen 2012).

From the above description, it is found that among all the other municipalities, only Copenhagen municipality has prepared climate change adaptation plan. Besides, the municipality has also prepared cloudburst plan to make the city resistant against cloudburst. The approaches that municipality will follow according to the Copenhagen climate adaptation plan are: having larger sewers, underground basins and pumping stations, create extra drainage capacity, separating sewerage system, managing rainwater locally instead of guiding it into the sewers and to let flooding in the areas where it does least damage for example: car parks, playing fields and parks etc. On the other hand, the cloudburst plan incorporates the solutions like most of the precipitation from the cloudburst will be directed to the sea while small part of discharge water will pass to the lakes of the inner city, the possibility of delaying the rainwater passage towards the sewers and store rainwater in buffer areas during a cloudburst is crucial of the urgent need to establish special cloudburst solutions and establishing more green and blue structures. These findings will be incorporated with the findings from the interviews and will be presented in the analysis chapter.

# 4.12 Municipality of Rødovre

In the below section there will be a description on how the Municipality of Rødovre incorporates climate change adaptation in their different plans. Besides, there will be a presentation on how rainwater is handled by the municipality and which approaches they follow for handling rainwater.

The Municipality of Rødovre has prepared climate policy which includes both mitigation and adaptation for climate change. There are seven themes in the policy, which are aimed toward the challenge to adapt society to the changing climate, and partly to reduce CO2 emissions. The themes

are urban, transport and infrastructure, green spaces, buildings and construction, steam, behavior and shopping (Rødovre Kommune 2009). Climate policy is interdisciplinary approach and it deals with many themes at a time. The policy has a close collaboration with several local policies and plans like municipal health, traffic plan, and wastewater, municipal and local plans. Climate policy is not a general policy but as a holistic policy interfaces to a number of other policies and plans. Climate policy has a close relationship with local Agenda 21 strategy that has objectives to promote sustainable development. The climate policy proposes some of actions through planning municipality's urban areas these are: incorporate rainwater as a part of city's identity in the form of artificial lakes and canals, make urban renewal plans considering the pass of surface water, inform citizens to use rainwater for toilet flash and laundry and the possibility of infiltration of rainwater (Rødovre Kommune 2009).



Figure 16: Artificial Lake where rainwater will be stored during heavy rainfall

According to the climate policy, the green areas in the city have an important role in adapting to a climate change because the green areas and green surfaces absorb more water than built and fortified areas. Besides, Green areas are a part of the solution for handling more and heavier rains. Therefore, the climate policy of Rødovre Municipality prioritizes more on building more green areas (Rødovre Kommune 2009).

In the summers of 2010 and 2011 there has been heavy downpours in Rødovre Municipality and it is obvious that in future there will be more and heavier downpours due to climate change. Therefore it is necessary to secure homes against water damage caused by torrential rain. Rødovre municipality is working with now Avedøre Wastewater which has made a cloudburst folder in their website where individual can find tips for securing their house. Besides, from the climate change adaptation website, people can get inspiration how theirs house will be climate change resistant (Rødovre Kommune 2013a).

Rødovre Municipality has prepared two maps (25 years flood map and 100 years flood map) showing who are at risk of being flooded by torrential rain. The maps are prepared by the cooperation of Rambøll and the municipality. The maps give indication of where there may be particular reason to secure properties from the effects of floods for example, by installing high water close in properties with basement or low sill that is raised above the ground level (Rødovre Kommune 2013b).

From the above description it is found that, the approaches municipality will follow for rainwater events are: incorporating rainwater as a part of city's identity in the form of artificial lakes and canals, make urban renewal plans considering the pass of surface water, inform citizens to use rainwater for toilet flash and laundry and the possibility of infiltration of rainwater, establishing more green areas. Besides, the municipality has already prepared flood maps that show which areas need to protected in case of flooding. These findings will help to guide the analysis of interviews and will be used to identify which approach municipality is following now.

# 4.13 Municipality of Vallensbæk

In the below section, the activities of the Municipality of Vallensbæk regarding climate change is described. The municipality did not prepared climate change adaptation plan but it is a member of climate municipalities and considers the goal of Agenda 21 in their plans.

The Municipality of Vallensbæk works for climate by minimizing CO2 emission. Therefore, municipality cooperates with other municipalities, inhabitants and companies. The municipality has signed ESCO (Energy Service Companies) agreement with the Danish Energy Management A/S in order to reduce energy consumption in municipal buildings in December 2008. The municipality has entered into one of climate municipality to reduce 2% CO2 emission per year until 2021. The goal of Vallensbæk municipality is to make it sustainable city to live in by following Agenda 21 (Vallensbæk Kommune 2013).

According to the strategy for Agenda 21, the policy objectives within the 5 areas are: Reducing the environmental impact

- to reduce the consumption of electricity, water and heating
- To reduce traffic, environmental impacts, including noise
- to reduce waste and increase recycling
- to allow for CO2-reducing systems and behavior

Promoting sustainable urban development and renewal

- to allow for densification around the station areas
- to contribute to a commercial structure with lower transport consumption
- to create more city life and beautiful surroundings with lower resource

Promoting biodiversity

- to prevent the use of pollutants and pesticides
- to enable a diverse wildlife in the green wedge
- to ensure high water quality in lakes, rivers and the sea

Involvement of people and businesses in the local Agenda 21 work

- to raise awareness of sustainability
- to engage more in local Agenda 21 work
- to work for a sustainable lifestyle among citizens and businesses

Promotion of interaction between the decisions

- to involve interest groups in Agenda 21 Council
- to strengthen the local Agenda 21 organization
- to anchor organization wide in municipal management and control systems to ensure that the objectives are achieved. (Vallensbæk Kommune 2011)

Avedøre wastewater A/S is responsible for the operation of the sewer system in Vallensbæk municipality whereas HOFOR is responsible for water utility for the municipality. Avedøre wastewater is responsible for the operation and maintenance of mains and service lines into the property but within the property it is the owner's responsibility to establish operate and maintain sewer system (Vallensbæk Kommune 2013).

From the above description it is found that, the Municipality of Vallensbæk is focusing more on energy consumption as it is a member of climate municipality. But it also considers the goal of agenda 21 to make the city sustainable. Along with these findings the interview findings will investigate what approaches municipalities follow for climate change adaptation.

In this chapter it is described how climate change adaptation is included in different plans of municipalities and which approaches are mentioned in those plans for handling rainwater. These findings will be incorporated with the findings from the interviews from the responsible persons from municipalities, utilities and water expert. Therefore, it will be easier to analyze which approaches municipalities are following now and how they are incorporating their plans which municipalities have already prepared. In the next chapter the findings from the interviews will be analyzed and interpreted.

# 5. Analysis and Interpretation

Denmark has experienced the impacts of climate change, mostly in 2009, 2010 and 2011 due to the extreme rainwater events. The situation was worst for the Copenhagen area. Danish Government has decided on a national strategy for climate change adaptation in March 2008 due to the political will to minimize the risks and to be resilient to climate change. The municipalities are now obliged to prepare climate change adaptation plan. HOFOR is a utility company that is responsible for urban water management in eight municipalities in the greater Copenhagen area, those are: Albertslund, Brøndby, Copenhagen, Dragør, Herlev, Hvidovre, Rødovre and Vallensbæk. Except Brøndby and Vallensbæk all the six municipalities own HOFOR for water and wastewater services. Brøndby and Vallensbæk are working with Avedøre wastewater for wastewater services. All other municipalities within HOFOR except Brøndby and Vallensbæk are working with Avedøre wastewater services for the preparation of climate change adaptation plan while Brøndby and Vallensbæk are working with Avedøre wastewater services for preparation of climate change adaptation plan while Brøndby and Vallensbæk are working with Avedøre wastewater services for preparation plan while Brøndby and Vallensbæk are working with Avedøre wastewater services for preparation plans.

The analysis is based on the interviews from different professionals like: professionals from utility companies, section leader, supply manager, company, water expert, urban planner, architect, project manager, Biologist etc. Based on these interviews and strategies and plans described in the previous chapter analysis of the research is conducted to find out the answers of the analytical questions. Following the analytical frame, this analysis is divided into three parts: climate change adaptation plans by different municipalities which explores climate change adaptation approaches, institutional changes in water sector and actors involved in climate change adaptation and finally analysis of institutional capacity to find out how municipalities build their capacity to allow institutional changes for adapting climate change approaches.

# 5.1 Climate change adaptation plans of different municipalities

This section describes the different plans prepared by the municipalities considering climate change adaptation. The analysis is based on the findings from the interviews and the plans that municipalities have prepared so far which is described in the previous chapter.

Firstly the status of the different municipalities is described and then in the second subsection the approaches for climate change adaptation is described.

#### 5.1.1 Status

According to the legislation, municipalities have to prepare climate change adaptation plan within 2013. Due to the political pressure and responsibility to protect city against cloudburst municipalities are preparing climate change adaptation plans. Some municipalities have already prepared a climate change adaptation plans and some are preparing their plan. Besides, climate change adaptation plans municipalities have prepared other strategies and plans considering adaptation approaches. Details of the strategies and plans are described in the previous chapter under each of the cases. An overview of the municipality's climate change adaptation plans is presented in the table below:

Municipalities	Climate change adaptation plan	Other plan
Albertslund	Climate change adaptation strategy and actions	2012-
Brøndby	Climate strategy 2008-2020	
Dragør	Local climate strategy 2009	

Table 4: Different plans prepared by municipalities

Herlev				Municipal plan 2005-2017 Waste water plan 2010-2019
Hvidovre				Plan strategy 2011
Copenhagen	Copenhagen climate 2011 Cloudburst plan 2012	adaptation	plan	
Rødovre	Climate policy 2009			
Vallensbæk				Strategy for Agenda 21

The above table shows that municipalities have already prepared different plans considering climate change adaptation. The Municipality of Albertslund has prepared a plan for climate change adaptation strategy and actions to deal with climate change. The Municipality of Brøndby has prepared climate strategy 2008-2020 including both climate change mitigation and adaptation. Dragør Municipality has prepared local climate strategy 2009. Municipality of Herlev did not prepared any plan addressing climate change adaptation but it includes some issues for adaptation to climate change in the municipal plan and wastewater plan. The Municipality of Hvidovre has prepared plan strategy 2011 addressing climate change adaptation. Copenhagen municipality has prepared climate change adaptation plan and cloudburst plan. Rødovre municipality has prepared Climate change adaptation plans yet but it has prepared strategy for agenda 21 where it includes how to handle rainwater for climate change adaptation. Details of these plans are described in the previous chapter.

But from the interviews, it is found that the plans have not been prepared according to the guidelines from the Nature Agency. Municipalities are preparing climate change adaptation plans now by following the guidelines from the Nature Agency. The responsible persons of the municipalities and Utility companies described the reason for adapting climate change during the interviews.

Sonia Sørensen from HOFOR also mentioned that in 2<sup>nd</sup> July 2011, Copenhagen had experienced flooding in urban areas. So, there was a necessity to adapt climate change. She added that before the flooding of 2<sup>nd</sup> July HOFOR - at that time Copenhagen Energy - was addressing only climate change mitigation. HOFOR has changed their strategy from mitigation to include adaptation due to the cloudburst event in 2011 (Personal interview with Sonia Sørensen).

HOFOR is making an overall flood maps for all municipalities so that each municipality can take what they need for their climate change adaptation plan. The municipalities which have already prepared climate change adaptation plan can use also some of the important parts as the plan includes flooding calculations of the whole controlled area. According to the legislation, as a utility company HOFOR has to handle wastewater while municipalities are not allowed to handle wastewater. Therefore, municipalities need to cooperate with utility company for handling wastewater including rainwater. By this way municipalities and HOFOR are supposed to share their knowledge and responsibilities for climate change adaptation. All six municipalities have joined HOFOR for handling wastewater for wastewater treatment and they are preparing climate change adaptation plan for both Brøndby and Vallensbæk. Besides, Municipality of Brøndby has prepared climate strategy 2008-2020 which includes both adaptation and mitigation. The municipality does not have a separate climate change adaptation plan yet. But in the climate strategy 2008-2020 the municipality sets some goals for adapting climate change (Brøndby Kommune 2011).

While other municipalities are in the initial stage of the preparation of climate change adaptation plans, Copenhagen Municipality has already prepared the plan in 2011 and they have made also cloudburst plan with the cooperation of HOFOR. According to Palle D. Sørensen

"(...) now the situation is that every municipality has to make climate adaptation plan. The only two topics which this plan has to contain are everyday rain and cloudburst. There is nothing in the agreement about urban heat island and rising sea levels. It's a result of major cloudburst we had in 2011".

Hvidovre municipality has prepared plan strategy 2011. The plan proposes to utilize climate changes positively with local use of rainwater creating a greener and more beautiful city. Besides, it also prioritizes that urban renewal and urban development projects must consider possibilities for local management of rainwater (Hvidovre Kommune 2012). From the personal conversation with Morten Beha Pedersen it is found that Hvidovre municipality has prepared a draft of the climate change adaptation plan in 2012 in cooperation with Rambøll and Hvidovre utility company. In that plan the municipality had identified the challenges of the area, strategies, problems and what kind of adaptation they need. But according to Morten, the plan has been prepared too early and did not include the required maps. Now HOFOR is doing the maps for the municipality along with other municipalities.

Albertslund has prepared a plan for climate change adaptation 2012 which includes both actions and strategies that will Albertslund follow to adapt climate change. But from the personal interview with Sigrid Glarbo, it is found that the plan has not been prepared according to the agreement with the government. She also mentioned that the Nature Agency had added some guidelines on maps that are needed to be included in the plan. So, the municipality is cooperating with HOFOR for making the new maps.

The Municipality of Rødovre has prepared climate policy which includes both mitigation and adaptation for climate change. The policy has a close collaboration with several local policies and plans like municipal health, traffic plan, and wastewater, municipal and local plans. From the interview with Lars Kuhnau Hansen, it is found that Rødovre municipality is in the initial stage of the process of making their climate change adaptation plan and cooperating with HOFOR along with other municipalities to prepare the adaptation plan.

The Municipality of Dragør has prepared local climate strategy 2009 which includes both mitigation and adaptation and now the municipality is cooperating with HOFOR for making climate change adaptation plan. Municipality of Herlev also did not prepare climate change adaptation plan yet. But the municipality of Herlev has prepared Municipal plan 2005-2017 and Waste water plan 2010-2019 which includes climate change adaptation tasks.

From the above analysis it is found that only Copenhagen municipality has prepared a climate change adaptation plan and cloudburst plan and they are far ahead of the other municipalities. Some other municipalities are in the initial stage of preparing climate change adaptation plan though they have different plans considering climate change adaptation as these plans have not been prepared according to the guidelines of the Nature Agency. So, the municipalities are cooperating with HOFOR as HOFOR is making an overall plan of flood mapping which will help municipalities to identify risk areas in their designated areas.

#### 5.1.2 Climate change adaptation approaches

This sections deals with the approaches that municipalities will follow for handling rainwater. The approaches here are divided into two types: pipe based approach and a new approach with green

infrastructure. It will be identified whether municipalities follow traditional pipe based approach or they are moving to new approach with green structures for handling rainwater. The details of the findings from the interviews are presented below:

Different municipalities have different approaches for climate change adaptation. From the interview it is found that, the city of Copenhagen has identified two major hazards in Copenhagen while preparing their climate change adaptation plan. The first one relates to that Copenhagen is a harbor city so when sea level rises there will be flooding in huge areas and the second one is cloudburst. Palle D. Sørensen from Copenhagen municipality said that the risk for sea level rise is now low because it is not probable that sea level will rise now but it will create problems after 30-40 years. So, the municipality is planning to minimize the risk from cloudburst first and then about sea level rise (Personal interview with Palle D. Sørensen). Copenhagen has a combined sewer system. If there is heavy rainfall sewers cannot handle the amount of water. As a result there is huge risk of flooding. Therefore the municipality has decided to handle the sewer system in an efficient way to minimize the risks of flooding. They found two solutions: one is to make sewer system bigger and the other one isto see if the catchment area of the sewer system can handle 30% rainwater locally with LAR solutions so that it will not create pressure on the sewer system. But according to Palle D. Sørensen, LAR is not a solution for cloudburst management while LAR solutions can minimize the risk. So, Copenhagen is using both the pipe based approach and the new approach with more green areas for handling rainwater.

The Municipality of Hvidovre is working on their climate change adaptation plan. From the interview with Morten Beha Pedersen it is found that most of the problems arise in the municipality is due to the combined sewerage system where rainwater and sewerage water pass together. In Hvidovre municipality there is a separated sewerage system in the newer area and in the industrial area. Avedøre wastewater treats in those areas while older portion of Hvidovre municipality has combined sewerage system which is handled by Lynettefællesskabet. Besides, the soils in this area are not good for infiltration as he added. Therefore, the main problem arise when there is heavy rainfall and there is no space to keep the water somewhere on the surface. So, the municipality is planning to keep the rainwater stored in the surface and then passing through the streams to the sea. The approaches which municipality wants to use are to separate rainwater from the combined sewerage system and to collect some rainwater down the streets and then led them to the sewerage and by handling rainwater locally. In this case municipality is moving from technocratic paradigm to new paradigm with green solutions for handling rainwater.

From the personal interview with Sigrid Glarbo it is found that Albertslund has already moved towards the new approach with the use of more green areas for handling rainwater. Albertslund has a completely separate sewerage system. From the interview it is also found that Albertslund is very keen to use rainwater and store it in the canals. Besides the municipality wants to have water in the city and is working with meadows, wetlands and big parks for storing rainwater as Sigrid Glarbo mentioned.

Avedøre Wastewater, Brøndby Municipality and Vallensbæk Municipality are working together to make some demonstration projects to develop green solutions for handling rainwater. From the interview with Søren Hansen it is found that they are also doing traditional solutions with making pipes bigger. These two types of solutions are combined together to handle rainwater more efficiently. He also added that in Brøndby municipality there is a plan for separated sewerage system by making separate pipelines and LAR solutions. There are lots of green areas in Brøndby and the demonstration projects have broadened their knowledge about how to separate sewerage system and how to adapt as Søren Hansen said (Interview with Søren Hansen). This findings shows that

Brøndby and Vallensbæk municipality use both technocratic approach and new approach with green solutions.

From the interview with Lars Kuhnau it is found that Rødovre municipality has both combined sewerage system and separated sewerage system depending on which treatment plant the areas are using. The approach municipality will use in future for handling rainwater is using roads for local infiltration to leave them to the canals as he added. But according to Lars Kuhnau, the municipality will not suggest the politicians to make bigger pipes for handling rainwater as it is not financially feasible.

Besides, HOFOR as a utility company has a responsibility to co-invest in climate change adaptation projects in the following ways:

- Firstly, HOFOR will expand the capacity of existing pipe system which is their primary activity. In this case they own and operate the system.
- Secondly, when municipality or private investor includes climate change adaptation by lowering a soccer field, square or bicycle lane then the utility will co-invest. In this case municipality or private company owns and operate this plan.
- Besides, HOFOR can cover extra cost to a municipal or private project to handle surface runoff. Though it is not the primary responsibility of the municipality to operate surface areas but they will cooperate with the municipalities and share the costs (HOFOR 2013a).

Moreover, HOFOR will compare the municipal climate change adaptation project and the traditional piped solution in a cost effective way. Besides, there will be an agreement between the utility company and municipality for distribution of costs. HOFOR will justify the costs of co-investments in projects based on the municipal risk mapping (HOFOR 2013). From the interview with Sonia Sørensen it is found that HOFOR is sharing their knowledge with the municipalities to give solutions for climate change adaptation. HOFOR has more technical knowledge on hydrology. But HOFOR's primary activity is to make the pipe bigger which is very expensive. So, they are collaborating with municipalities because if they agree to work together and co investment together they can find a cheaper solution. As Sonia Sørensen said that

"So as legislation is now, we cannot operate in the surface. That's only municipality who can operate. We as HOFOR cannot operate them. We can only operate underground. So, there is a very big collaboration between municipality and us. We know how to deal all the hydrology, but they are of course as the municipality they are next to this project and they have to look at other issues traffic and recreational areas and so on".

Though the approach which HOFOR is using now is tube based by making larger pipes for handling rainwater but HOFOR and city of Copenhagen has identified that they can use the road to handle rainwater. Therefore, road structure will be changed besides the traditional one. They will change the road in a way that in the middle of the two roads there will be green areas for storing rainwater. This way they will use cities green infrastructure for handling rainwater and will move from pipe based paradigm to new paradigm with green structures. Besides, the green structure will add some values to the urban environment. The below figure will show the details of their plan:



#### Figure 17: Using road infrastructure for handling rainwater (HOFOR 2013)

From the above analysis it is found that municipalities use both pipe based approach by making larger pipes to increase the capacity of sewerage system and new approach with green structure by making separate sewerage system with LAR solutions. It shows an ongoing shift from traditional pipe based approach to the new approach with green structure as traditional pipe based approach is very expensive while green structures handle rainwater locally and add values to the urban environment. But this shifting is not so dominant till now. Besides, the new approach with more green areas is still very limited as there are only some small projects that are implemented. Besides, the new approach is being integrated on a more substantial level depending on characteristics of area and natural conditions.

#### 5.2 Institutional changes in the water sector

This section deals with institutional changes in the water sector, which are analyzed based on more concepts. There will be a discussion on how water sector law affects planning and how utility companies are taking part in the preparation and implementation of climate change adaptation plan. Moreover, the role of the utility company and municipality will be identified here and due to the water sector law if municipalities face any challenges or barriers it will be also addressed. Finally the actors involved are outlined as they occur in the statements in the interviews.

As Scott argues institutions have three vital ingredients – regulative, normative and cultural cognitive systems that provide stability and meaning to social behavior that consists of rules and regulations (Scott 2001). From the study it is identified that regulative pillar like administration, rules and systems is the guideline for implementation in climate change adaptation. There is an agreement with the government regarding climate change adaptation that municipalities have to prepare the plan by 2013. Therefore, municipalities are cooperating with the utility company as utility companies are dealing with water and they can provide more technical support. Normative pillar consists of norms, values and belief. From the study it is found that the normative pillar is the growing focus on the importance on climate change adaptation approaches and to adapt these approaches collaborative planning is important and cognitive pillar is the dominant knowledge, skills and thinking in climate change adaptation which is reliance on technical knowledge here. Regulations are made by the government who has the formal institutional power considering mostly cognition.

Brown et al. (2009) identify stages of urban water transitions framework through institutional changes pursuing to more sustainable futures (Brown et al. 2009). Different phases run from water supply city to water sensitive city. From the interviews it is found that cities are transitioning to more sustainable cities. As described in the earlier section municipalities are moving towards a new paradigm with more green structures from technocratic approach. Municipalities are making climate change adaptation plan. For implementation of the plan new infrastructure will be built. Green growth and blue areas will be emphasized and thus making more values in the planning. In this way cities will be more resilient to climate change.

In 2007 there had been some institutional changes in the water sector. Government system of Denmark consists of three levels of administration: national level, regional level and local or municipal level. But in 2007 regional level was demolished and all the responsibilities of regional level were divided to the national and local levels in the water sector management as Palle D Sørensen said that

"We have to adapt a change in 1st January 2007 and there were three levels of government you can say. It was state and region or councils and the municipalities. And the water management was divided into these two counties and municipalities. After 2007 this regional part was eliminated. So, some of the topics the councils were dealing with water management for example were divided. So, small part of it went to the state and the rest went to the municipality".

The National level takes the responsibility to monitor water quality, to monitor plants and animals etc. while the municipality takes the responsibility of administrative tasks, environment permits and controls and climate change adaptation. But in the National level there is no climate change adaptation body to take care climate change adaptation issues. The nature agency only provides some guidelines for making plans. Climate change adaptation is being prepared in the municipal level and in the national level there is no body to take care of it as Palle D Sørensen added

"In the national level there is nobody to take care of climate change adaptation matters. Some neighbor countries like Sweden, Germany have a special climate adaptation body in the national level".

In Denmark there is a private organization named KL (Kommunernes landsforening) where all the 98 municipalities are members of this organization. The organization shares municipality's common interests and contribute to the local political and administrative tasks. According to Palle D. Sørensen, in 2012 there was an agreement with the KL and Government to make climate change adaptation. He added further that it was not a law but an agreement between them which says that municipalities have to prepare climate change adaptation plan within 2013. Municipalities decide the

responsibilities of the utilities and municipality is cooperating with utility because they have more technical knowledge as the technical departments like water sector ran to the utility companies according to Palle D. Sørensen. Basically municipalities do plans and utility company make projects on the basis of technical knowledge. But when utility companies do something in the project they can only pay for water projects that deals with only water system as Chiara Fratini added. According to Chiara Fratini, in 2009 when water sector law was made, the utility company was not allowed to pay for the projects except technical things like making the pipe bigger, bigger pump which creates a problem in dealing with above ground structures. But after 2010 utilities can pay in some projects where the structure is related with sewerage system for example both municipalities and utility company use streets for their projects. Both the parties have some requirements which create problems in case of sharing responsibilities as Chiara Fratini said. She also added that in theory municipalities has still political influence but the utility companies have more technical knowledge.

Besides the problems with sharing responsibilities, the water sector law has created some other problems. As Chiara Fratini mentioned that the law has been prepared without thinking out the complexity of the water service while the law did not consider the water and urban quality. The legislation is built on very technocratic perspectives on water service delivery. In January 2013 there was an addition in the water sector law that utilities can pay for above ground structures for functioning and improving water system not for basically improving the environmental quality as Chiara Fratini added.

From the above analysis, it is found that the new water sector law has been prepared to divide the responsibilities of the municipalities and utility company. But the law cannot give solution where problems arise due to shared responsibilities of municipality and utility. In this case municipality and utility company have to collaborate to find out solutions.

#### 5.2.1 Important actors for climate change adaptation

This section deals with important actors identified by the municipality responsible persons for climate change adaptation. The findings from the interviews are presented below:

From the theory it is found that stakeholder engagement in any project in case of the process of social assessment is an integral part. Maguire and Cartwright (2008) argue that if the community is involved in the process of change from the very beginning, the level of uncertainty may be reduced and community's resilience to the change can be increased (Maguire & Cartwright 2008). They also argue that technical knowledge varies from one department to others while different stakeholder groups can give important insights about the community as they have the best understanding about the vulnerabilities, resources and adaptive capacity (Maguire & Cartwright 2008). Besides, Danish national adaptation strategy (2008) and Copenhagen climate change adaptation plan also inspire stakeholders and citizens to involve in climate change adaptation.

Throughout the literature review it is found that collaborative planning is important for climate change adaptation as climate change adaptation itself a collaborative approach. National Government plays an important role in climate change adaptation as laws are made there through representative democracy. On the other hand, municipality needs to cooperate with other municipalities, utility companies, citizens, research institutions etc. From the interviews with different municipalities and utility companies the identified actors for climate change adaptation are as follows:

**Rødovre Municipality** 

Organization	Identified actors
Copenhagen Municipality	<ul> <li>Government and legislative framework</li> <li>Other municipalities</li> <li>Utility companies</li> <li>Citizens and local councils</li> <li>NGOs</li> </ul>
HOFOR	<ul> <li>Government</li> <li>Politicians</li> <li>Municipality</li> <li>Citizens</li> </ul>
Hvidovre Municipality	<ul> <li>Utility company</li> <li>Citizens</li> <li>Housing associations</li> <li>Companies working with municipalities</li> <li>State owners</li> </ul>
Avedøre wastewater	<ul> <li>Private garden owners</li> <li>Municipality</li> <li>Advisors</li> <li>Road department</li> <li>Environment agency</li> <li>Politicians</li> <li>Police</li> <li>Children</li> </ul>
Albertslund Municipality	HOFOR

Table 5: Identified actors important for climate change adaptation from the interviews

According to Palle D. Sørensen from Copenhagen Municipality the government and the legislative framework are important actors for climate change adaptation along with other municipalities, utility companies, citizens and local councils. Palle D. Sørensen also mentioned that local councils are the main way to reach the people as they know all the people and stakeholders in that area. There are some NGOs like nature Preservation Company, local councils with same interests like park user councils which Palle D. Sørensen identified as important actors.

•

Municipality Citizens

Municipality

Sewerage company

the municipality And citizens

Planning and Technical department of

Sonia Sørensen also identified that citizens have a role in climate change adaptation as they have to solve the problem within the area. Besides, the municipality, politicians and the government has big responsibility for climate change adaptation as she added.

According to Morten Beha Pedersen from Hvidovre municipality utility company, citizens, housing associations have a great role in climate change adaptation. Along with citizens, companies working

with municipalities, state owners are needed to involve in the discussion to solve the problems as he added.

As earlier mentioned that Avedøre wastewater is working with Brøndby and Vallensbæk municipalities, together they made some demonstration projects including all kinds of people related to the project. But stakeholder's involvement depends on the type of project as Søren Hansen said

"(...) it depends from the project. This project is on our own land here. We have rain garden as different kind of small LAR solutions, SUDS solutions. Here the stakeholders could be the users of the garden, the owners of the company. For example, because it's their land and also who are the people maintaining this as well. That could be stakeholders as well".

Besides, Søren Hansen identified that private garden owners, municipality, advisors, road department of the municipality, police, environment agency, children, politicians etc.

According to Lars Kuhnau from Rødovre municipality, the important actors for climate change adaptation are the municipality itself, the sewerage company, technical department of the municipality and citizens. Sewerage companies are important because they deal lots of tasks regarding drainage. Citizens are important in climate change adaptation because it's their city and their areas will be used for handling rainwater locally.

From the interviews it is found that municipalities have close cooperation with utility company as they are working together for climate change adaptation. Utility company, HOFOR is sharing their knowledge with municipalities which means that utility company has more technical knowledge. From the literature review it is found that, the government authorities rely more on technical departments as Lund et al. (2012) mention that in Denmark climate change adaptation is handled in the technical departments in the municipality that make adaptation is a technical issue (Lund et al. 2012). From the interview with Sonia Sørensen from HOFOR, it is found that the collaboration is taking place by having a daily contact with the municipalities and utility company HOFOR. Again municipalities are collaborating within the municipalities through different networks like water in cities and they also have an organization called KL. Municipalities are collaborating with housing associations through arranging a meeting along with utility company to show them what they are working for climate change adaptation. They think that citizen's involvement is important for climate change adaptation as they are going to use their property.

From the above analysis it is found that, the most important actors for climate change adaptation are municipalities and utility companies. Citizens are important because the municipality uses their area to implement adaptation plan. Brøndby municipality has implemented some demonstration projects with the active participation of the citizens. But still such kind of approach is very limited. Citizen participation is important for them because the municipalities will use their area to implement adaptation approaches. But often citizens participation is ignored because municipalities faces some challenges to work with them. For example, in case of Rødovre Municipality, they are using public roads so that they do not need to go and talk with individual house owners. Besides, there is communication challenge to work with citizens when citizens do not experience any problems from extreme rainwater events. Another thing is that citizens have very high expectation that municipalities will solve all the problems related to cloudburst. But in case of climate change adaptation they have also some responsibilities. Therefore, the collaboration between municipalities and citizens is not seen very directly from the process. Besides, the adaptation task is done only between government institutions and utility companies as adaptation is seen as a technical issue and solved by the utility companies as they have more technical knowledge. From the theory it is also found that adaptation is seen as a technical issue and solved only by technical departments. In the

municipalities it is found that more cross disciplinary approaches are playing important role. Municipalities are collaborating with road and traffic department, environment department, nature and park department and planning department for adaptation purpose. In most of the cases, municipalities organize climate change adaptation group by including technical people from all the departments especially from technical department where planners are also included.

# 5.3 Analysis of Institutional capacity

This section describes the institutional capacity of the municipalities. The analysis is based on the interviews. In the paper delving into the "Institutional Black Box": Revealing the attributes of sustainable urban water regimes, van de Meene and Brown identify the institutional capacity (van de Meene et al. 2009) which is used here as an analytical framework for the project. In their paper they identify four spheres as sustainable management regimes: administrative and regulatory sphere, inter- organizational sphere, intra-organizational sphere and human resource. Here attributes of each sphere from the interviews will be discussed.

From the interviews the identified capacity building attributes are divided into enabling factor and constraining factor. The findings are presented in the below table:

Sustainable management regimes	Enabling factor	Constraining factor
Administrative and regulatory	<ul><li> Political will</li><li> Legislation</li><li> Agreement</li></ul>	<ul> <li>Financial barrier</li> <li>Collaboration is hindered because of not having a clear understanding of the responsibilities.</li> </ul>
Inter- organizational Sphere	<ul> <li>Collaboration with utility company</li> <li>Collaboration with other municipalities</li> </ul>	<ul> <li>New approach to planning</li> <li>Unclear responsibilities</li> <li>Different interests</li> <li>Collaboration with Citizens</li> </ul>
Intra- organizational Sphere	<ul> <li>Organizational structure and administration</li> <li>Collaboration within departments</li> </ul>	<ul> <li>Inadequate technical resources</li> <li>Inadequate financial resources</li> </ul>
Human Resource Sphere	<ul><li>Technical skills</li><li>Manpower</li></ul>	<ul> <li>Lack of technical knowledge</li> <li>Lack of manpower</li> <li>Not having enough time</li> <li>Communication challenge with the citizens</li> </ul>

Table 6: Management Regime Framework and Capacity Building Initiatives from interviews:

#### 5.3.1 Administrative and regulatory sphere

This section deals with administrative and regulatory sphere to build institutional capacity. From the literature, the identified attributes for administrative and regulatory spheres are:

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- strategic planning and design
- tools and instruments
- guiding principles and
- management and implementation.

Strategic planning and design includes institutional arrangements including stakeholder engagement. Tools and instruments include political, institutional, financial, regulative and technical support. The third attribute is the guiding principles which include trust, transparency, accountability, integration, collaboration, cooperation, flexibility, innovation and focus on clear objectives. Management and implementation attribute includes top-down and bottom – up approaches to get multiple benefits, leaderships from politicians and other stakeholders that influence implementation, coordination and risk management (van de Meene et al. 2009).

From the interviews the identified attributes for administrative and regulatory sphere are:

Enabling factors:

- Political will: Due to the experience of rainwater events in the previous years, climate change adaptation is a political will now to make city resistant against cloudburst.
- Agreement: The government and municipalities agreed on to make climate change adaptation plans which need to be finished by 2013.

Constraining factors:

- Legislative barrier
- Financial barrier and
- Unclear responsibilities of municipalities and utilities

The details of the findings from the interview are discussed below.

Climate change adaptation is a political will as all of the interviewees have agreed on that. Moreover it is a necessity as Denmark has experienced heavy downpours recent years. According the interviewees the rain water incidents in 2nd July 2011 has made a political focus on climate change adaptation. Besides, there is an agreement with municipality and government that by 2013 municipalities will prepare climate change adaptation plan what they are doing now in cooperation with utility companies.

Climate change adaptation has a legal barrier as there is no appropriate law about the responsibilities of different actors. Moreover, they have financial barrier as there is a perplexity of the municipalities and utility company about who will finance in the planning. Moreover, climate change adaptation is not possible without the collaboration of utility company. But there are some problems with the utility company as utility company is used to work in underground water services like pipes, pumps etc. Utility company is new in planning. They are organizing themselves in a way so that they could give a good result.

According to Palle D. Sørensen legislation of Denmark says, municipalities are not allowed to handle wastewater. Utility companies have to handle wastewater including rainwater management. Therefore, municipalities have to cooperate with utility company to do the plan. Utility companies invest on the plan but they do not pay all the cost as he said. Besides, the legislation says all the projects above ground is managed and paid by the municipalities and underground tasks are managed and paid by the utility company. Palle D. Sørensen said that

"So the system is now everything above earth level is owned by the municipality and paid by the municipality and this is not a good example if we could make another system like this and say like this is a channel or some system to handle water and may be there could be some trees or grass on top of this or flowers and all these things above ground is paid by the municipality and is maintained by the municipality. All everything below us is on account to HOFOR".

According to the law, utility company can invest in the project. They cooperate with municipalities but due to the co-investment there arise some problems. According to Lars Kuhnau, when HOFOR and municipality together pay for a project there arise some complications as the process is too bureaucratic. Morten Beha Pedersen from Hvidovre municipality has also mentioned that the funding law is too bureaucratic and it is not possible to make an adaptation with this funding law. If there are some combined projects then the fund can be divided but till now Hvidovre municipality did not have such kind of projects.

All of the demonstration projects in Brøndby are made by close cooperation with Avedøre wastewater, Brøndby utility and Brøndby municipality. In some of the projects it was co-financed. But according to Søren Hansen from Avedøre wastewater, there is not a clear law about who should pay for climate change adaptation. Therefore, he said, it is needed to cooperate with the municipality as they are quite closer to the approval process. In some of the projects municipalities simply coordinate with Avedøre wastewater but not co-invest in the project as Søren Hansen said.

From the above discussion it is found that due to strong political will and agreement, municipalities are preparing climate change adaptation. Municipalities are cooperating with utility company as according to legislation they are the one who handles wastewater. Municipalities are not allowed to handle wastewater. But this cooperation creates some problems in sharing responsibilities and co-investment.

#### 5.3.2 Inter-organizational Sphere

This section deals with inter organizational communication of the municipalities. Through literature review, the attributes of inter-organizational sphere are:

- Organizations effectively coordinate activities and engage in regular and open communication, focusing on learning and flexibility, and drawing on experience.
- Partnership, cooperation, and collaboration
- A shared vision, interests, sense of ownership and norms of cooperation, and reciprocity
- Cooperative attitude, willingness, commitment to the relationship, and are willing to share power (van de Meene et al. 2009).

While from the interviews the identified attributes for inter-organizational sphere are:

Enabling factors:

- Collaboration with HOFOR and other utility companies
- Collaboration with other municipalities

Constraining factors

- New approach to planning: Though the working environment is now different and this new approach creates some problems due to the different interests of all the actors. But this new approach also creates an opportunity to work together by overcoming challenges.
- Different interests: All the actors have their own interests that's why collaboration does not work all the time.

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- Unclear responsibilities of municipalities and utilities: Legislation does not clearly define the responsibilities of municipalities and utilities.
- Collaboration with citizens.

The details of the findings from the interviews are presented below:

#### Collaboration with HOFOR and other utility companies

HOFOR is working with eight municipalities for sharing knowledge. They have a lot of technical knowledge about hydraulics and hydrology. Besides they give important suggestions to make solutions. They also finance the plan. HOFOR cooperates with the municipalities so that both of them can find an authentic solution as Sonia Sørensen said

"Our role is that we have the knowledge about water and how the water acts and reacts in the surface and the underground. So, we can give a lot of input and give a lot of guidance to solve problems".

HOFOR as a utility company is responsible to handle water and wastewater because in Denmark there is a legislation that says that municipalities are not allowed to handle wastewater. Before 2007 municipalities had their own utility companies. But utility companies and municipalities are separated now and have their own finances as Palle D. Sørensen added

"Municipalities borrowed money from the utility services and used them for other purposes. At some point the government found that they had to be separated so that the economy of the utility company can be separated totally. And this include that all the handling of wastewater should be done from the utility company, municipality cannot handle this at all".

Copenhagen municipality is collaborating with HOFOR for preparing plans for example preparing cloudburst plan. They have decided that they solve the problems together and HOFOR will pay most of the cost for implementation. According to Palle D. Sørensen, the agreement is now that everything above the ground is owned and paid by the municipality and all others in the underground is owned and paid by HOFOR.

Both Hvidovre municipality and HOFOR have a shared responsibility where municipality will decide how much water they can accept, where the problems are and how much money they need to solve the problems and HOFOR will basically solve the technical problems. Besides, most of the problems are about the sewerage system. Therefore, HOFOR will solve most of the problems. So, the municipality is working in a close dialogue with HOFOR to solve the problems. HOFOR is a new organization but Hvidovre utility also owns it as Morten Beha Pedersen added. The municipality has worked with their own utility company and now working with others. There is a good collaboration between them. Besides, HOFOR is a big organization and working to solve their organizational problems to make it an effective organization.

It is found from the interview that Avedøre Wastewater has cooperation with HOFOR in CCA plan preparation. They make calculations where water passes. This is prepared for whole the area of Copenhagen. Besides Avedøre wastewater meets once every second month in the network organization Water in Cities where they meet HOFOR, utility companies from other areas like from Jutland, advising engineers etc. So, there is a lot of interaction in such kinds of arrangements, conferences where they meet not only HOFOR but with others as Søren Hansen said.

From the interview with Morten Beha Pedersen from Hvidovre Municipality it is found that HOFOR is making a common plan for the municipalities. But it is important that they make only maps and look

to the sewerage system. It is the responsibility of the municipality to solve the problems. HOFOR can give some ideas about how to solve the problems but it is the responsibility of municipality to take decision what they are going to do in their area as Morten Beha Pedersen added.

HOFOR is preparing flood maps on a large scale covering all the municipalities they are working with. But it does not cover all the details of individual municipality. According to Lars Kuhnau, from Rødovre Municipality,

"HOFOR is preparing maps where flooding is expected to happen. But since they are doing it for larger areas they are doing it with lower level of detail and the maps we were shown last Friday were not really detailed or good enough that we can use them".

Besides, Rødovre Municipality has prepared flood mapping in their own area with all the details while HOFOR is also preparing the same maps with less detail according to Lars Kuhnau. These problems are created due to overlapping and unclear responsibilities.

HOFOR is a very new organization and it is facing some challenges to work with other municipalities. According to Sigrid Glarbo, from Albertslund Municipality, HOFOR is working with eight municipalities with different interests. But it is difficult to cooperate outside the boundary. Morten Beha Pedersen from Hvidovre municipality also agreed on that HOFOR has the possibilities to make big solutions but it is not always easy to take account of inside problems of each small municipality.

From the interview it is found that Copenhagen municipality is working with HOFOR for preparing plans. But they face some challenges while working with them. As HOFOR is a new organization and it is a new experience for them to work in such environment. Palle D. Sørensen said

"It's a major barrier is that cloudburst management is different from what HOFOR is used to do. This is a change in culture and change in the way we think. And they are afraid of that they have to hire garden to maintain trees and flowers and so on and of course it's a new experience for them and it's new for us also. But it's a little bit difficult for them to imagine how the future will look like and ok we cannot do like this, we are used to how people react by being a little skeptical or they resist that".

Sonia Sørensen also mentioned that they face some challenges as it is quite new planning. Before they work with underground making bigger pipes for increasing the capacity of the sewer system but now they are working on the surface. Because HOFOR found that it's the most economic way to handle climate change adaptation.

From the interview with Søren Hansen it is found that Avedøre Wastewater faces some challenges to cooperate with Brøndby municipality and Vallensbæk municipality. All are different organizations and have different interests. They have different finances also. But the main challenge here is to concentrate on whole area not only one single area with more details. Avedøre Wastewater cooperates with them by arranging a meeting where they can talk together and negotiate. Politicians, people, environment group, park and nature group want the cooperation. If they meet together they can solve their financial barrier. In the cooperation they can discuss who pays for what and how much they can pay for the projects.

#### Collaboration with other municipalities

From the interviews, it is found that Copenhagen municipality is a member of coordination forum of the municipalities where they discuss about the problems which they face regarding border issues. Copenhagen, Hvidovre and Rødovre have common border line with the water course. So, if there

arises any problem, it is solved by these three municipalities. The forum is made to solve these problems and it also addresses the financial matters as Palle D. Sørensen said.

HOFOR is a fusion with eight municipalities. So the collaboration is easier now as the utility companies of the municipalities are working together with HOFOR. HOFOR has a dialogue with the municipalities. But there arise some problems as municipalities vary from each other with the finances, politicians and ambitions. HOFOR has a daily contact with all the municipalities. According to Sonia Sørensen, they have a good dialogue but the process is very slow. It should be faster as Sonia Sørensen said. HOFOR arranges workshops where the municipalities participate and discuss about their problems and solution approaches.

HOFOR, utility companies and municipalities have created Rainwater Forum and are meeting once or two times in a year to discuss matter of water passing from one municipality to other. The aim of the forum is to ensure the collaboration among the participants. Besides head of the planning department of the municipalities meet to discuss their problems.

From the interview with Morten Beha Pedersen, it is found that, Hvidovre municipality has collaboration with other municipalities around Copenhagen for many years about wastewater where climate change adaptation has become the main agenda. The municipality has direct contact with Copenhagen municipality to solve the problems. If they face any problems Hvidovre Municipality directly call them.

From the interview with Sigrid Glarbo, it is found that Albertslund municipality is situated in high areas therefore rain does not affect it badly. But rainwater from the municipality passes to other municipalities. Therefore, municipality has to cooperate with other municipalities. They have some local groups. But it's hard to cooperate with the municipalities for their different interests. Some municipalities have very minor interests. Albertslund is not facing any problem due to rainwater. But, they want to help their neighbor municipalities.

From the interview with Søren Hansen it is found that Wastewater Center Avedøre, Vallensbæk and Brøndby municipality, Vallensbæk and Brøndby utility companies are trying to figure out how to deal with climate change adaptation plans. They are making the plan together so that they can develop good results and find more synergies. Another reason behind this is water does not respect the boundaries. In some projects they fund together, prepare and implement together. Wastewater center Avedøre meets Brøndby municipality and utility company once in a month. They coordinate the project so that they can divide their responsibilities. There are some problems with Vallensbæk municipality as some of the municipality assignments are handled in Ishøj municipality. Therefore, Avedøre wastewater needs to coordinate with both Vallensbæk and Ishøj municipalities.

#### **Collaboration with citizens**

According to Palle D. Sørensen, Copenhagen municipality is collaborating with the citizens and other stakeholders. In Denmark when a plan is made public hearing is mandatory so that people can give their reactions. Copenhagen municipality is preparing the cloudburst plan. After the plan there will be public meetings and discussion with the people to see their views. Sonia Sørensen said that citizens have a big role in climate change adaptation but HOFOR did not have dialogue with the citizens yet as they think that it is the responsibility of Municipality to engage them in the plan. Right now they are only focusing on technical solutions.

From the interview with Morten Beha Pedersen, it is found that citizens have a great role to find a good solution. So, the municipality is also cooperating with them. There will be a meeting with the citizens, state owners, HOFOR and the municipality where the municipality and HOFOR will tell the

citizens about their ideas in this area as Morten Beha Pedersen said. HOFOR is looking at the possibilities on making some rainwater streets where they can handle rainwater that falls on the streets instead of putting them in the sewerage. There will be some improvement in the sewerage system. Alongside there is a possibility to make the new neighborhoods with more green and blue areas. The municipality did not discuss it with the politicians yet. Before that it wants to see the reactions from the citizens. Besides, political decisions are also dependent on how citizens react as Morten Beha Pedersen mentioned.

Rødovre Municipality has some road renovation projects. They have already implemented one renovation project where they had meeting with the residents and with the local organization they are involved. The cooperation ran very well according to Lars Kuhnau. Besides, he said that when any new plan is approved, then there comes also public hearing process where citizens can give their reactions which show that citizen participation is a process of public hearing. From the interview with Lars Kuhnau it is found that, they are using public roads for renovation work so that it will be easier to implement and they do not need to consult with the citizens. As he said,

"And our road residential road that is going to be renovated, part of that becomes smaller and rainwater then can be infiltrated locally. So, without that being like major decision that been written down in the plan it looks like we are probably moving in that direction as rules prefer those kinds of local solutions but this is perhaps not for the entire municipality because it depends also what is feasible in each area that probably not a realistic solution so in some areas it could also be road water separation with the intention not to lead not to infiltrated locally but to leave it outer fascines, canals. That might be piece of solutions in some areas. You have actually 2 systems to drain the rainwater. The advantage of this one is that you do not have to go the single home owner to talk. It is also much easier to implement. Basically make work in the public road. And you don't have to go into it in single house".

From the interview with Sigrid Glarbo, it is found that Albertslund Municipality is working with climate change adaptation plan. But the municipality will involve citizens so that they can use their green areas for adaptation. Municipality will provide guidelines how citizens can adapt.

Avedøre wastewater and Brøndby Municipality have some good examples of involving citizens for climate change adaptation. Together they did lots of demonstration projects incorporating citizens. They used gardens for local rainwater handling and made some renovation projects in school yards where they cooperated also with school children and also the school authority. They have made demonstration projects around Brøndby and also in Wastewater center where they cooperated with citizens. According to Søren Hansen citizens involvement is important because,

"(...) especially when you do a project over the surface, visible projects you need to take opinion from citizens to solve the problems".

From the above analysis it is found that municipalities have close cooperation with utility companies HOFOR and Avedøre wasterwater. Because together they are making climate change adaptation plans. Besides, they can share their knowledge and municipalities are part of a big organization. By this way municipalities can get inspiration from other municipalities. Besides, municipalities are cooperating with utility companies as they have technical knowhow. HOFOR is arranging workshops where all the municipalities are taking part and share their ideas. Except Copenhagen municipality all other municipalities are in the initial stage for preparing climate change adaptation plan. So, citizen's participation is not very highlighted until now. But all of them think citizens are important they will cooperate with citizens because they have to adapt in their own ground.

#### 5.3.3 Intra-organizational Sphere

This section deals municipality's organizational structure for climate change adaptation. Besides, it will identify municipality's capacity and challenges which they face for preparing climate change adaptation plan. From the literature the identified attributes of Intra-organizational Sphere are:

- Resources
- Stakeholder and community engagement,
- Organization structure and administration,
- Leadership and culture.

Resources are identified as adequate financial resource and technical resource. By stakeholder and community engagement it is possible to achieve community ownership of the local area and the problems it faces. Organizational structure and administration connects the outcomes of organizational processes and facilitates integrated decision making process. Leadership is related to the organizational commitment to make it public and influences also organizational culture by making the culture flexible, innovative, creative and adaptive (van de Meene et al. 2009).

From the interviews the identified attributes of Intra-organizational sphere is divided into two categories: enabling factors and constraining factors.

The enabling factors for intra organizational sphere are:

- Organizational structure and administration,
- Collaboration within departments

The constraining factors are:

- Inadequate technical resources
- Inadequate financial resources.

These factors are also identified in the literature.

From the interviews it is found that in case of Albertslund, planning department is responsible for climate change adaptation. There are 3-4 persons working on climate change adaptation which is not enough right now as it is found from the interview. On the other hand, in Hvidovre municipality planning and environment department are working together for climate change adaptation. In case of Copenhagen nine persons are working in climate change adaptation group. They have prepared a budget for climate change adaptation and they did not get all the finances they ask for as Palle D. Sørensen mentioned. In Copenhagen municipality there is a good cooperation with planning department, environmental department and road department.

In case of Rødovre municipality climate change adaptation plan is handled in the environment department. But the department has close cooperation with other technical departments like road and traffic department, planning department and nature and park department. In the municipality there is a group of 8-10 people working for climate change adaptation plan who are also responsible for LAR. Different people from different departments work together and by this way they develop their ideas for climate change adaptation. Besides, from the interview it is found that the cooperation between different departments runs very well. Lars Kuhnau said,

"The planning department of the municipality is quite important for long solution. Actually all the departments here in the technical department are important and we are having very positive

atmosphere where also road and traffic people, plan people are very positive about this. So, there is a very good cooperation here".

In HOFOR there are two departments: project department and planning department. Planning department is responsible for climate change adaptation tasks. In case of climate change adaptation there are some problems regarding technical and financial issues. Financial problem is bigger as Sonia Sørensen said that if climate change adaptation is solved by making the sewer bigger than it will be more expensive. The finances come from the citizens. There will be big investment if citizens pay more but it is hard to get finances from citizens if they do not experience big rainwater events. On the other hand, HOFOR has enough technical knowledge as Sonia Sørensen mentioned during interview. Municipalities have also technical knowledge. Together they cooperate and share their knowledge so that they can solve the problems very well.

Søren Hansen mentioned that the capacity of Avedøre Wastewater is that it has sufficient amount of money which citizens are paying. So, it is the responsibility of Avedøre Wastewater to use it in an appropriate way. Besides they have enough manpower in the organization and technical experts like landscape architecture, engineers, administrative people, biologists, communication workers etc. But if they need some help then they consult with COWI, NIRAS, RAMBØLL and so on.

From the above analysis it is found that municipalities have begun to work across different sections and disciplines. Municipality's climate change adaptation group includes technical groups from different departments for example, planning department, environment department, road and traffic department and park and nature department. Still technical people are dominant here. But as climate change adaptation offers huge responsibilities, municipalities face lack of manpower. Municipalities share their knowledge with utility company and work together in climate change adaptation as utility company has more technical knowhow. Besides, due to the financial reason, municipalities have to cooperate with utility companies as according to the law, utility company can invest in climate change adaptation.

#### 5.3.4 Human Resource Sphere

This section deals with municipalities skills with the human resource. The analysis will find out which resources municipality has and what barriers they face due to climate change adaptation. In the literature it is argued about human resources sphere where it presents different attributes:

- Knowledge and information
- Internal qualities
- Resilience,
- Interest in organization's role.

Individual must have sufficient knowledge and information to pursue their job with proper understanding and using information from the consultants. Besides, individuals have their internal qualities for example, respect to the other persons responsibilities and aware of their own responsibilities. Individuals have an interest in organization's role and are resilient through training and experience (van de Meene et al. 2009).

From the interviews, the identified enabling factors for human resource sphere are:

- Adequate technical knowledge and
- Adequate manpower and

The identified constraining factors are:

An analysis of institutional capacity for climate change adaptation in the Copenhagen area

- Lack of technical knowledge
- Lack of manpower
- Not having enough time
- Communication challenge with the citizens

From the interviews some of the attributes that are described in the literature is not found for example: internal qualities, resilience, interest in organization's role.

It is found from the interviews that some municipalities have adequate manpower and technical skills for example in Copenhagen. Though municipalities have technical knowledge and manpower but for climate change adaptation the municipalities cooperate with utility company as utility company has more technical knowledge. By this way they share their knowledge to get a good result.

On the other hand, some municipalities do not have enough manpower for handling climate change adaptation. For example Municipality of Albertslund does not have enough manpower and enough time for adaptation. As Sigrid Glarbo from Albertslund Municipality said

"(...) we have very huge political focus on adaptation from the government, from EU and other places. That point of view I have to be in touch with all the groups, I could be part of them of course and collect information then I do not have enough time for whole work. And we do not have capacity for that now. So in a way with the needs and problems we have I think right now we do not have manpower too so much communicate with citizens what you can do to climate change as yourself round adaptation and mitigation".

Municipalities are cooperating with the utility company as they think that utility company has more technical knowledge. As Morten Beha Pedersen from Hvidovre Municipality said

"(...) we are working in this way, where do we have problems and what do to solve these problems. While the technicalities about how to solve the problems is the responsibility of HOFOR".

That seems municipalities depend on Utility Company for technical knowledge. In case of Rødovre Municipality, they cooperate with consultancy companies for example Rambøll for technical knowledge and now they are also cooperating with HOFOR for the same purpose. According to Lars Kuhnau, climate change adaptation is very time compressive and the guidelines came very late from the Nature Agency for climate change adaptation. So, there are a lot of tasks to do within limited time period. He also mentioned about another challenge which is the expectation of citizens. Citizens expect that municipality will solve problems regarding rainwater events immediately. But it will take time to adapt. Lars Kuhnau added that

"There's some kinds of communication challenge about making people understand where does the responsibility of the municipality end and where do their own responsibility begins".

From the above analysis it is found that municipalities do not have enough manpower and technical knowledge for climate change adaptation. For technical knowledge municipality consult with Consultancy Company and cooperate with HOFOR. Besides, there are other barriers like: limitation of time and communication challenge with the citizens that hinders climate change adaptation.

#### 5.4 Resilient approach and social assessment

This section deals with resilience approach which will be used to identify municipality's capacities and resources, vulnerabilities and adaptive capacity as Maguire and Cartwright (2008) identify resilience approach as a powerful tool to identify community's resources and adaptive capacity to
overcome challenges (Maguire & Cartwright 2008). From the interviews the identified resilience model is shown in the below figure.



Figure 18: Identified resilience model from the interviews

Here external process is political will. Due to strong political focus on recent rainwater events municipalities have to adapt climate change. Besides, adaptation is a necessity because these rainwater events cost huge damages. Therefore, there is an agreement with the government and municipality to prepare climate change adaptation plan by 2013. Due to these external process municipalities are preparing climate change adaptation plan.

But municipalities have some capacities and also they have some barriers that hinder this capacity which was discussed above. Municipalities have administrative support and inter organization collaboration and intra- organizational collaboration while the barriers that municipalities face are: not having enough manpower, technical barrier, financial barrier, communication challenge and unclear responsibilities of the municipalities and utilities.

As discussed in the analysis of institutional capacity section, municipalities have a very good collaboration within departments and have a good administration system to deal with climate change adaptation. Most of the cases climate change adaptation is dealt in the planning department

but it is not possible to adapt without the cooperation from other departments like: road department, environment department and park and nature department. Therefore, municipalities have to cooperate within departments and from the interviews it is found that the cooperation runs well. According to the legislation municipalities can use surface area for climate change adaptation and they can invest on it. While all the underground works is done and paid by utility company. So, there needs a close cooperation with municipalities and utility as climate change adaptation plan includes both surface and underground tasks. According to the legislation utility company can invest on the projects which are handled by the municipalities. But due to this co-investment there arise some problems with shared responsibilities. So, according the interviewees this legislation is too bureaucratic. Besides, municipalities are cooperating with other municipalities through workshops which are organized by HOFOR. Municipalities face some barriers like technical, financial and legislative which tempts to cooperate with utility company to work together for sharing knowledge, responsibilities and co-invest. With these characteristics municipalities take action to adapt to climate change through leadership, networking with other stakeholders and empowering citizens.

From the interviews, it is found that some municipalities have enough technical knowledge, manpower, administrative support etc like, Copenhagen while other municipalities do not have these resources. Beside, due to the collaboration with the utility company HOFOR, municipalities ensure adaptive capacity for climate change adaptation as the collaboration with utility company runs well even though they are quite new in the area of planning with some difficulties. Municipalities think that citizen's participation is important in climate change adaptation. But they are in the initial stage of the preparation plan and there will be a public hearing process where citizens will give their comments. But this public hearing process is a very traditional approach where hearing is not working very well as a participatory process. Only people who have knowledge on the issue and interests they participate in the hearing process which do not work after because of the reliance on technical knowledge. But citizens should be involved in the process because they have more local knowledge. By incorporating technical knowledge and local knowledge, it is possible to find best possible solutions. Brøndby municipality has implemented some demonstration projects where they ensure citizen involvement for adaptation explicitly. But still the number of such projects is very few. Therefore, it is needed to identify the new relations to include citizens in the planning process. Even though community's adaptive capacity is dependent on collaboration with utility company and empowering citizens, municipalities face challenges to work with citizens if they do not experience rainwater events and they are not aware of their responsibilities.

### 5.5 Summary of the analysis

From the above analysis it is found that due to the agreement with the government and the municipalities, municipalities have to prepare climate change adaptation by 2013. But among the eight municipalities that are working with HOFOR, only Copenhagen has prepared climate change adaptation plan and it also prepared cloudburst plan. Other municipalities are cooperating with utility companies for preparing climate change adaptation. Albertslund, Dragør, Herlev, Hvidovre and Rødovre are working with HOFOR for climate change adaptation plan while Brøndby and Vallensbæk municipalities use different approaches for climate change adaptation. They will choose pipe based approach by increasing the capacity of sewerage. But this approach is very expensive to implement. So, together with HOFOR and municipalities have a plan that they will cut 30% rainwater locally. Therefore, they will use green areas, parks and roads for local handling of rainwater. This seems that municipalities are concentrating new approach for adaptation with green solutions and there is an ongoing shift from traditional pipe based to increase institutional capacity of the municipalities. From

the analysis of institutional capacity it is found that institutional capacity is depended on four spheres: administrative and regulatory, inter-organizational, intra-organizational and human resource sphere. From the analysis, it is found that enabling factor for administrative and regulatory sphere are: political will, legislation and agreement. But there are some constraining factors in the administrative and regulatory sphere. These are financial barrier and not having a clear understanding about the responsibilities of municipalities and utilities. From the analysis, it is found that due to strong political will and agreement, municipalities are preparing climate change adaptation. Municipalities are cooperating with utility company as according to legislation they are the one who handles wastewater. Municipalities are not allowed to handle wastewater. But this cooperation creates some problems with sharing responsibilities and co-investment.

From the analysis it is found that enabling factor for inter organizational communication of the municipalities are: collaboration with HOFOR and other utility companies, collaboration within municipalities and collaboration with citizens while constraining factors are: new approach to planning, different interests and unclear responsibilities. From the analysis it is found that municipalities have close cooperation with utility companies HOFOR, Avedøre wasterwater. Because together they are making climate change adaptation plan. Besides, they can share their knowledge now and municipalities are part of a big organization and that's why they can get inspiration from other municipalities what they are doing. Beside, municipalities are cooperating with utility companies as they have technical knowhow. HOFOR is arranging workshops where all the municipalities are in the initial stage for preparing climate change adaptation plan. So, citizen's participation is not very highlighted until now. But all of the interviewees think citizens are important and they will cooperate with citizens because they have to adapt in their own ground.

From the analysis it is found that enabling factors for intra organizational communication of the municipalities are: organizational structure and administration, collaboration within departments while constraining factors are: inadequate technical and financial resources. From the analysis it is found that municipalities have quite good cooperation within departments inside municipalities. But as climate change adaptation offers huge responsibilities, municipalities face lack of manpower. Municipalities share their knowledge with utility company and work together in climate change adaptation as utility company has more technical knowhow. Besides, due to the financial reason, municipalities have to cooperate with utility companies as according to the law, utility company can invest in climate change adaptation.

From the interviews, the identified enabling factors for human resource sphere are: adequate technical knowledge and manpower while constraining factors are: lack of technical knowledge and lack of manpower. Some municipalities have adequate manpower and technical skills for example in Copenhagen. Though municipalities have technical knowledge and manpower but for climate change adaptation the municipalities cooperate with utility company as utility company has more technical knowledge. By this way they share their knowledge to get a good result. Besides, there are other barriers like: limitation of time and communication challenge with the citizens that hinders climate change adaptation.

From the interviews, it is found that some municipalities have enough technical knowledge, manpower, administrative support etc like, Copenhagen while other municipalities do not have these resources. Beside, due to the collaboration with the utility company HOFOR municipalities ensure adaptive capacity for climate change adaptation as the collaboration with utility company runs well even though they are quite new in the area of planning with some difficulties. Municipalities think that citizen's participation is important in climate change adaptation. But they are in the initial stage of the preparation plan and there will be a public hearing process where citizens will give their

comments. Beside, Brøndby municipality has implemented some demonstration projects where they ensure citizen involvement for adaptation explicitly. This means that community's adaptive capacity is dependent on collaboration with utility company and empowering citizens. By increasing community's adaptive capacity it is possible to build institutional capacity which is dependent on collaboration skills.

### 6. Discussion and Reflection

In the previous chapter, different approaches that municipalities follow for climate change adaptation are identified. Furthermore, the institutional capacity of the municipalities has also been analyzed. The analysis of institutional capacity includes identifying the capacity of the organization, challenges, barriers and also the collaboration with different actors. On the basis of the analysis, the adaptation approaches by the municipalities will be precisely discussed in this chapter. Moreover, there will be also a discussion on how municipalities cooperate with other municipalities, with the HOFOR, citizens and other stakeholders. The last part of the chapter identifies the limitations of the analysis and how these limitations have an impact on the analysis.

The main research question is: How do different municipalities within HOFOR develop their own plan to implement climate change adaptation? This research question is answered by analyzing four other sub-questions as mentioned in the methodology chapter.

# What approaches do the municipalities follow for climate change adaptation and how do they relate those with the national adaptation strategy?

In this part, the approaches municipalities follow for climate change adaptation will be discussed. From the analysis, it is found that municipalities have made agreement with the government to make climate change adaptation plan by 2013. Therefore, municipalities have started preparing climate change adaptation plans. Only Copenhagen municipality has prepared Copenhagen climate change adaptation plan while other municipalities are far away of preparing climate change adaptation plans. Municipalities are cooperating with the utility company for the purpose of the preparation and implementation of climate change adaptation plans. From the analysis the identified approaches for climate change adaptation are:

- Making bigger sewerage so that the capacity of the sewerage system is increased
- Making underground basins and pumping stations
- Separating sewerage system for example separate sewerage system for rainwater and wastewater.
- Making a large pipe that passes from flooded area to the harbor directly.
- LAR solutions like using more green and blue infrastructure for handling rainwater locally.
- The possibility of delaying the rainwater passage towards the sewers.
- Let flooding in the areas where it does least damage for example: car parks, playing fields and parks etc.
- Municipalities want to have water in the city and are working with meadows, wetlands and big parks for storing rainwater.
- Using roads for handling rainwater by changing the road structure road in a way that in the middle of the two roads there will be green areas for storing rainwater.

But the approaches like making bigger sewerage, separating sewerage system and making a large pipe are expensive solutions. So, the municipalities and utility company found another solution to store rainwater locally so that it can cut 30% rainwater passing through the sewerage system. Besides, HOFOR has already started making a large pipe to pass rainwater from the flooded area to the sea.

In Copenhagen, there is a combined sewerage system. So, it is necessary to increase the capacity of the sewerage in Copenhagen whereas in Albertslund there is a completely separated sewerage system. So, they store rainwater in the large parks, ponds and pass them in the big channels. Besides, Brøndby and Vallensbæk municipalities have implemented some demonstration projects by using

green areas for climate change adaptation that improves the values of the city. These approaches are followed according to national adaptation strategy along with the vision of making livable cities with more green and blue infrastructures. So, the findings show that municipalities are now concentrating on local solutions with more green areas along with pipe based solutions for example, making larger pipes for adapting rainwater events. This also seems that municipalities are shifting from traditional pipe based solution still this shifting is not so dominant. The reasons behind this shifting are:

- Traditional pipe based solution is very expensive.
- Pipe-based solution requires more excavation work which hampers daily lives of the citizens for long time.
- Using green and blue infrastructures for handling rainwater add more values to the city.
- Green solutions also make the city more livable and provide recreational opportunity.

To sum up the analysis identifies that municipalities are concentrating more on a new paradigm which prioritizes using green structure for climate change adaptation. Together municipalities and utilities found this solution because the traditional pipe based approach very expensive. Besides, the technical solutions like making larger pipes require more excavation work which will affect the life of the citizens. Moreover, the new approach with green structure indicates that municipalities are moving towards more sustainable solutions keeping in mind to use water to add values to the city instead to remove water. Therefore, water is seen as a resource by the municipality which will help to increase recreational possibility to the citizens and will add more aesthetic value. But which approach municipalities use depends on the nature of the area. Some municipalities direct their canals in way that it passes through the city so that it can store rainwater. Some other municipalities use their roads for infiltration while some other make green roofs, rainwater gardens etc along with pipe based solutions. For coping this approach it is needed to increase the institutional capacity of the municipalities which is discussed in the next portion.

#### How to build institutional capacity for climate change adaptation?

In this part the institutional capacity of the municipalities for climate change adaptation will be discussed. The institutional capacity includes the capacities, challenges and barriers that municipalities face. Besides it defines the inter-organizational collaboration and intra organizational collaboration of the municipalities.

Institutional capacity includes:

- Collaboration with other municipalities.
- Collaboration with utility company.
- Collaboration with different departments within municipalities.

The analysis of institutional capacity answers all the following sub research questions identified for the project: "How do municipalities collaborate with other municipalities and how do they share responsibility across boundaries in regards to climate change adaptation?"

The questions indicate the inter-organizational sphere of institutional capacity. Municipalities need to cooperate with each other for adapting rainwater events because water does not know any boundaries. Municipalities are cooperating with each other by sitting in a dialogue in 'Coordination Forum', 'Rainwater Forum', 'Vand I byer' (water in cities) etc. But the dialogue does not work all the time because of their different interests. Some municipalities have not (yet) faced any problems due to extreme rainwater events. So, they are not interested in adaptation. For example, Albertslund

municipality is situated in a high area and they are not affected by the extreme rain. And Albertslund is also a new municipality having a separated sewerage system. So, they do not face any problems when there is heavy rainfall. But they are open to collaborate with their neighbors as the rainwater passes from their area to other municipalities and affects those municipalities. But due to the minor interests of other municipalities it is hard to cooperate with them. The collaboration with different municipalities is not dominant in case of climate change adaptation. Utility company is dealing climate change adaptation with other municipalities by organizing workshops where the responsible persons attend and discuss the problems and issues. There is no horizontal collaboration with the municipalities.

The third research question is "How do they relate to HOFOR? How responsibilities in climate change adaptation are shared between municipalities and the utility?" which indicates the interorganizational capacity of municipalities. From the analysis it is found that municipalities have direct collaboration with HOFOR for preparation and implementation of the climate change adaptation plan as they are preparing the plan together. HOFOR is preparing the risk maps and doing the technical tasks while municipality is preparing the plan. So, there is cooperation in knowledge sharing as HOFOR has the technical knowledge and it can invest in the solutions/projects. Besides, according to law, municipalities are not allowed to handle wastewater. HOFOR has a daily contact, meetings and dialogues with the municipalities. This shows that municipalities rely more on technical knowledge which is also found in the theory. But it is always hard to work in different environments as the municipalities used to work with their own utility companies, some years ago in the same compound. But now their working environment is different. HOFOR is not a single organization and it is working with eight different municipalities. The interests of the municipalities and HOFOR vary from each other. Besides, HOFOR is a new organization and ways of working are also new. HOFOR is cooperating with other municipalities to get a good result from extreme rainwater events by sharing responsibilities and co-investing in the projects.

The fourth research question touches on an important challenge in climate adaptation: "How do different municipalities engage people and other stakeholders in climate change adaptation?" This also indicates the inter-organizational sphere of institutional capacity. Municipalities will collaborate with citizens because they want them to handle rainwater in their own ground. Some municipalities have already included citizens in their project for example Brøndby municipality cooperated with citizens for some demonstration projects and Rødovre municipality had a discussion with the citizens for road renovation projects. But still citizen participation is a part of hearing process and municipalities and utilities face challenges to work with citizens if citizens do not experience rainwater events. Therefore, some municipalities use public road for handling rainwater locally so that they do not need to discuss with the residents there. Besides, citizens, municipalities point to politicians, housing associations, government and local councils are important actors for climate change adaptation.

Municipalities have very good collaboration within different departments. Together all the departments cooperate for preparing climate change adaptation plans. The climate change adaptation groups of some municipalities consist of representatives from all the technical departments for example, road and traffic department, planning department, environment department and park and nature department. Technical departments are prioritized here also. But the collaboration in house runs very well as most of the interviewees agreed.

But collaboration alone is not adequate to identify the institutional capacity for climate change adaptation. There is also an administrative and regulative sphere, an intra organizational sphere and finally a human resource sphere. In case of climate change adaptation there is already an agreement between the government and the municipalities. Besides, the working environment is changed as

utility companies that worked within municipalities are now merged with other utility companies and this new way of working is a challenge for both the municipalities and the utility company. Municipalities have their own manpower, technical staffs and funds. But these resources are not adequate for climate change adaptation. Besides, the limited time period for the adaptation plan make it difficult to organize their tasks.

#### How to increase community resilience for climate change adaptation?

In the analysis chapter municipalities resources and adaptive capacity have been identified which also indicate the resilience approach of the municipality for adaptation to climate change. Climate change adaptation plan is not only the necessity but also a political will. In 2007, 2010 and 2011 Denmark has experienced heavy rainfalls which flooded huge areas in Copenhagen and other municipalities which was not acceptable by the politicians at the national and local level. So, they put pressure on the municipalities to prepare climate change adaptation plan for finding solutions from extreme rainwater events. Therefore, municipalities have started preparing climate change adaptation plan and according to the agreement they have to finish the plan by 2013.

The identified resources of the municipalities are:

- Technical skills
- Manpower
- Administration
- Collaboration skills etc.

But these resources vary in the different municipalities. Some municipalities have enough technical knowledge, manpower and collaborating skills for example: Copenhagen while other municipalities are lacking technical knowledge and manpower for example, Hvidovre municipality and Albertslund municipality. But there exists direct collaboration with municipalities and utility companies while collaboration with other stakeholders is not highlighted due to different interests. Municipalities do not have any direct collaboration with other municipalities regarding climate change adaptation while they only participate in the workshop which is organized by HOFOR to discuss their problems and solutions. But municipalities have very good collaboration within departments and climate change adaptation groups of the municipalities include all the responsible persons from different departments.

There are some barriers that hinder municipalities work. These barriers are:

- Technical barriers: Municipalities are collaborating with utility company and Consultancy Company to get technical knowledge.
- Financial barriers: Municipalities do not have adequate money for the adaptation tasks but now utility companies can invest in climate change adaptation projects. But the system is too bureaucratic as it is found from the interviews.
- Legislative barrier: the legislation about water sector law itself a barrier as it did not clearly mentioned about the responsibilities of municipalities and utilities and also about the finances.
- Communication challenge with the citizens: Most of the municipalities face communication challenge to work with citizens due to high expectation of the citizens. According to the interviewees it is hard to cooperate with them if citizens do not face any problems due to cloudburst and if they do not aware of their responsibilities.

- Lack of confidence: Utility Company is a big organization now which also handles larger area. But municipalities are not satisfied with the work of utility company as it does not include all the details of single municipality.
- Limitation of time: All the interviewees mentioned about the time limitation for the project. Climate change adaptation plans include huge tasks but the guidelines for that had been provided to them too late (in March 2013 according to the interviewee).

But with all these barriers and challenges municipalities are working with utility company for preparing climate change adaptation plans in a new environment. This new approach of working environment opens up the opportunity to cope with new challenges and find out the solutions.

### 6.1 Project limitations

From the study, it is found that the Copenhagen municipality has already prepared a climate change adaptation plan according to the agreement with the government and the municipalities. Other municipalities are still working to develop climate change adaptation plans. The Municipality of Albertslund had prepared a Climate change adaptation- strategy and actions but it did not fulfill the requirements of the agreement. Therefore, they are preparing a new climate change adaptation plan. The Municipality of Hvidovre had the same problem. Along with Albertslund and Hvidovre the other four investigated municipalities are working with HOFOR for preparing climate change adaptation plan with the collaboration of Avedøre wastewater. But the process of working in such a situation is a very new.

Therefore, the analysis possibilities are limited because the approach of working climate change adaptation with eight municipalities is a new experience for HOFOR. But the result of this analysis cannot be generalized. It gives an important insight into the process that is going on with the corporatized utilities and the new challenges of addressing climate change in the municipalities in Denmark.

In the beginning of the project it was decided to conduct interviews with the responsible person from all the municipalities within HOFOR. The responsible person of the Dragør municipality was too busy with their task as they were only two people dealing with climate change adaptation; it was not possible to undertake the interviews with them. It was not possible to undertake face to face interview with the responsible person from Herlev municipality while the interview was undertaken over phone. Brøndby and Vallensbæk municipality is collaborating with Avedøre wastewater services for adapting climate change. Therefore one interview with two persons from Avedøre wastewater was undertaken which gave insights of both Brøndby and Vallensbæk municipality. But the data would be more valid if it was possible to take interviews from the responsible persons of all the municipalities that work with HOFOR. Besides, if it was possible to more interviews both with the municipalities and utility company it would give more insights. Due to the bindings of the interview time it was not possible to get more details. But overall the project covers all the important parts of the analysis and explores the research question.

## 7.Conclusions

In this chapter answers the research questions is addressed by bringing together the theoretical framework and the analytical framework based on the practical evidences. The main research question of this project is 'How do different municipalities within HOFOR develop their own plan to implement climate change adaptation? To answer this research question four sub-questions are formulated which will also be answered in this chapter. These are: What approaches municipalities follow for climate change adaptation and how they relate those with national adaptation strategy? How do municipalities collaborate with other municipalities and how do they share responsibility across boundaries in regards to climate change adaptation? How do they relate to HOFOR? How responsibilities in climate change adaptation are shared between municipalities and the utility? And how do different municipalities engage people and other stakeholders in climate change adaptation?

There are eight municipalities that are working with HOFOR. Therefore these eight municipalities are eight cases in this study. The chosen unit of analysis is HOFOR here. Besides, the case study is an embedded one where each single case has one single unit of analysis. All the municipalities that are working with HOFOR are inside greater Copenhagen region.

Copenhagen region has chosen here as it has experienced extensive rainwater events in 2007, 2010 and 2011. These events have influenced the politicians to adapt climate change. Therefore, there is a political pressure on the municipalities to adapt climate change to make city resilient against extreme rainwater events. There is an agreement with the municipalities and government that municipalities have to prepare climate change adaptation plans by 2013. Therefore, municipalities are working on it.

The main research question 'How do different municipalities within HOFOR develop their own plan to implement climate change adaptation is answered by whether municipalities follow pipe based approach or they choose another approach for handling rainwater locally with more green solutions. Therefore, it is necessary to identify the approaches that municipalities follow for climate change adaptation and their relation with national adaptation strategy. To find out the answer four sub research questions is prepared where the first sub research question deals with identifying the approaches municipalities follow. From the analysis it is found that among the eight municipalities that are working with HOFOR only Copenhagen municipality has prepared climate change adaptation plan. Other municipalities are in the initial stage of preparing the plans. Some municipalities (Albertslund, Hvidovre) have prepared climate change adaptation plan but they did not do the plan according to the agreement. All the municipalities are cooperating with Utility Company for the preparation and implementation of climate change adaptation plans. In Denmark municipalities are not allowed to handle wastewater according to the law where utility companies are not allowed to handle surface areas. But climate change adaptation tasks include the both areas. Therefore, there is a need for collaboration effort here. From the analysis the identified approaches for climate change adaptation are: making bigger sewerage, separating sewerage system, LAR, storage of rainwater, delaying passing rainwater, making a large pipe that passes from flooded area to the harbor directly. But the pipe based approaches like making bigger pipe is very expensive and requires excavation work which will hampers daily life of the citizens. So, the municipalities and utility companies are considering other approaches like handling rainwater locally with green solutions. This shows that municipalities are now concentrating to local solutions with more green areas from pipe based solution for example, from making larger pipes for adapting rainwater events to using green areas for local solutions. Therefore, there is an ongoing shift from pipe based approach to the new approach. But still the examples of the implementation of new approach concentrating more green areas are very few.

The second sub research question of the project is "How do municipalities collaborate with other municipalities and how do they share responsibility across boundaries in regards to climate change adaptation?" Municipalities need to cooperate with each other for adapting rainwater events because water passes from one municipality to another. This is a part of water ways regime of sustainable urban water management which indicates that municipalities have to respect water and they cannot control it completely in pipes. From the interviews it is found that municipalities are having dialogue with each other by taking part in a coordination forum, rainwater forum and water in cities forum etc. Besides, municipalities attend in the workshops organized by HOFOR. There is no other cooperation among municipalities except these workshops and seminars. In these seminars and workshops municipalities discuss their problems and solutions. But the dialogue does not work all the time because of the varying interests of the municipalities. Some municipalities did not face problems due to extreme rainwater. Therefore, they have minor interests. Due to the minor interests of other municipalities it is hard to cooperate with them.

The third sub research question for this project is 'How do they relate to HOFOR and how responsibilities in climate change adaptation are shared between municipalities and the utility? From the analysis it is found that municipalities have direct collaboration with utility company as utility companies have a great role in climate change adaptation. Utility companies are obliged to prepare flood maps to identify the problem areas. Besides, it is the responsibility of the utility company to handle wastewater. They have long experience for handling wastewater and have enough technical knowhow. It is already known here that municipalities are preparing climate change adaptation plans with the cooperation of utility companies. Together they identified some approaches for adaptation where pipe based approaches are very expensive. So, the municipalities and utility companies have decided to handle rainwater locally where they will co-invest in the projects. HOFOR is organizing workshops, meetings to have dialogue with the municipalities because they want all the municipalities in the same level. But the dialogue does not work all the time due to the conflicts of interests. Besides, HOFOR is a new organization and working in a new environment now with eight municipalities having different interests. Therefore HOFOR is concentrating on a larger area than only one single municipality. Besides, there is a lack of confidence of the municipality while working with HOFOR as they do not know much about single municipalities. Moreover, the legislation does not clearly say the responsibilities of the municipalities and utility company.

Municipalities are cooperating with utility companies for adaptation to climate change plans. Utility company has a role in climate change adaptation. Normally utility companies handle wastewater including rainwater. According to water sector law, municipalities are not allowed to handle wastewater while utility companies are not allowed to handle surface. But climate change adaptation includes both surface areas and underground areas. While there is an extreme rainwater event, it creates pressure on the sewerage systems. Therefore, it is necessary to increase the capacity of sewerage systems which is an expensive solution. Another solution could be to handle rainwater locally which will minimize pressure on sewerage capacity. But for both the solutions municipalities and utilities have to work together and according to the water sector law, utility companies cannot handle surface areas. In this case, they can co-invest in some of the projects on the surface. Therefore, it seems that climate change adaptation is a collaborative approach between municipalities and utility companies. Utility companies are also collaborating with the municipalities as they are preparing flood maps for climate change adaptation plans of the municipalities. Besides, utility companies have long tradition of handling wastewater. Therefore, utility companies have more technical knowledge which is also one reason to collaborate.

The fourth research question is that 'How do different municipalities engage people and other stakeholders in climate change adaptation'. From the analysis it is found that all the interviewees are

agreed on citizen participation on climate change adaptation. But the municipalities are in the initial stage of preparing climate change adaptation plans. Therefore, collaboration with the citizens is not dominant here whereas they are a part of the hearing process which is not a good example of participatory approach. It is needed to involve citizens in the adaptation process because they have local knowledge. If this local knowledge is combined with technical knowledge then it is possible to find out better solutions. The municipality of Brøndby has made some demonstration projects where they included citizens in their project. But still the number of such projects is very limited and often municipalities face challenges to work with the citizens if citizens do not experience problems due to rainwater events and if they do not aware of their responsibilities regarding them. Most of the cases, municipalities rely more on technical knowhow. Besides, citizens the municipalities think politicians, housing associations, government, local councils are important actor for climate change adaptation.

These four sub research questions help to answer the main research question where it says that municipalities are following both tradition pipe based approaches of making larger sewer pipes and local handling of rainwater with more green and blue infrastructures. But they have more concentration on the new approach of handling rainwater locally with green structures. By this way municipalities are prioritizing water management in a more sustainable way where they see water as a resource that adds more aesthetic value. This requires collaboration with utility companies, other municipalities and citizens to make the city resilient to climate change. This collaboration approach also increases the institutional capacities. But from the analysis, it is found that collaboration with municipalities and utilities want to include citizens in more active ways but they have very little experience with this. Besides, along with other barriers like legislative, technical, financial, lack of confidence, limitation of time municipalities face some communication problems to work with the citizens. Besides, there is not direct collaboration with other municipalities but there is a good cooperation within the departments of the municipalities.

On the basis of the analysis, discussion and reflection it can be concluded that collaboration with municipalities and utility companies, other municipalities, citizens and other stakeholders are necessary to cope with climate change. Municipalities need to cooperate with utilities for technical knowledge while they need to cooperate with other municipalities as water runs across borders and for local knowledge and information they need to cooperate with citizens and other stakeholders. Besides, new approach of working environment gives municipalities an opportunity to deal the problems in a cooperative way.

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## Appendices

#### Appendix A: Interview Guidelines for Utility Companies (HOFOR, Avedøre wastewater)

Ask permission to start the recording. Introduce yourselves and what you are doing:

Thank you for meeting with me. I am conducting a research project about how do different municipalities in Copenhagen region follow national adaptation strategies and develop their own plan to implement climate change adaptation. This interview should last approximately an hour. I would like to be able to use the information gathered from this interview for a written Master`s thesis. Is it alright with you that I identify you by name in the report? Name:

Position:

Main responsibilities:

#### Climate change adaptation

- 1. Tell me something about the organizational structure? How are you working with climate change adaptation?
- 2. How do you approach climate change adaptation? What do you mean by CCA?
- 3. Do you have any CCA plan or strategy?
- 4. How do you follow national adaptation plan?
- 5. What are the responsibilities of Utility Company regarding CCA?
- 6. What are the roles of utility companies for CCA?
- 7. What is your capacity? What challenges do you face to implement climate change adaptation?
- 8. Do you have any technical/financial barriers for implementing CCA?
- 9. How do you implement climate change adaptation?
- 10. How climate change adaptation included in your work? Is it a political will?
- 11. Who is articulating climate change adaptation?

#### **Collaborating Planning**

- 1. What have been the main channels of communication and coordination between municipality authorities, residents, stakeholders and utility?
  - How do you communicate with municipalities?
  - How do you communicate with residents and stakeholders?
- 2. How do you engage people in implementing CCA?
- 3. Is there anything that hinders negotiation process?
- 4. Which actors, do you think should be involved in CCA implementation?
- 5. Do you think the approaches you are using to engage stakeholders are effective and people are responding effectively on this?
- 6. Do you want to add something here?

Thank you for your time and if you think of anything else that may be relevant or that you would like to add, please feel free to contact us.

#### **Appendix B: Interview Guidelines for Municipalities**

Ask permission to start the recording. Introduce yourselves and what you are doing:

Thank you for meeting with me. I am conducting a research project about how do different municipalities in Copenhagen region follow national adaptation strategies and develop their own plan to implement climate change adaptation. This interview should last approximately an hour. I would like to be able to use the information gathered from this interview for a written Master`s thesis. Is it alright with you that I identify you by name in the report? Name:

Position:

Main responsibilities:

#### Climate change adaptation strategies

- 1. Did you experience any kind of rainwater events in recent years?
- 2. Does the municipality have its own climate change adaptation strategy or plan?
- 3. How the adaptation strategy integrated with national adaptation strategy and how?
- 4. Who is articulating climate change adaptation? Is it a political will or something else?
- 5. How climate change adaptation is included in municipal work? How do you implement climate change adaptation plan? What measures do you take into account for climate change adaptation?
- 6. Do you see any difference between before and after implementing climate change adaptation?
- 7. What are the specific responsibilities of the municipality to implement climate change adaptation?
- 8. How far municipality is to incorporate climate change adaptation plans and strategies? (if municipality does not have a strategy yet)
- 9. What are the barriers and conflicts municipalities experiencing with climate change adaptation implementation?

#### **Collaborative planning**

- 10. What have been the main channels of communication and coordination between the municipality authorities, surrounding municipalities, HOFOR and residents?
- 11. Which actors, in your opinion, should be involved in implementation of climate change adaptation? Please, draw a map of actors.
- 12. How does the municipality cooperate with other stakeholders to implement climate change adaptation? If the answer is that they don't cooperate:
  - If not, why not. If so, how do they cooperate?
  - If the answer is that they cooperate:
    - How do you coordinate division of tasks between different actors?
- 13. Is there anything that hinders negotiation process?
- 14. Do you think the approaches you are using to engage stakeholders are effective and people are responding effectively on this?

Thank you for your time and if you think of anything else that may be relevant or that you would like to add, please feel free to contact us.

# Appendix C: Interview Guidelines for Municipalities Summary of the interview with Sonia Sørensen from HOFOR

Climate change adaptation plans are handled in the planning department of HOFOR. First it handled climate change mitigation approaches on how to lower CO2 emissions. But after the flash flood on 2nd July, they started thinking about the adaptation. Besides, there is an also political interest in climate change adaptation. HOFOR is also interested in it as it's a new way of planning and there scope for innovations which can help citizens. So, HOFOR has two strategies now. One is before 2011 and the other is after 2011. This strategy has addressed now more issues because of this cloudburst like handling rainwater efficiently before it goes to the sewer. So, they are looking for green solutions first before doing any projects. HOFOR has an ambition to handle 30% rainwater on the surface. But there is also one legislative barrier as HOFOR cannot operate on the surface. They can only operate on underground pipes. Only municipality can handle surface areas. Therefore, there is a big collaboration with the municipality and HOFOR. HOFOR knows how to deal with hydrologies and can share it with the municipality in handling their projects. HOFOR shares their knowledge by giving solutions to the municipality. HOFOR can pay for the project. So, if municipality is agreed on this authentic solution, HOFOR can find cheaper solution than making the sewerage bigger. So, the main role here for HOFOR is to share the knowledge about how the water acts and reacts in the surface and underground and provides guidance to solve them. HOFOR has finished climate change adaptation plan but the implementation will go through the political system in the municipality. HOFOR suggests that if bicycle lanes are made in a little steeper and in a lower area allowing water running through it to the parks then it will solve some of the problems from rainwater events. Besides, it is needed to protect harbor area from flooding. HOFOR makes a pipe from the flooded area to the harbor and let water to flow to the sea. This solution is not expensive but prevents flooding and damages.

HOFOR faces some challenges because climate change adaptation is quite new in the plan. People are little bit confused as the plan is new. Besides, HOFOR thinks that the most economic way to CCA is to find out solutions in the surface. It is easier to get the opinion from the people when there is something going on the surface not the underground because people can see it and can react. But some problems arise when people do not experience this flooding then it is hard to convince them for adaptation. For example, if a road is used for extreme rain events then people can say why it is on my road why not others. So, there arise some conflicts here. Again there is some financial problems. It is very expensive to make bigger pipes in the underground. All are the investments are from people. If they pay more then there will be more investments. But people are not interested to pay more.

Inhabitants have a great role to solve problems along with utility companies which share their knowledge, municipality, the politicians and the government has a very big responsibility for climate change adaptation. HOFOR is a fusion now with 8 other municipalities. So the collaboration is more easier now as the utility companies of the municipalities are working with HOFOR. HOFOR has a dialogue with the municipalities. But there is also some problems as municipalities varies from each other with the finances, politicians and ambitions. HOFOR has a daily contact with all the municipalities. But regarding the climate change adaptation plan some of the municipalities have already prepared the plan and some did not. HOFOR is making and overall CCA plan for all municipalities so that each municipality can take what they need for their climate change adaptation

plan. The municipalities which already have climate change adaptation can use also some of the things as there are flooding calculations in the plan. Theres a lot of things in the plan to implement by HOFOR so it is obvious to collaborate with the municipalities. By this way municipality will get a good tool for CCA and for working together. HOFOR has a good collaboration with the municipalities. They have a good dialogue but the process is very slow. It should be more faster.

HOFOR, utility companies and municipalities have created Regnvand Forum and are meeting once or two times in a year to discuss matter of water passing from one municipality to other. The aim of the forum is to ensure the collaboration among the participants. Besides head of the planning department of the municipalities meet to discuss their problems. HOFOR did not have dialogue with the citizens yet as they think that it is the responsibility of Municipality to engage them in the plan. Right now they are only focusing on technical solutions.

# Appendix D: Summary of the interview with Rikke Nicolajsen and Søren Hansen from Avedøre wastewater

Wastewater plant at Spildevandscenter Avedøre is owned by 10 municipalities and all of them have their own utility company. Some of them have joined HOFOR for drinking water and wastewater. Only Brøndby and Vallensbæk have joined Spildevandscenter Avedøre for wastewater treatment while they own HOFOR with drinking water. Spildevandscenter Avedøre, utility companies of Brøndby and Vallensbæk municipality and both the municipalities are working together to make some demonstration projects to develop green solutions for handling water. They are doing also traditional solutions with pipes. These two types of solutions are combined together to handle the water more efficiently.

In 2009 Brøndby municipality was inspired by some of the green solutions and made a new plan to handle the wastewater and rainwater. But they didn't know about how to do it. They just wanted to be able to solve climate problems and also to get green structures of the city. Besides they wanted to handle their wastewater in the best environmental way. In 2010 Brøndby utility company and Vallensbæk utility company joined Spildevandscenter Avedøre. So, along with the two municipalities Spildevandscenter Avedøre started to prepare the plan. To get some ideas they joined Vand I Byer (water in cities) network. Then they hired landscape architect who gave some of the ideas to make green solutions. The projects were discussed with their consultants, two municipalities, engineers etc. Besides, it is needed to ask private garden owners how they can see when solutions working out. While doing projects in the school yard children are asked so on for road projects road department of the municipality are involved. If there is a project on the surface, people are asked to get their opinion to solve the problems and to get more approvals.

Together with Brøndby municipality and Brøndby utility company, Spildevandscenter Avedøre implemented some demonstration projects in Brøndbyøster, Brøndby Strand and inside spildevandscenter Avedøre in Kanalholmen. Besides, Spildevandscenter Avedøre works with Vallensbæk Municipality and Vallensbæk utility company in a team. The team member from Vallensbæk municipality is working on under dimension system to make the pipes bigger. He is working on storing the basins and making more green solutions for handling rainwater along with making the capacity of sewerage bigger for climate adaptation. Besides, there is a strong political will in Vallensbæk along with Brøndby. Now Vallensbæk is trying more green solutions to share their experiences with the citizens and stakeholders.

Spildevandscenter Avedøre, Vallensbæk and Brøndby municipality, Vallensbæk and Brøndby utility companies are trying to figure out how to deal with climate change adaptation plans. They are making the plan together so that they can make good results and more synergies. Another reason

behind this is water does not respect the boundaries and some people are so strong that water flows from one municipality to others. The plan will be finished in the coming winter. They are working in close cooperation. In some projects they fund together, prepare and implement together. Spildevandscenter Avedøre meets Brøndby municipality and utility company once in a month. They coordinate the project so that they can divide the responsibilities. There are some problems with Vallensbæk municipality as some of the municipality assignments are handled in Ishøj municipality. Therefore, Spildevandscenter Avedøre needs to coordinate with both Vallensbæk and Ishøj municipalities.

Spildevandscenter faces some challenges to cooperate with Brøndby municipality and Vallensbæk municipality. All are different organizations and have different interests. They have different finances also. But the main challenge here is to concentrate on whole area. Not only their own area. Spildevandscenter cooperates with them by arranging a meeting where they can talk together and negotiate. Politicians, people, environment group, park and nature group want the cooperation. If they meet together they can solve their financial barrier. In the cooperation they can discuss who pays for what and how much they can pay for the projects.

Spildevandscenter has a capacity project which shows that when there is heavy rainfall a new pipe going like a bypass is made so that it can transport the rainwater. When there is heavy rain, there is not enough time to clean the water. The responsibility is not clear now because some of the municipalities have joined HOFOR so some tasks they will do. But this not decided yet who will do what. Spildevandscenter has a data centre http://www.dogl.dk/ for all the main pipes, if it is combined or separated. Different kinds of historical information are also available there. In Brøndby municipality there is a plan for separated sewerage system. These could be separated with pipelines and LAR. There are lots of green areas in Brøndby and the demonstration projects have broaden their knowledge about how to separate sewerage system and how to adapt.

All of the demonstration projects are made by close cooperation with Spildevandscenter, Brøndby utility and Brøndby municipality. In some of the projects it was cofinanced. But there is not a clear law who should pay. Therefore, it is needed to cooperate with the municipality as they are quite closer to the approval process. But sometimes it is hard to approve the projects as the law is too old and when it was prepared it didn't consider climate change adaptation. So, in some of the projects they simply coordinate with spildevandscenter not in cofinance.

Spildevandscenter has also cooperation with HOFOR in CCA plan preparation. They make calculations where water passes. This is prepared for whole the area of Copenhagen. The director of Brøndby and Vallensbæk municipality is one of the path leaders in HOFOR. So, the cooperation runs well. Besides it meets once every second month in the network organization Vand I byer where they meet HOFOR, utility companies from other areas like from Jutland, advising engineers etc. So, there is a lot of interaction in such kinds of arrangements, conferences where they meet not only HOFOR but with others.

The capacity of Spildevandscenter Avedøre is that it has sufficient amount of money which citizens are paying. So, it is the responsibility of Spildescenter to use it in a responsible way. But it is possible now to ask people for more money for bigger climate change adaptation solutions. But Spildescenter has not asked citizens for more money yet in Brøndby. Besides they have enough manpower in the organization and technical experts like landscape architecture, engineers, administrative people, biologists, communication workers etc. But if they need some help then they consult with COWI, NIRAS, RAMBØLL and so on.

# Appendix E: Summary of the interview with Morten Beha Pedersen from Hvidovre Municipality

Hvidovre Municipality has experienced several rainwater events in 2009, 2010 and 2011. The biggest incident which Hvidovre Municipality has experienced was in 2nd July. These incidents have opened the eyes of all. Some years before the municipality was working on climate change adaptation about raising the sea level. There are some areas in the municipality that flooded rather early. So, the municipality was looking at that part first. But when the municipality saw some works of Copenhagen, it identified that still there is a problem of rising sea level but it is not the first problem. Again the incidents of 2nd July made the municipality to focus on rainwater events. There was also a political focus on the area when the Mayor said that it was not accepted that Hvidovre municipality has flooding in some of the areas.

The municipality has identified some problems and presented them in the map. The map shows that the major problems are in the border area where two municipalities are merged. In that area a lot of municipalities are leading their rain into the stream where water cannot move out but damages small area in the municipality. The municipality is surrounded by Copenhagen municipality, Rødovre municipality and Brøndby municipality. The main problem is the stream which is lying in the municipality of Copenhagen but floods into Hvidovre municipality. The problems need to be fixed by the neighbor municipalities. Therefore, Hvidovre municipality needs to cooperate with Copenhagen municipality to solve the problems. Besides, the municipality has prepared some high areas like dykes alongside the stream. They made it little higher to solve the problem and removed two bridges there which were used for bicycling and for walking as the space under the bridges were too small. The municipality is also hoping that in the coming years it will not rain heavily.

The municipality is working on a climate change adaptation strategy. It has also a plan to make political decisions about the plan in this year or in 2014. Besides, there is a problem of handling data. The data are not valid yet. So, the municipality is working to make the data valid. The municipality is thinking about how to solve the problems. Most of the problems arise here because of the combined sewerage system where rainwater and sewerage water pass together. In the Hvidovre municipality there is a separated sewerage system in the newer area and industrial area. Spildevandscenter Avedøre treates wastewater in those areas while older portion of Hvidovre municipality has combined sewerage system which is handled by other municipalities owned HOFOR. Besides, the soils in this area are not good for infiltration. Therefore, the main problem arise when there is heavy rainfall and there is no space to keep the water somewhere on the surface. So, the municipality is planning to keep the rainwater stored somewhere and then passing through the streams to the sea. Because it wants to separate rainwater from the combined sewerage system. Other solutions could be to collect some rainwater down the streets and then putting it to the sewerage. But most of the problems are about the sewerage system. Therefore, HOFOR will solve most of the problems. So, the municipality is working in a close dialogue with HOFOR to solve the problems.

Both the municipality and HOFOR have a shared responsibility where municipality will decide how much water they can accept, where the problems are and how much money they need to solve the problems and HOFOR will solve the technical problems. Besides, citizens have a great role to find a good solution. So, the municipality is also cooperating with them. There will be a meeting with the citizens, state owners, HOFOR and the municipality where the municipality and HOFOR will tell the citizens about their ideas in this area. HOFOR is looking at the possibilities on making some rainwater streets where they can handle rainwater that falls on the streets instead of putting them in the sewerage. There will be some improvement in the sewerage system. Alongside there is a possibility to make the new neighborhoods with more green and blue areas. The municipality did not discuss it

with the politicians yet. Before that it wants to see the reactions from the citizens. Besides, political decisions are also dependent on how citizens react.

The municipality has prepared a draft climate change adaptation plan in 2012 prepared in cooperation with Rambøll and Hvidovre Forsynings. In that plan the municipality identified the challenges of the area, strategies, problems and what kind of adaptation they need. But the plan was prepared too early and didn't prepared in the right way as it missed lots of maps. Now HOFOR is doing the maps for the municipality along with other municipalities. The idea of making bigger pipe for sewerage system is not new and it was decided three years ago to make the pipe bigger. Now HOFOR is starting building the pipe bigger. But the main thing is to solve inner problems. So, the municipalities. But it is important that they make only maps and look to the sewerage system. It is responsibility of the municipality to solve the problems. HOFOR can give some ideas about how to solve the problems but it is the responsibility of municipality to take decision what they are going to do in their area.

The municipality is facing challenges regarding funding. As the funding is too bureaucratic because it is quite impossible to make an adaptation with this funding law. Most of the expenses are shown for paying the sewerage which HOFOR is doing. If there are some combined projects then the fund can be splitted out but till now the municipality did not have such kind of projects.

HOFOR is a new organization but Hvidovre Forsyning also owns it. The municipality has worked with their own Forsyning and now working with others also. There is a good collaboration between them. Besides, HOFOR is a big organization and working to solve their organizational problems to make it an effective organization. HOFOR is so big that they can make the solution for the place where it is necessary. Hvidovre municipality cannot solve the problems outside their border. So, HOFOR will solve such problems by cooperating with other municipalities. HOFOR has the possibilities to make big solutions but it is not always easy to take account of inside problems of each small municipalities.

The municipality cooperates with HOFOR when they make any changes in their municipality which can affect the sewerage system. Alongside if the citizens face any difficulties with the sewerage system then the municipality calls to HOFOR and find out a solution. The municipality has some technical discussions with HOFOR and has several meetings with them. Therefore, they have a good interaction with HOFOR.

The municipality thinks that along with utility company, citizens housing associations have a great role in climate change adaptation. They have green areas that could be used as different kind of rainwater solution. Besides, companies working with municipalities, state owners are needed to involve in the discussion to solve the problems. The collaboration is taking place in HOFOR or in the wastewater treatment plant. The municipality has collaboration with other municipalities around Copenhagen for many years about wastewater where climate change adaptation has become the main agenda. The municipality has direct contact with Copenhagen municipality to solve the problems. If they face any problems Hvidovre Municipality directly call them.

#### Appendix F: Summary of the interview with Palle D. Sørensen from Copenhagen Municipality

In Denmark there were three levels of Government: national, regional and local level or municipal level. But in 2007 there has been a change on the level for water management. In 2007 regional level has been demolished and all the work has been divided into state level and to the municipal levels. The main tasks in the state level are monitoring water quality, monitoring plants and animal etc. And the administrative tasks, environment permits, measurement and controls, waste water treatment

plant all are the responsibilities of the municipalities now. In the national level there is nobody to take care of climate change adaptation matters. Some neighbor countries like Sweden, Germany have a special climate adaptation body in the national level. In 2012 there was an agreement with KL (kommunernes landsforening) and the state. All the municipalities are member of KL and negotiate with the state about financial matters and others. Today the municipalities have to prepare climate change adaptation plan. It is not a law but an agreement between the municipalities organization and state mostly about the economics most of all. So, the agreement contains that within 2013 municipalities have to prepare climate change adaptation plan. The plan will contain mostly two topic, one is about water and the other is handling rainwater: everyday rain and cloudbursts. The adaptation plan is the result of the major cloudburst that happened in 2011. Therefore, it does not contain about urban heat island and sea level rising.

Climate change adaptation plan is a result of political will. Copenhagen has already developed climate plan. It was necessary for Copenhagen after this heavy rainwater events. Climate change adaptation plan is just under climate plan. In the adaptation plan city of Copenhagen looked into the hazards in Copenhagen and identified two major hazards first of all, Copenhagen is a harbor city so, if sea level rises, flood will occur another threat is cloudburst events. Therefore it is needed to do something now otherwise risks will rise more in future. So, right now the intention is to do something to reduce the risk from cloudburst management. Cloudburst problem is the biggest problem now. The municipality is making cloudburst where they are in the middle of the steps now. They made a cost benefit analysis to find out which methods could be used to solve the problem. The municipality found that the more the investments the lower the costs of damages. Municipality identified that when there is too much water on the ground then it will cost more. If the water on the ground are on an accepted level then there will happen no damages. So, it is planned that 10 cm water on the ground will be accepted. Politicians approved a budget of 3.8 billion of DKK to make city more robust or resilient to cloudburst. The solution has a side effect as there will be major changes in the city with new infrastructure. Besides, the municipality is planning to make an artificial path to get the water to the open sea. The municipality has identified two solutions to minimize the risk of flooding. One is making the sewer system bigger and other is that sewerage system has its catchment area. Some of the rainwater can be handled locally thus not pressuring the sewer system. Copenhagen has a combined sewerage system. It is estimated that 30% rain can be dealt locally. So LAR is not a solution for cloudburst but it is a mean to keep the sewerage system fit. But the infrastructures that will be built for cloudburst solutions, have to add more values for the city as politicians agreed. There must be some green and blue elements in the area. Cloudburst solution is combination of conveying water in the surface using roads, rainroads, constructed wells and the sewerage system. Some roads will be changed so that water can be easily transported to the sea.

The municipality has collaboration with HOFOR. In Denmark there is a legislation that says that municipalities are not allowed to handle wastewater. Earlier utility companies were a part of the municipality. So, municipality borrows some money from them and used them for other purposes. So, the government has separated them so that the economy of the utility company is separated from the municipality. So, it was decided that all the handling of wastewater should be done from utility company's side. Utility company HOFOR has to do all the tasks regarding wastewater including rainwater and cloudburst water. The municipality cannot do the cloudburst plan alone. So municipality together with HOFOR has an agreement of doing the plan together and HOFOR will pay most of the costs for implementation. But they will not pay all the cost. When utility company invests on sewer systems they always own it. But if they pay for the implementation of planning for example if municipality uses roads as a solution HOFOR cannot own it. So, the agreement is now, everything on the ground is owned and paid by the municipality and everything below the ground is owned and paid by the municipality and everything below the ground is owned and paid by HOFOR or other utility company.

The municipality faces some challenges while working with HOFOR. HOFOR is a very new organization and has now new experiences. Besides, they are used to do other things. So, its little difficult to work as now they are making cloudburst plan which is very different from what they are doing actually. Copenhagen is a part of coordination forum where it discusses the matters that cross the borders between municipalities. Copenhagen, Rødovre, Hvidovre deals their problems together where they have the same water course in the border. This coordination forum is made to make it easier to find out what to do to finance or to solve the problems. Besides, municipality cooperates with citizens. During the public hearings there arise lots of discussions. They discuss the plan with the people because their area will be used for the implementation of the plans.

The municipality thinks that state and legislation is an important actor for climate change adaptation along with other municipalities, utility companies, citizens and local councils. In Copenhagen there are 10 local councils which are politically elected but very local oriented. Municipality talks to the local councils because they know all the people and stakeholders there. Local councils are the main way to reach the people. Besides, there are some NGOs like nature Preservation Company, local councils with same interests like park user councils.

The municipality has enough manpower for climate change adaptation. Besides, they have enough budgets right now. Copenhagen municipality is Denmark's largest municipality and so their capacity is bigger as they can allocate resources where they can. The plan is prepared in collaboration with the municipality and HOFOR. Two persons from Copenhagen municipality, HOFOR's planning team, specialists from other municipalities, traffic experts, environmentalists etc. The collaboration is well. There is also a decision making group which decides about financial matters, time, results and quality of the body.

#### Appendix G: Summary of the interview with Chiara Fratini

There was a local reform of administration in 2007. Before 2007 there were 227 municipalities, 14 counties. After 2007 there were 98 municipalities and 5 regions. Counties were monitoring water quality and informed national actor and they were giving feedbacks to the municipalities also on how to organize the plan to improve water and environmental qualities. They also get feedback from the municipalities and on the basis of this they inform national actors. But now municipalities have all the responsibilities of counties except monitoring. National actors are monitoring environmental gualities now. As a result it saves a lot of money on that. They wanted to save money in this sector. The regions are not doing any environment planning now instead they are doing business planning. But basically the responsibilities of regions or counties are divided between national and local level. Before utility companies were working with municipalities. Counties were demolished because they were requiring high quality. Besides, it was a political issue that time to disappear them. But another reason was that to save money. But in 2009 water sector law was introduced which divided utility company from municipalities. There was a clear division on who is doing things and who is giving permission. Between 2007- 2009 municipalities were doing all the tasks including doing the projects, making the plan and giving permission by their own. But small municipalities where other departments are sitting together in the same office at the same time if they do the project and give permission then there arise some problems of transparency.

National actors give the legislation and monitoring the nature and the utility secretary regulates water. They provide regulations for 200 utilities. National actor gives the regulation from financial perspectives. Then municipalities are planning and agreeing in theory deciding what the utility companies do depending on their knowledge. So, municipalities decide what utility company will do as municipalities own utility companies. Utility companies are combined together and instead of 200 utilities now there are 10 utility companies because they merge with some other utility companies.

They are merging together to handle their tasks better and to save money. It is mentioned in the legislation that the utility companies are not supposed to make profit but are not supposed to go below cost recovery. The utility company is owned by the municipality they are supposed to control by the municipality politically.

Municipalities decide the responsibilities of the utilities. Often municipality is cooperating with utility because they have more technical knowledge as the technical departments like water sector ran to the utility companies. Basically municipalities do plan and utility make projects on the basis of technical knowledge. But when utility companies do something in the project they can only pay for water projects that deals with only water system. In 2009 when the law was made, the utility was not allowed to pay for the projects except technical things like making the pipe bigger, bigger pump. That creates a problem in dealing with above ground structures. But now utilities can pay in some projects where the structure is related with sewerage system. For example in case of streets the utility companies are also using the streets. Therefore, they partly regulate the form of the street and they put requirements to the municipality on how they manage the streets. From here arise problems with sharing responsibilities. Citizens are now customers also. They pay to the utility companies. In theory the municipalities have power but the utility companies have more technical knowledge.

The law has been prepared without thinking out the complexity of the water service. The law did not consider the water and urban quality. The legislation is built on very technocratic perspectives on water service delivery. In January 2013 there was an addition in the water sector law that utilities can pay for above ground structures for functioning and improving water system not for basically improving the environmental quality.

#### Appendix H: Summary of the interview with Sigrid Glarbo from Albertslund Municipality

Albertslund has prepared climate change adaptation 2012- strategy and actions which did not cover all the issues of adaptation. Now Albertlund is preparing climate change adaptation plan according to the agreement with the government. For that the municipality is working with HOFOR. HOFOR delivers maps and is going to arrange workshops with all the municipalities they are working with. HOFOR wants that all the municipalities are in the same level of working. Naturestyrelsen has set some rules which kinds of maps will be included.

Albertslund has a separate sewerage system. All the rainwater is stored in the stream that passes through Albertslund, vallensbæk, ishøj, brøndby municipality. Albertlund is very keen to use rainwater and store it in the canals. Besides it wants to have water in the city. The municipality is working with meadows, wetlands and big parks for storing rainwater. Albertslund municipality is situated in high areas therefore rain does not affect it badly. But it passes rainwater to other municipalities. Therefore, municipality has to cooperate with other municipalities. They have some local groups. But it's hard to cooperate with the municipalities as they have different interests. Some municipalities have very minor interests. Albertslund is not facing any problem due to rainwater. But, they want to help the neighboring municipalities.

Albertslund municipality does not have enough money. Again they do not have lots of problems with climate change adaptation. But due to the interests of politicians, government and EU, there is a lots of tasks in climate change adaptation that takes time, money and manpower. The municipality does not have enough manpower to communicate with citizens.

As the municipality is located in the top of the hill, it does not face any challenges. But the greatest challenge is to work with other municipalities. In 2010 the channel was overflooded due to heavy

rainfall in Albertslund. Therefore, it is a challenge for the municipality that it will not happen again. So the municipality is going to make a bigger channel to store more rainwater.

The municipality is doing adaptation plan in their own administrative area. Right now they are making the plan without involving citizens. But municipality will incorporate citizens so that they can make some adaptation on their own ground. Municipality is cooperating with HOFOR as they have finances. HOFOR owns the system therefore; the municipality and HOFOR have a very good dialogue between them. But it is quite difficult to cooperate with others if they have different interests. And there are not too many people who know especially much about Albertslund. Besides, they are working with 8 municipalities so they have to look through 8 other municipalities also. But, as HOFOR is a big organization and being a part it is now possible to see what other municipalities are doing for climate change adaptation.

#### Appendix I: Summary of the interview with Lars Kuhnau from Rødovre Municipality

Rødovre Municipality had experienced heavy rainfall in August 2010 and in July 2011 which resulted flooding from the sewerage systems. Municipality has started preparing climate change adaptation plans. But the municipality had prepared flood maps to find out which areas in the municipalities are expected to be flooded. But municipality is following the agreement now and it is in the initial process of preparing climate change adaptation plan. Rødovre municipality is attending workshops to discuss about problems and solutions which are organized by HOFOR. But municipality thinks that HOFOR is doing the same mapping which Rødovre municipality have already prepared. Besides, the maps they prepared covered larger areas with low levels of details.

Rødovre municipality has combined sewerage system in one part and separated sewerage system in the other part. Rødovre municipality has different approaches for climate change adaptation. They are using their road for renovation so that rainwater can be infiltrated locally. Besides they will pass rainwater to the canals and other water bodies. The reason behind using road for infiltration of rainwater is, there is no need to talk with individual houses and it is easier to implement. But it depends on whether the solutions are environmentally and economically feasible. But to make the pipe bigger will be least preferred solution as it is not economically feasible.

Citizen's participation is seen here as a process of hearing but the municipality had meetings with the residents for road renovation project where citizens were quite positive. Besides, citizens, municipalities think that Sewerage Company and municipalities are important for climate change adaptation. Besides, planning department of the municipality is quite important for long solution. Municipality has very positive atmosphere with different technical departments. Besides, 8-10 members from different departments are handling climate change adaptation plan in Rødovre municipality. The same group is also working on local afledning af rainwater (LAR) local drainage of rainwater projects.

Municipality consults with Consultancy Company for technical knowledge. Besides, municipality face challenges due to very limited time period. Municipality thinks that the guidelines have been provided very late. Besides, financing is also too bureaucratic where HOFOR can finance for the plan. Another challenge is the expectation of the citizens as they expect that municipality will take all necessary steps for flooding. People has the expectation that municipality will solve all the problems. Therefore, there is a communication challenge to make people understand their responsibilities and municipality's responsibility. Rødovre municipality is attending workshops, meetings that are organized by HOFOR where they discuss their problems and solutions and the collaboration runs well.