

HOW CAN AWARENESS IN CIVIL SOCIETY AND IN GOVERNANCE BE RAISED? REDUCING RISKS FROM COASTAL HAZARDS

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Abstract:

Risks to human life, the economy and the environment are increasing globally in coastal areas. There is therefore a strong need to implement holistic and highly developed flood risk management systems which incorporate both risk mitigation and climate change adaptation. Based on the implementation of the EU Floods Directive and of municipal level climate adaptation plans in Denmark, we explore shortcomings in the ways we coordinate disaster risk management (DRM) and climate change adaptation (CCA) between scientists, decision- and policymakers, and the public in relation to coastal flooding and erosion. From top-down approaches to law enforcement at European and national levels on DRM and CCA, respectively, to the local bottom-up approaches and actual implementation of plans, we investigate and pinpoint areas where major improvement is needed to deal with current and future risks and vulnerabilities in the coastal zone. Major topics are: i) No political and financial links between DRM, where budgets are reduced for preparedness etc, and CCA where there is only a vague political opinion on how to proceed; ii) The gap must be closed between academia based provision of tools and maps, and the needs of decision makers and the public; iii) Lack of knowledge and awareness about risk and risk reduction in the public; iv) Lack of transdisciplinary work especially between natural and social sciences; v) Timing of actions for coastal protection and DRM/CCA. Although legislative frameworks and capacity building efforts are different to those in Australia, many of the Danish coastal challenges are comparable in relation to future as well as acute risks to coastal communities and individual property owners.

Introduction

“Reducing disaster risk is everybody’s business, and needs everyone’s participation and investment – civil society, professional networks as well as municipal and national governments”. (United Nations Secretary-General, Ban Ki-Moon, 2010)

The quality of flood risk assessments is crucial for well informed decision making and successful flood risk management. It is important to gain an understanding of the vulnerabilities associated with the flood risk among decision makers and the civil society. Apart from being more unbiased, a comprehensive vulnerability analysis will improve the overall analysis; enhance the credibility of the analysis, and support better informed decision making (Merz et al., 2010). Identified vulnerabilities that target the population should make the basis for future flood risk management to implement sustainable and meaningful mitigation and adaptation measures. Attention to vulnerabilities in developed countries is often not given. This is mainly due to the assumption that society more easily can cope with disaster and that people are well

informed and have the capacity to be prepared for catastrophic events. A number of disasters, with hurricane Kathrina being one of the most prominent, have shown that this is not the case (Jasanoff, 2010). Analyzing vulnerabilities in developed countries could therefore reveal unexpected outcomes.

Flood risk management done by authorities and consulting companies in developed countries have a strong focus on tangible losses. Most often these assessments do not involve qualitative vulnerability assessments among the civil society. Besides underestimating the damage from flooding, this approach does not include the concerns of the population and is likely to result in decision making which does not mitigate the needs of the people.

This paper discusses some of the current challenges and issues identified from flood risk management in Denmark and presents preliminary result from a pilot study to investigate and analyze the vulnerabilities among decision makers, emergency management and the civil society. Conclusions are drawn from recent flood risk mitigation and adaptation plans produced by municipalities and government as well as from semi-structured interviews held with governmental institutions, municipalities, water supply units and private business owners as well as the emergency management and civil society. Hitherto the Danish government organizations and consultants have had a strong focus on quantitative analysis. Here, we focus on qualitative methods to identify the different social vulnerabilities to improve flood risk management in Denmark and to provide advice on how to proceed in relation to disaster risk management (DRM) and climate change adaptation (CCA).

Flood risk vulnerabilities in Denmark

The Danish vulnerability towards flooding is generally considered to be limited but the country has a long experience with coastal flooding. The 11th October 1634 storm surge allegedly led to the loss of 8,000-15,000 lives in the Wadden Sea area of the North Sea and is the highest impact event on record (Gram-Jensen, 1991). In November 1872 a storm surge with incredibly high extreme water levels hit the shores of the western Baltic Sea (e.g. Baensch, 1875; Colding, 1881; Jensen & Töppe, 1990) and caused over 80 deaths in Denmark. Two recent storm surges in 2006 and 2013 flooded 4,000 and 3,000 properties, respectively, and caused substantial coastal erosion in the affected areas (Sorensen, 2015). As in many other countries, the pressure from human development and climate change (e.g. Douben, 2006; EM-dat, 2015; IPCC, 2012; Nicholls, 2011; Stal et al., 2008) increases the values and number of people at risk along the Danish coasts (Hallegatte et al., 2011). In Denmark the loss of lives has not occurred as a direct consequence of storm surges since 1923, however (Piontkowitz and Sorensen, 2011).

Physical Background

Denmark (43,000 km²; population 5.7 mio.) is a low-lying country with a 7,300 km long, diverse, and predominantly sandy or soft cliff shoreline, Figure 1. The country is situated between the North Sea and the Baltic Sea which are connected by three relatively narrow straits that act as bottlenecks to the through flow of water e.g. during storms where large gradients in water levels are found between north and south. In general, towards the North Sea there are high-energy coasts whereas the rest are low- to medium energy coasts. During storms water levels may reach 5 m DVR90 (0 m

DVR90 datum \approx Mean Sea Level in 1990) in the Wadden Sea, 3-3.5 m along the North Sea coast, and 1.5-2.0 m elsewhere in the Danish waters (Sorensen, Madsen and Knudsen, 2013). Storm surges mainly occur during winter (October – March) from eastward travelling atmospheric lows that force water onto the North Sea coast and into the Kattegat area. Only on rare occasions like the 1872 Baltic storm surge where water levels exceeded 3 m, are travelling lows from an easterly direction observed. The flooding hazards vary between the different water compartments and the country is confronted with two different overall storm surge scenarios originating in the North Sea and Baltic Sea, respectively. Accordingly, the risk varies across the country. On the North Sea coast and in the Wadden Sea areas extensive flooding and erosion protection schemes have been carried out over the past century. The protection levels are fairly high but the areas are not very developed, however. In the middle parts are many low-lying coastal towns and holiday houses, and many port areas have recently transformed into fashionable housing and office spaces. Along the Baltic Sea coast the probability of flooding may not be high, but large urban developments in connection with the capital of Copenhagen have occurred in flood-prone areas. About 80% of the Danish population lives less than three kilometers from the coast (Olesen, 2008).



Figure 1. Map of Denmark and surrounding waters.

The sea level rise in Denmark is around the global average for the 20th century (1.5-1.8 mm/y). Land uplift rates of up to 2 mm/y are found towards north and east as a result of glacio-isostatic adjustment (Knudsen, Engsager & Khan, 2014) which has counteracted much of the rise in sea level in the past century. Climate change impacts of the Danish coastal zone include (Grinsted, 2015; IPCC, 2013; Olesen et al., 2014): Sea level rise, a higher groundwater table, a higher frequency in extreme precipitation, potentially more severe storms, and more extreme storm surges than anticipated from sea level rise alone in some areas. Furthermore, coastal erosion rates are likely to increase and very low-lying areas become inundated (Piontkowitz and Sorensen, 2008) and the concurrency of extremes (e.g. storm surges and extreme precipitation coinciding) will become more likely in the future.

Legislation and initiatives

The state of Denmark has three levels of governance: a national government, 5 regional entities, and 98 municipalities of which 76 have a coastline. The regional level mainly serves health issues and will not be dealt further with here. Furthermore, Denmark is a member of the European Union (EU).

EU (2007) requires its member states to implement the Floods Directive (2007/EC/60) which was formulated by the European Parliament and Council succeeding large river floods in central Europe about 15 years ago. The Directive does not provide a clear definition of when a potential flooding is substantial and it is up to individual member states to define selection criteria for risk areas. The implementation of the Directive is divided into three two-year phases (2010-2015) after which a new round of implementation starts (Figure 2). The first was a screening phase where the areas with the largest assumed risk of flooding were identified. The second phase contained the actual hazard, vulnerability and risk assessment. For the 10 identified areas in Denmark (affecting 22 municipalities) the risk was calculated as the summed economic damage times the probability/return period of the hazard.

Floods Directive (2007/60/EC) - Overall approach/methods for implementation in Denmark (2010-2015)

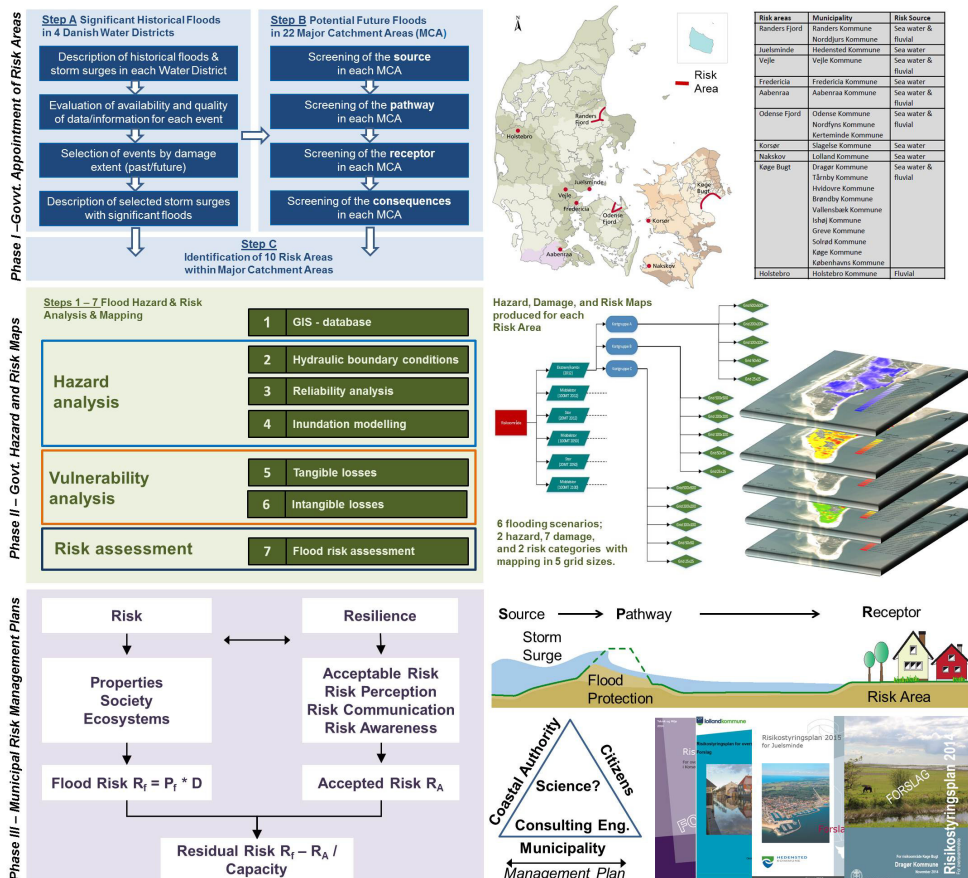


Figure 2. EU Floods Directive's implementation in Denmark (2010-2015). For the 10 risk areas identified (top), hazard and risk analyses were performed (middle), and risk management plans were made by the municipalities in the risk areas (bottom).

The first two phases of the Directive were carried out by the Danish Coastal Authority and Nature Agency; refer to DCA (2013); Kortenhuis and Oumeraci (2014); NA & DCA (2011), Piontkowitz & Sorensen (2011), and Piontkowitz et al. (2014) for methods and results. In the third phase to be concluded by the end of 2015, the municipalities and the local emergency managements make risk reduction plans by integrating the risk assessment into emergency management plans hereby improving these and targeting the threats in the different areas.

In 2012, the Danish Government decided that all municipalities should make climate adaptation plans by mid-2014 to enter the municipal planning acts. The law enforcement was accompanied by an action plan and guidance on how to 'climate proof' Denmark (DG, 2012; NA, 2011). This initiative seems closely related to a cloudburst event in central Copenhagen in July 2011. The climate adaptation and the climate proofing scope is very narrow, however, as it only deals with water and adaptation and mitigation actions to avoid flooding. Furthermore, the time horizon is 2050 for dealing with climate change although the individual municipalities can look further ahead. All municipalities should make hydrological modelling to gain knowledge about their challenges, e.g. for "blue spot" mapping, and the water supply companies (by law) either executed the modelling themselves or left it to consultants. Sorensen, Jebens & Andersen (in prep.) provide a comprehensive list of references to individual EU flood risk management and climate plans and investigate their interrelations.

Previous to 2012, the only national strategy on climate adaptation from 2008 addresses 12 sectors where climate adaptation efforts become necessary (DG, 2008). The strategy contains only vague formulations on how to proceed and addresses that everyone has a responsibility. At the time it was published, climate change adaptation gained some cross-sectorial national focus before the COP15 in Copenhagen in 2009 (UN, 2009) but progress soon lost momentum thereafter.

Methods and Theoretical Framework

Challenges faced in Denmark in relation to the implementation of flood and erosion risk management are investigated through a pressure-release model concept. Current flood risk mapping of the Directive and incorporation in management plans, and the municipal climate adaptation plans together with the preparedness plans are reviewed and combined with 12 semi-structured interviews held in three municipalities. In one municipality the main focus was on stakeholders' opinions, needs, and responsibilities in relation to flooding and climate change related governance. The two other municipalities were appointed as flood risk areas in the EU Floods Directive. The interviews here were done to analyze how two case areas could reduce flood risk by using structural and/or non-structural measures (Jebens, 2013). The three areas were chosen to reflect different hazards today, different past experiences, and to represent areas in Denmark which may have different approaches towards disaster and flood risk management.

Pressure and Release Model

In accordance with the risk concept a disaster can only happen if it impacts people (Coppola, 2011). Disasters are, by definition, a social phenomenon where the root causes are vulnerabilities created by the society (Figure 3). Vulnerability is defined as "*the characteristics of a person or group and their situation that influence their capacity*

to anticipate, cope with, resist and recover from the impact of a natural hazard” (Weisner et al., 2004). This implies that the vulnerability of a person is determined by the impact on one or more elements which to a variable extent is at risk. These elements will vary between different areas because of cultural and socio-economic differences, can be tangible or intangible and will include the risk of life, changes in livelihood and property. Vulnerabilities exist on global, national and local levels and can potentially have a snowball effect where e.g. global economy will influence local conditions. They are often dynamic and time dependent and can change on a yearly, daily or on an hourly basis. In addition, studies have identified that root causes often are a consequence of political decision making, or lack of such, which can be dated back several centuries (Davies, 2013; Weisner et al., 2004). Vulnerabilities are thus strongly dependent on society actions and can increase or decrease as a consequence of these.

Since the vulnerability definition by Weisner et al. (2004) in their first edition of ‘At Risk’, a large number of studies have been analyzing the vulnerability concept. These studies include the importance of the capacity of people and society to protect them self from disaster. The capacity can therefore be understood as the counterpart to vulnerability. The capacity of the society and population will include preparedness, responsible governments, local leadership, awareness etc. By building capacities the risk level will move towards an acceptable level since the vulnerability will decrease.

The disaster crunch model/Pressure and Release model (PAR) by Weisner et al. (2004), Figure 3, is a valuable tool to define disaster risk reduction measures by analysing and understanding the root causes behind the potential event. It explores the relationship of hazards and vulnerability and looks at the links between root causes, dynamic pressure and unsafe conditions.

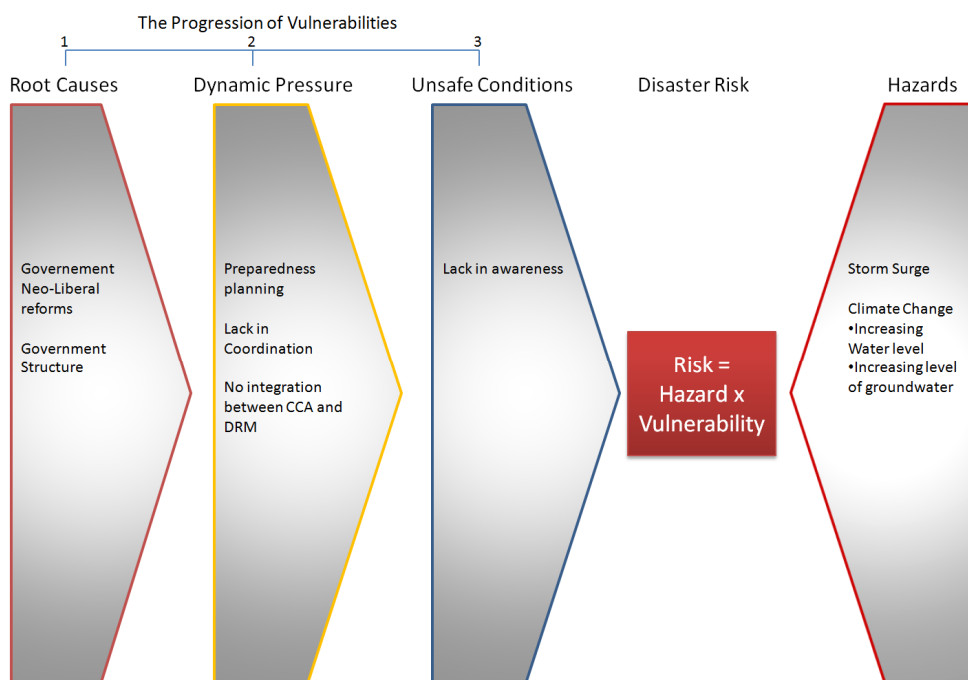


Figure 3. The pressure and release diagram showing the dynamic pressure and unsafe conditions described in this paper

This progress in vulnerabilities can be used to describe the interrelationship between and explain the different elements of vulnerabilities. The root causes, dynamic pressure, and unsafe conditions are according to the model the three layers of social processes which give rise to vulnerability. The root causes will give rise to a number of dynamic pressures which, in turn, explains how the unsafe conditions have started. The opposite of vulnerability is capacity or resilience as mentioned. Effective vulnerability assessments will therefore also define the needed capacities and the resilience essential to mitigate disasters. Root causes are often a result of very long term actions and implemented in the society to an extent where a disaster by itself often will not change them. As such, the political system is important to explain the vulnerabilities faced by the Danish society and to get a comprehensive understanding of the progression of vulnerabilities and how these are interlinked.

Rauken and Kelman (2010) investigated the potential river flood vulnerabilities in Norway which has a governmental and a social structure comparable to the Danish. They argued that the three layer system by itself composes a root cause for vulnerabilities since it impacts and affects how decisions are made. As in a number of EU member states, Denmark has implemented neo-liberal reforms, where increased power and decision making are transferred from the national government to the municipalities. This is done as a part of a decentralization process where national ministries provide municipalities with guidance and general policies instead of giving detailed instructions. Using the general policies as guiding tools it is the responsibility of the municipalities to implement them according to identified local needs. The coast is a cross-zone of interconnected vulnerabilities (Weisner et al., 2004; Alexander and Davies, 2015) and legislation (e.g. Sorensen, 2015 regarding Denmark), and coordination between stakeholders and different policy areas is needed to reduce these vulnerabilities. The Danish municipalities, in general, do not possess the capacity to implement cross-cutting issues and therefore lack the ability to coordinate and include all stakeholders. This is reflected in the fact that municipalities often act on direct and isolated policies and directives only, instead of taking a lead to define own agendas. Also, neo-liberal reforms aim at increasing the efficiency which has recently been identified in Denmark after the national government initiated a pilot project allowing a limited number of municipalities and business owners to develop projects in the coastal zone. Hereby shifts in land use planning could create a more vulnerable coastal zone through the promotion of economic development/profit making.

Results

The national government and the municipalities have by the implementation of the first plan period of the EU Floods Directive and municipal climate adaptation plans, respectively, begun to deal with flooding hazards and risks in a structured way. These are first attempts, however, and still no one knows which additional requirements that must be fulfilled in the future. As it seems, it is still uncertain which position and role the national government will take in relation to future implementation and advances of risk management in Denmark. Regarding the Directive, ambitious and research based methods were developed and applied for the risk assessment in the 10 areas with many lessons learnt by the involved parties. Although the municipality climate adaptation plan demands were ambitious regarding hydrological modelling, they were neither really adaptation driven nor truly risk assessment oriented, we postulate. Still, progress was made hoisting the municipal DRM and CCA agendas. The lessons learnt should be evaluated, shared, disseminated, and used to advance disaster risk management and climate change adaptation in Denmark in a broader sense.

A number of municipal preparedness plans have been evaluated and theoretically they should incorporate a diverse set of outcomes towards all disasters and their related impacts (Coppola, 2011). According to Zupka (2013) a number of requirements have to be fulfilled to have a comprehensive preparedness plan. These include but are not limited to: Coordination at all levels, contingency planning, capacity analysis and capacity building, hazard forecasting, monitoring and early warning, emergency services, incorporation of early recovery and resource allocation. None of these requirements are yet incorporated into preparedness planning in Denmark.

From interviews it is apparent that flooding is not identified as a main concern where, however, potential future flooding as a consequence of climate change could raise some concern. Instead, more immediate and especially financial issues were raised. Municipalities as well as water supply units and the emergency management argue that awareness among the public and business owners is limited. It is the general opinion that the civil society does not prepare itself towards flooding. One municipality suggests that the complex Danish legislation has a profound influence on this. In contrast, the participants representing the civil society were not aware whether or not the municipalities and emergency management would be able to protect the society during a flood event. The emergency management did state that they would have problems coping with larger flooding events. Furthermore, the municipality, water supply unit and emergency management identify a need from the government to give better guidelines and support with minimum criteria on the level they should protect against, to mitigate and adapt flooding. This was further supported by some participants who felt a lack of drive among decision makers to decide on and make adaptation measures for future flooding. In addition, there was a feeling that solutions after flood events tend to be *ad hoc* and not cross-cutting and that, although Denmark possesses both technical and financial solutions, few are thinking ahead (Jebens, 2013). The need for science to give better estimates of the return period of events as well as the potential water level increase was also raised.

Discussion

The past has shown that it takes a disaster before the society implement risk reducing measures. This is the case in Denmark, too, and collective memory is short. (Jasanoff, 2010; Roskilde Municipality, 2014). This may be explained by a lack of awareness.

Lack of Awareness

Among interviewed stakeholders the risk of flooding today and the future climate change impacts are not themes which give rise to large concerns. Asked what they thought their main vulnerabilities were, they point to the lack of funding and economic issues. The lack of awareness towards flooding in contrast to more urgent problems is also described by Coppola (2011) who state that time often is not spent on reflecting on unusual risks. According to the municipalities, a problem in creating awareness lies in quantifying the accuracy of sea level rise and potential changes in climate as well as the understanding of the return period of an event. It is difficult for people to understand the science behind the climate models and the large variation in the future. Especially the variation of the climate scenarios was mentioned as a problem by municipalities because it is very difficult to adapt to different outcomes.

Awareness is a part of the unsafe conditions through the fact that it is difficult to predict future climate. This puts pressure on politicians and uncertainty often leads to indecision (World Bank, 2012). It can be difficult for politicians to implement expensive

flood protection measures for a future which might not happen. It is important to prepare for future outcomes even though it will lead to unpopular decisions. The awareness is highly dependent and linked to other more fundamental society matters which are evident from the PAR model. Changing the awareness will potentially relieve the pressure by changing the dynamic pressure in the model. With limited awareness the society is likely to act too late to overcome the impact from flooding. To increase awareness civil society and the public administration should use current flood events to improve the understanding

Integration between Climate Change Adaptation and Disaster Risk Management

Looking at the society actions towards disaster risk management (DRM) and climate change adaptation (CCA) we will argue that there is no integration between DRM and CCA mainly because of the lack of interest towards DRM in contrast to CCA. There are several examples of this. The review of preparedness plans show that they are insufficient in many municipalities: They will not increase the capacity to mitigate disasters and there are no requirements on what the plans as a minimum should encompass. Present preparedness plans thus do not cope with the current risk from flooding especially when taking into account the already known historic flood events. In addition, the government has cut the emergency management budget by >5 million \$ in 2015 which has a negative impact on the maintenance and procurement of new equipment (Beredskabsinfo, 2014), and a negative effect on current capacities to mitigate flooding. In contrast the focus on CCA is higher. This is supported by the implementation of the EU Floods Directive and municipal climate adaptation plans. A number of the interview participants did also identify a higher concern towards climate change. DRM and CCA do have a number of common goals and benefits could be gained by combining the initiatives. Profound goals are that they both aim at increasing community resilience, at managing flood hazards and they have a shared goal in long-term sustainable development.

The lack of coordination between CCA and DRM is also observed internationally. One example is within the UN system where the main expertise by the UNISDR is DRM and CCA is handled by the UNFCCC. Likewise the lack of coordination in Denmark can be explained by the system of governance where to a large extent it is a municipality responsibility to make this coordination. The municipalities do often not have the capacity to take on this work. In addition, different ministries have a lead on CCA and DRM, respectively. This is identified in the PAR diagram.

Lack of transdisciplinary work

As for DRM and CCA, coordination should be improved between science and decision makers, and a national coordination of flood risk management is needed since it is a multi-sectorial and cross-cutting business. A lack of coordination can lead to gaps in knowledge. It is therefore crucial that science and decision makers collaborate and it is important for the science sector to understand the needs of the decision makers to decide on the protection level, as well as decision makers must have an understanding of the results science supports them with. Science sometimes yield complex answers too difficult for decision makers to cope with or use as identified in the interviews.

This e.g. is the case for the vast amount of maps provided to the municipalities for the 3rd phase of the Directive. Decision makers must know about the different potential futures to make well informed decisions, however. Natural science is an important

foundation to understand and map the hazard areas linked to flooding as well as to develop damage models for tangible losses. All Danish flood risk analyses have excluded the social aspects. Since disasters are society generated, social sciences should play a prominent role in protecting the Danish coast from flooding. This will likely uncover unknown social vulnerabilities and improve the understanding of awareness issues, risk perception, and risk communication. Implementing social science into flood risk management will provide a more comprehensive risk analysis and potentially increase awareness. This is identified as a dynamic pressure by a lack of coordination in the PAR model and points to a lack of awareness in the Danish society. This is partly due to a lack in coordination between organisations on different levels, which can be related to the structure of the Danish system of governance. There are very different attitudes in different municipalities to address the flood risk, both in a disaster risk management and a climate change adaptation context. This creates a very uneven awareness across the country.

In addition, there is a need to define an acceptable risk level as the municipalities do not know what they are protecting them self against and which measures to use. Is it, for example, sufficient to have well developed preparedness plans so people can be evacuated or should protection involve structural measures? Currently the acceptable risk is defined by municipalities and it varies throughout the country. This uneven risk level would potentially transfer the risk from one municipality to another, especially if there is no coordination between them.

Timing of action

The flood risk assessments, management plans and climate adaptation plans are a good starting point for raising awareness amongst politicians and in society at large. Debates can be initiated in different ways to support the DRM/CCA agenda. Here, the municipalities have very different approaches. The two largest cities/municipalities take the lead and use the economic development agenda to also implement sustainable solutions. A few other municipalities have a strong agenda as well due to staff members or politicians acting as first movers. These municipalities have started to implement measures and are way ahead of the rest. To them the timing is now based on a strong growth and/or political agenda more than on actual DRM/CCA measures, but these may follow on. Then there is a huge span across to e.g. a municipality with a large fisheries port that gets flooded now and then as it always has been. Here, the municipality are open about their challenges but seek not to engage the citizens, and the citizens do not expect any efforts on behalf of the municipality. Other municipalities' main point in their risk management plan is: "*The affected citizens along the coast have the responsibility to protect their property and facilities against flooding from the sea*" (e.g. Brøndby Municipality, 2015). The probability of flooding is low, citizens are unaware, and the municipality may avoid any effort until it is too late; after a flood, that is. To the municipalities affected by the 2013 Xaver storm event, future floods and coastal erosion are now being dealt with in various projects of which some are visionary and some are truly not. We will argue that there is a need for both horizontal and vertical action in governance in order to advance DRM/CCA due to the very diverse and fragmented current efforts.

Conclusion

Over the past 6 years Denmark has been working systematically with flood hazard and risk assessments, flood risk mapping, and flood risk management planning through the implementation of the EU Floods Directive. Furthermore, all 98 Danish municipalities have in the past three years made climate adaptation plans concerning primarily water related hazards and vulnerabilities. From this work, knowledge and experiences need to be gathered in order to advance disaster risk management and climate change adaptation in Denmark in general. Our preliminary study points to several issues that need to be addressed in order to mitigate and adapt to future flooding as a society. The horizontal and vertical levels of governance need to become better coordinated and trans-sectorial and transdisciplinary collaboration must be improved. Furthermore, the awareness level must be raised among citizens and in society at large. This will enhance debates about acceptable risk levels and improve timeliness of actions to prevent future flooding. Finally, climate change adaptation and disaster risk management must become better integrated and must be prioritized in order to deal with challenges in relation to flooding today and in future in Denmark.

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