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Integrating Flood Risk, River Basin Management and Adaptive Management: Gaps, Barriers and Opportunities, Illustrated by a Case Study from Kristianstad, Sweden

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The increasing risk of floods in Europe calls for a revision of current governance and management practices. Sweden has not yet experienced flood events of the magnitude seen in central Europe over the past few years; hence flood-risk management is low on its political agenda. This paper investigates the gaps, barriers and opportunities in implementation of flood risk reduction, which to be effective needs to be part of an adaptive river basin management framework. It analyses progress on the ground illustrated by a case study from Kristianstad, the most flood-exposed municipality in Sweden. We conducted a literature review, interviews, a regional workshop and a focus group discussion. The results show that structural flood-control measures dominate in the municipality, mainly due to the prevalence of sectoral approaches, which are reinforced at the national level. There is no integrated and holistic spatial planning model for flood risk management that takes water resources management and green infrastructure into account at the river basin scale. The local planning level therefore needs guidance on a broader set of measures to manage flood risk across sectors. Also, reliance on expert opinion needs to be complemented by strengthened stakeholder participation in the spatial planning process. Future opportunities include synergies between the EU Water Framework Directive and Flood Directive guided by national priorities.

Keywords: flood risk management, Sweden, nutrients, wetlands, spatial planning, adaptive river basin management

1. Introduction

Recent European floods illustrate the need to improve current approaches to water and land development and address the risks created by these approaches. Floods are not only caused by climate events; instead they are most often the result of long term and slow changes in land use, river modification, population increase, economic shifts and human activities in hazard–prone areas (Follner, Ehlert, & Neukirchen, 2010). For example, the floodplain of the Upper Rhine, has been reduced by 60 per cent, or 130 km^2 (BMU/UBA, 2010), removing ecosystems which provide important services and goods such as flood

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buffer capacities, clean drinking water, biodiversity, habitats and bathing water (European Union [EU], 2012). A recent estimate predicts that extreme floods are expected to increase in frequency in Europe. The average annual economic losses due to flooding are expected to be around €23.5 billion by 2050; over five times the annual amount for the period 2000 to 2012 (€4.2 billion). Around two thirds of these increases are attributed to socio-economic growth, with the remaining third due to climate change (Jongman et al., 2014).

Sweden is yet to experience dramatic flood events of the magnitude seen in central Europe, hence flood risk has so far been low on the political agenda, with the emphasis placed instead on efficient emergency and rescue procedures. This is in contrast to other European countries such as Austria, Belgium, England, France, Germany, Hungary, Italy and Poland that have experienced recent flood events and have placed this issue high on the political agenda, in particular spatial measures to mitigate floods (Fiselier & Oosterberg, 2004). However, in recent years, economic damage from flood events has significantly increased in Sweden (Svensk Försäkring, 2014), even causing costly flood damage in cities such as Malmö, which has not even been identified as one of the 18 most flood-exposed areas of Sweden (MSB, 2011). This situation has led insurance companies to put increasing pressure on politicians to act, and insurance companies consider Sweden to be lagging behind on tackling flood rise, and being less prepared for extreme weather than the other Nordic countries, such as Denmark (Dagens Nyheter [DN], 2014). There is no lack of information about the general threat. For example, Swedish governmental agencies involved with climate adaptation jointly point to the increasing flood risks posed by climate change (Klimatanpassningsportalen, 2013). Therefore one would expect measures to avoid flood disasters (or at least to mitigate the socio-economic damage associated with severe floods) to be a higher political priority in Sweden, and for decisions to be taken and choices made about appropriate management approaches.

Integrated and adaptive river basin management approaches have been put forward as a solution for handling complex water management issues. Such approaches have been developed from the realisation that water managers have to handle uncertainty, variation and change, and involve many different stakeholders in learning processes (Raadgever, Mostert, Kranz, Interwies, & Timmerman, 2008). At the level of European policy, integrated and adaptive approaches that address challenges of flood risk and water and environmental quality are provided by the European Water Framework Directive of 2000 (WFD), and the European Flood Directive of 2007 (FD), stressing among other things the important role of ‘green infrastructure’.

Via a case study of Kristianstad municipality, this study offers a critical insight into the gaps, barriers and opportunities in implementation of flood risk management within an adaptive river basin management framework. We investigated the use of wetlands as green infrastructure, and their perceived value and use to various stakeholders for flood and nutrient management. In Sweden, municipalities are responsible for flood-risk management. We therefore investigated progress on the ground from the perspective of Kristianstad municipality and its linked Helge river basin. Kristianstad is one of the 18 areas

that have been identified as the most flood-exposed in Sweden, and has the highest number of people at risk of all the areas (MSB, 2011). Because of the area's high exposure and risk, we assumed that flood-risk management approaches there would be among the most advanced in Sweden.

Below we describe the analytical framework, the local setting, and present the findings. In the discussion we put these findings into a Swedish context with reference to flood management approaches in Germany, the Netherlands, and the UK. We then highlight the gaps in governance in adaptive river basin management in Kristianstad, and the barriers and opportunities to achieving it. We also point to implications that this case study may have for Sweden as a whole.

2. The analytical framework

2.1. Flood-risk management

Current literature suggests a risk-based approach to flood management aimed at reducing the overall flood risk to human life and assets (van Alphen & van Beek, 2006). In general, flood risk management focuses on three things: 1) flood control, aimed at preventing flooding with structural measures, e.g., embankments or detention areas; and 2) flood alleviation, aimed at reducing flood impacts by non-structural measures such as hazard zoning and flood-adapted spatial planning, flood-proofed buildings, development or upgrading of early warning systems, insurance, awareness campaigns in order to improve the preparedness of people at risk, training and putting rescue units on stand-by; and 3) flood abatement, aimed at preventing peak flows, e.g., by the improvement of the water retention capacities of the catchment (de Bruijn, 2005).

2.2. River basin management (and integrative elements)

For flood-risk management to be effective, river basin management (RBM) has to be considered. RBM follows the water's natural flow by focusing on the river basin as a management unit. Within this geographical area, all water, via lakes and rivers, flows out to the sea. This understanding implies adjustments in planning, land use and behavioural change on the part of a range of actors who share the water resource. In addition to the water sector, diverse changes in forestry, urban planning, architecture, agriculture, infrastructure and landscape management are required (White & Howe, 2003). A central goal of integrated management of water resources (IWRM) at the river basin level is to achieve water security for all purposes, as well as manage risks while responding to, and mitigating, disasters (Medema, McIntosh, & Jeffrey, 2008). IWRM hence recognizes the intersection with water security issues. In turn this requires that people recognize their interdependence and engage in both collective action and the resolution of conflicts (Tippett, Searle, Pahl-Wostl, & Rees, 2005).

2.3. Adaptive management

Adaptive management can more generally be defined as a systematic process for improving management policies and practices by learning from the outcomes of management strategies that have already been implemented (Pahl-Wostl et al., 2007). Adaptive management stems from the recognition that interactions between people and ecosystems are inherently unpredictable, that current knowledge will never be sufficient for future management and thus management needs to be adaptable to new information and changing circumstances (Raadgever et al., 2008).

In a river basin there may be a multitude of co-existing legitimate views and interests. Shifts in acceptance of what constitutes a legitimate practice, or policy, may be triggered by different events and shifting trends, such as new world views, new socio-economic realities and information, which open up learning for certain groups of stakeholders (Larsen, 2011). The kind of knowledge that is sought is therefore no longer focused on the need to simply have experts who 'know more' but rather multiple types of knowledge which enable robust decision making (Pahl-Wostl, Mostert, & Tabara, 2008). The learning is highly dependent on (participatory) processes that allow for a constant exchange of information and knowledge, and co-operation between sectors and levels (Huitema et al., 2009).

To enable adaptive management, the governance framework needs to allow for flexibility, thus meeting uncertainty and facilitating public participation and financial management (Raadgever et al., 2008). However, there appear to be a number of largely institutional reasons why the adaptive management framework has not been universally and successfully translated into practice (Medema et al., 2008). Current institutional settings are often too constrained to allow continuous improvement (Folke, Hahn, Olsson, & Norberg, 2005). There is also disagreement about what adaptive management can do, for example, whether it can support policy decisions even where there is a lack of sound scientific knowledge (Medema et al., 2008).

2.4. Adaptive river basin management

In summary, we argue that to manage floods effectively several elements needs to be considered; the three aspects of flood risk management, the river-basin level and its integrative elements, and adaptive management, in all comprising adaptive river basin management (see Figure 1).

3. The setting

3.1. European context

European policies in flood risk management are governed by the EU Flood Directive (FD) (EU, 2007) which stipulates that Member States should introduce a "*framework for the assessment and management of flood risks, aimed at the reduction of the adverse*

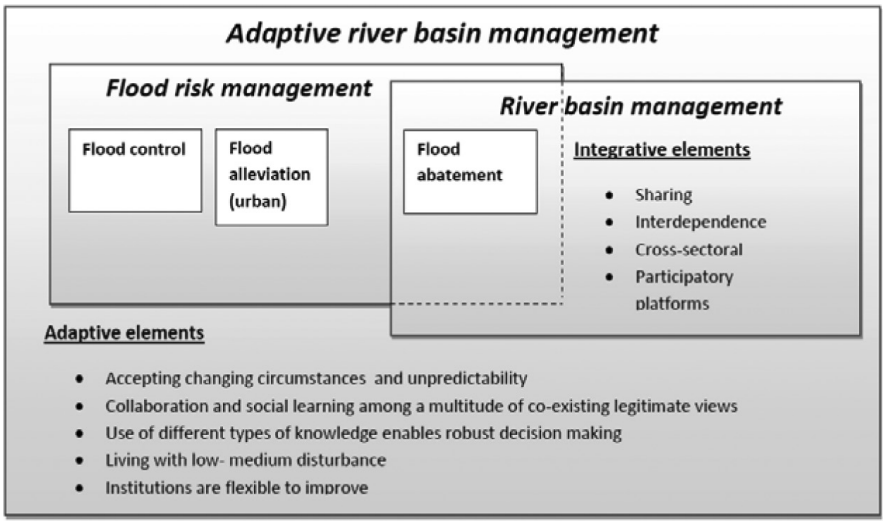

Figure 1. The analytical framework for this study: To be effective, flood risk reduction needs to be integrated with river basin management and have integrative and adaptive qualities.

consequences for human health, the environment, cultural heritage an economic activity" (EU, 2012). The EU Water Framework Directive (WFD) (EU, 2000), designed to act on the river basin scale, has several overlaps with the implementation of the FD and with Nature 2000 legislation. The WFD is the most important policy for sustainability in European water ecosystems, including their integration with land management and energy management. The WFD focuses mainly on water quality, but also addresses water quantity to the extent it affects quality (EU, 2012). The FD and WFD include provisions for adaptive management by encouraging learning and re-evaluating the strategy for future measures. It encourages the participation of all stakeholders at local and regional level (ibid). By December 2015 the FD requires that the Member States will produce catchment-based flood-risk management plans focusing on prevention, protection and preparedness, and which set out a prioritized set of measures. The plans should also be harmonized with the WFD river-basin management plans (ibid).

3.2. Swedish context

Sweden is a highly decentralized country in which municipalities are solely responsible for protecting its citizens against flooding through planning the use of land and water within a legal framework. Every five years, comprehensive plans are developed for Swedish municipalities for current and long-term aims. These plans are not binding, but contain guidelines for the future development, approved in a participatory process. The more detailed physical development plans cover parts of Swedish municipalities and is binding (Nordregio, 2004).

The Swedish Civil Contingencies Agency (MSB) is responsible for coordinating the ongoing implementation of the FD in close cooperation with county administrations. The implementation will take place in three steps during the period 2009-2015. In the year 2000, the WFD was enacted at EU level and transposed to Swedish legislation, which was a large change in the Swedish water management system (Gooch & Baggett, 2013). The Swedish Agency for Marine and Water Management (SwAM) (under the Ministry of Environment) has the mandate to coordinate the implementation of the WFD. At the regional level, 21 County Administrative Boards are responsible for carrying out part of the work to implement both directives. Five of these County Administrative Boards are at the same time Water Authorities, which coordinate the work with implementing the WFD. Water management is carried out in a six-year cycle. Water Councils provide platforms for participation by stakeholders in river basins. Sweden has also created web-based tools for public participation: the Water Map and the Water information system Sweden data base (Weichelt, 2009).

3.3. Kristianstad case study

Kristianstad has about 30,000 inhabitants in the inner city and 80,000 in the municipality as a whole. It is situated in the lower part of the Helge river basin with a catchment of 4725 km^2 (Kristianstad, n.d.) (Figure 2) and is part of the Southern Baltic Sea River

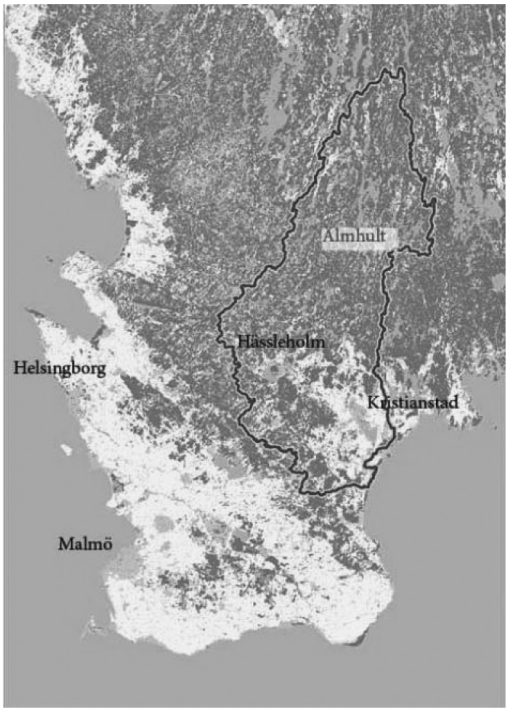

Figure 2. Map of Southern Sweden with the Helge river basin marked. The Municipality of Kristianstad is located at the lower end of the river basin. ©Lantmäteriet.

Basin District. The Helge river basin has forest in its upper reaches and mainly agriculture in the lower before it empties in the Baltic Sea. As a result of considerable physical land use changes there are issues of water quality where the majority of rivers and lakes are not expected to reach good ecological status in 2015 (Blekingekustens vattenvårdsförbund [BKVF], 2010). The Hammarlund embankment that protects parts of Kristianstad was built in 1868 (Friström, 2000) and has been challenged by floods on several occasions. The flooding is at the same time necessary for ecosystem dynamics, because it supports one of Sweden's largest areas (about 1600 ha) of 'wet grassland used for haymaking and grazing' (Naturvårdsverket, 2009), where many farmers have support from the EU Rural support programme to maintain the biodiversity. This landscape is part of the Kristianstad "Vattenrike" (Water Kingdom) which is listed by the Ramsar Convention, a UNESCO Man and Biosphere reserve and Natura 2000 (Olsson Folke, & Hahn, 2004).

4. Methodology

We carried out a literature review to complement the framing of the problem, and constructed an analytical framework. With the help of key informants and the analytical framework, a snowball sample (Bernard, 2002) was made of relevant stakeholders. We held semi-structured interviews between November 2011 and November 2013 with the aim of identifying stakeholders' perceptions on wetlands as green infrastructure. Complementary interviews with a few key expert people were carried out. We also refer to other interview material from research carried out in 2003. Interviews were held mostly over the phone, recorded and transcribed. Questions concerned perceptions of: 1) The role of the wetland as a flood buffer, 2) nutrient retention services, 3) the most important strategic and long-term intervention to address issues, 4) whether the former is being implemented? If not, why not? What are possible catalysts and barriers? and 5) who is responsible for such an intervention? A focus group discussion with five local policy and decision-makers reviewed the options for integrated and adaptive river management in local level planning. A workshop from 25–26th of September 2012 with a wide range of regional stakeholders (about 50 people) gave input into the findings. The information was then analyzed using the framework categorizing gaps and barriers, which were considered to be internal factors over which there is some measure of control, and opportunities, which were considered to be external factors over which there is essentially no control. The results were put in a Swedish context with reference to measures taken in Germany, The Netherlands and the UK.

5. Results

5.1. Flood control is the dominant approach to flood risk management

Around 1995, Kristianstad started its own initiative to mitigate flood risk, successively building knowledge with the help of MSB and others. The focus in measures thus shifted from: 1) one embankment of 1 km to several embankments where flood risk was

identified from other directions and 2) a time perspective of 100-500 years to a longer time perspective of 10.000 years. The present construction of 10 km of embankments, pumping stations and stormwater drains are Sweden's most costly measures to meet the flood challenge in modern history (Johannessen & Hahn, 2012), with a projected cost of 500 million SEK in total, to be finalised in 2021 (Kristianstad, n.d.). Increasingly the focus is also on the coastal risks, with an ongoing and future coastal planning process (Kristianstads kommun, 2013).

5.2. Urban flood alleviation well developed for internal floods but not for external floods

Two of the respondents from the city planning office consider stormwater management as a key solution to flood risk in the city. The local stormwater policy stresses the importance of infiltration and retention zones for rainwater, and such measures are showcased in some suburbs and a central park (C4 Teknik, 2010). While the policy is especially relevant for new developments it is perceived by local planners as difficult to retrofit stormwater solutions (Personal communication, city planning, March 2, 2012; and April 4, 2012).

However, there is scarce effort to reduce the impacts of an eventual flood from upstream areas. Instead, urban planners in Kristianstad trust the embankment security and are developing the central areas behind them. An early warning system exists, which was critical especially in 2002 (Johannessen & Hahn, 2012). But there have also been suggestions for developments in the flood risk areas by the urban planners. Risk experts both at national and local level have on such occasions engaged in dialogue with the urban planners to better include risk considerations, leading to learning by the planners in Kristianstad (personal communication MSB, Aug 2012 and Rescue service, May 25, 2012).

Prioritising development over risk has a long tradition, but risk considerations are slowly entering comprehensive planning. In the 1970s, 1300 apartments were built behind the embankment (Friström, 2000). The city planners knew about the flood risk but there was a dire need for land in the expanding city, and an extreme flood was considered "*improbable, perhaps once in 300 years*" (Personal communication, former city architect, Nov 13, 2003). Now, for example, it is mentioned in the current plan that new housing needs to be located in a non-risk zone, or adapted to cope with the flood risk, and revision of the risk levels needs to be done continuously (Kristianstads kommun, 2013). However, the only housing in Kristianstad which is built to be flood-proof (it is built on stilts) is the Naturrum museum, accessible by a footbridge. This was set up by the Biosphere office to create awareness of wetland issues (Personal communication, Biosphere office, Aug 23, 2012).

Over time, the risk issues have been better integrated with the other departments of the municipality (Johannessen & Hahn, 2012). However, our focus group discussion was the first time in this municipality that people from environmental, technical, strategic and spatial planning, and the rescue service all sat together to discuss flooding.

5.3. *Flood abatement in the river basin is not part of the flood risk management measures*

Some interviewees mentioned the importance of increasing retention times in the watershed to mitigate floods where wetlands, wet forests and bogs upstream were thought to be able to capture flood waters. However, these solutions were perceived as complex owing to issues of available land, financing mechanisms, legislation and political action (Personal communication, District Water Authority, April 2, 2012). A farmer mentioned the role of forest wetlands and drainage in relation to nutrient retention, and that although he thought farmers could do more, he also considered that the forestry sector had largely been exempted from implementing any measures (Personal communication farmer, April 2, 2012). The nutrient contribution from farming is still significantly higher (about 60% of N) than from forestry (about 12% total N) (Vattenmyndigheten, 2009). However, existing forest ditches constitute a significant source of 'dewatering' (Hånell, 1990), but one planner perceived that it is difficult to hold anyone accountable (Personal communication, District Water Authority, April 2, 2012).

In spite of views expressed in the interviews of the benefits of upstream flood abatement efforts, there is an absence of such measures. When the local rescue service and technical department at the Kristianstad municipality looked at alternatives to embankments, they made a basic assessment that upstream measures would not be sufficient (Johannessen & Hahn, 2012). They deliberated on upstream solutions, knowing that one of the main problems is the slow drainage of water to the Baltic Sea. They also concluded that 'the worst-case scenario' would (normally) occur in the early spring, and would entail frozen ground, with rapid snow melt, which means that large retention areas would be needed upstream. As there are no major dams regulating the flow of Helge river, measures upstream would either be inadequate or controversial (building a large dam in another municipality). They therefore concluded this was not a priority action. The rescue service in the municipality of Kristianstad said in interviews that they would be willing to take the initiative to coordinate with other municipalities but they don't have the mandate or funding to work at a river basin scale. Therefore, such activities were perceived by the rescue service as better postponed until the implementation of the WFD (personal communication Rescue service, Nov 12, 2003). Consequently, no other measures have been taken in the river basin to mitigate floods (Personal communication Rescue service May 25, 2012). However, no hydrological modelling upstream was ever done to calculate the principle effect on the flow regime from more ecosystem related measures (Personal communication flood modeller Sep 24, 2012). At the same time upstream river dredging has been carried out (e.g. in Finja Lake), without any coordination or knowledge on how this affected the flows to Kristianstad.

In terms of flood risk, only the extreme flow data seems to be interesting to risk managers. For example, mapping land vulnerable to less extreme floods in the river basin was not seen as a relevant resource by MSB for their implementation of the FD. On the other hand, the River Basin Authority has shown interest in this data (Personal

communication, District Water Authority, Sep 26, 2012). Although not life threatening, these less extreme floods were still considered by a national planner to have socio-economic impacts (Personal communication, WFD advisor, Aug 23, 2013) making them relevant for the FD.

5.4. Slow integration between flood risk reduction and river basin management

The WFD implementation brings with it opportunities for measures in the river basin, but it is perceived by some of the interviewees to be taking a long time. In the meantime, other initiatives start up, such as the "model forest" pilot in the lower part of the Helge river, where planners would like to see these initiatives expand upstream in the river basin (Personal communication, Biosphere Office Aug 23, 2012).

The water authority recognizes the potentially large role of flows in their water quality strategies for the Helge river basin. They suggest that: "*to achieve the desired nutrient reduction, physical changes in the river system are needed, such as recreating meandering and wetlands, and breaking up existing culverts. These changes would also impact the flow of water and possibly extreme water levels*" (Vattenmyndigheten, 2010). According to a district planner, the implementation of the FD has also triggered the interest within the District Authority to work in a more integrated way in the river basin, which could involve activities relevant for floods in the next administrative cycle. But how this will be done is not perceived by one of the planners as evident (Personal communication, District Water Authority, April 2, 2012). A suggestion by one of the planners is to introduce basin wide comprehensive planning (Personal communication advisor WFD, Aug 23, 2013).

Interviewees tended to view the main value of wetlands to be their capacity for nutrient retention and to maintain biodiversity, but with less focus on the dynamic flood regime. In one of the interviews it appeared that the person administering an EU support to biodiversity maintenance had not thought of the flood buffering function of these lands at all (Personal communication Scania County Administrator, March 21, 2012). In the municipal comprehensive planning document, wetlands recreation and restoration are only mentioned in terms of nutrient retaining capacity (Kristianstads kommun, 2013). Also, the EU biodiversity support lacks provisions for flooding which is affecting the farmers managing the wet grasslands. One farmer mentioned that fixed dates for required cutting of grass are a problem, because it is sometimes too wet for heavy machines to operate (Personal communication farmer, Feb 12, 2012). The flood regime is also causing uncertainty in financial support affecting all landowners adjacent to Helge river in Kristianstad, as reported by another Scania County administrator handling these claims: "*conditions do not allow for a few years of flooding during the five year period.*" The farmers are also negatively affected by seasonal shifts in flooding as summer approaches, because these shifts can destroy the grass for grazing, such as in 2007. This affects farmers' willingness and ability to manage the meadows for biodiversity, as it reduces the benefits of grazing as well as profits (Kristianstads kommun, 2007).

5.5. Expert opinion rather than stakeholder dialogue for floods

Although farming is not always compatible with wetland management, many farmers who have been living in the area for a long time are engaged in customary practices to maintain wet grasslands for haymaking and grazing on the fields closest to the wetland. Co-management of these seasonally flooded areas is ongoing mainly for biodiversity and nutrient management purposes (Olsson et al., 2004). The municipality's Biosphere Office has worked extensively with farmers to safeguard the most valuable wetland areas under Natura 2000, with EU support. However, one "newcomer" farmer, who depends on utilizing all the land for intensive agriculture, mentioned in the interview that he sees these protected areas as obstructing farming (Personal communication farmer, May 25, 2012).

Three planners reported they would like to see less intensive farming in the wetland, especially where some fields (in total about 1200 ha) are protected from fluctuating waters by agricultural embankments. Such practices cause nutrient leakage, and when embankments occasionally break, even more nutrients are released. Instead, the three planners suggest re-creating the wet grasslands, although there is no legislation to support this (Personal communication Scania County Administrator, April 2, 2012; Biosphere Office, Aug 23, 2012; and strategic planner, March 12, 2012). Future sea-level rise and higher water levels due to climate change will increasingly challenge existing agricultural embankments (Kristianstads kommun, 2013), and there may be a time when farmers consider investments to avoid breaching to be not cost effective (Berglund, 2008).

To change existing legislation to support more optimal land use planning for nutrient retention and flood risk reduction in a river basin is a challenge and a balancing act between two different types of interests. On the one hand, landowners are known to argue that such change imposes decisions on those who have made investments (Personal communication, interest group for farmers, Nov. 13, 2013) while on the other hand an advisor to the WFD argues that there should be more consideration of the common good: "*In Sweden, the paradigm behind dredged forests, lowered water tables, lakes, agricultural embankments and digging of ditches, where the focus is on livelihood security through forestry and agriculture to feed a growing population, needs to be replaced by a new paradigm acknowledging the role of wetlands for biodiversity, recreation, nutrient and flood [risk] management*" (Personal communication, advisor WFD, Aug 23, 2013).

Stakeholder participation, often aimed at facilitating dialogue between parties to balance such considerations, is an active component in the co-management of the Biosphere reserve in the municipality (Olsson et al., 2004) as well as provided by a Water Council formed in 2012 under the WFD (Helge river water council, 2014). However, a farmers' representative perceived the set-up under the WFD to be ineffective, and instead suggested professional facilitators for smaller dialogues involving relevant people (Personal communication, interest group for farmers, Nov 13, 2013).

One city planner mentioned that maintaining good relations with the farmers is also as a key strategy for maintaining the wetland buffer capacity (Personal communication, city planning, March 2, 2012). Many farmers in this study expressed that the wetland

would need to be dredged to "clean the drain" to allow for more rapid flood reduction. The municipality met these arguments with a commissioned study by an expert consultancy to look at the effects of dredging, but which showed it to have very little effect, and to have a high cost (DHI, 2009). This dissuaded the farmers from taking action, but they are still convinced this needs to be done (Personal communication farmer, April 2, 2012).

6. Discussion

Traditionally, flood protection and control strategies have been dominant in Europe, while many European countries have increasingly recognized the need to adopt a broader set of risk management approaches e.g. Germany (Deutsches Komitee für Katastrophenvorsorge e.V. [DKKV], 2004), the Netherlands (Vis, Klijn, De Bruijn, & van Buuren, 2003), the UK (Tunstall, Johnson, & Penning Rowsell, 2004). Why is Sweden not following this trend? Here we discuss our key findings, summarised in the table below.

Table 1
Summarises gaps, barriers and opportunities for adaptive river basin management in Kristianstad.

Gaps	Barriers	Opportunities
Flood control is the dominant approach to flood risk management with little alternative measures	1. *Flood risk is not managed cross-sectoral* 2. *The coordination of FD and WFD is located at different national agencies* 3. *Ecosystem services not in official risk strategy* 4. *Planning of flood risk is done at local level*	Implementation of the WFD and FD Emerging international experiences to be picked up by Swedish policy and practice
Urban flood alleviation well developed for "internal" floods but not for "external" floods (coming from the river basin)	1. *Houses already built in flood risk areas* 2. *Prioritisation of development over risk has a historic tradition* 3. *Urban planners in Kristianstad trust the embankment security*	
Flood abatement in the river basin is not an active measure	1. *Requiring political action, available land and financing model* 2. *The forest sector is exempted from measures* 3. *Only extreme water levels inform flood risk measures* 4. *Flood risk planning is not at river basin scale*	
Slow integration between flood risk reduction and river basin management	1. *Biodiversity and water quality are the perceived main benefits from wetlands* 2. *Lack of provisions for flooding in the EU biodiversity support*	Implementation of the WFD and FD Future adaptations in the Common Agricultural Policy (CAP) reform
Expert opinion rather than stakeholder dialogue to reduce flood risk	1. *Different interests and paradigms competing* 2. *Customary ways vs unclear regulations* 3. *Design of participatory platform*	Future sea level rise Shifting paradigms

6.1. *Flood control is the dominant approach*

Achieving flood control has the character of an adaptive management process. However, it is open to discussion how adaptive Kristianstad's flood control measures are in the end (Johannessen & Hahn, 2012). Embankments may initially seem like an effective measure, but they influence the flow regime and create increased flooding in other parts of the water course (Tobin, 1995). In so doing, they may in the long run increase rather than reduce flood risk. Kristianstad is sometimes referred to as "little Holland". However, countries like the Netherlands are relying on both 'resistance' (defence) and 'resilience' (giving in to stress but recovering immediately) strategies, where a combination of these two very different responses of a system to external stress is considered the best option (Deltares, 2010). Kristianstad has chosen to 'resist' and be "fail-safe" (there will be no failure). This is also the case for the Dutch approach to the dikes near the ocean, although for rivers they have adopted a more resilient or "safe-fail" approach, termed 'living with floods'. This means that they use productive land as buffer zones (i.e. green infrastructure), creating synergies with nature and landscape development, cultural heritage and scenery (Vis et al., 2003). In a review of adaptation measures in Swedish municipalities, Wamsler and Brink (2014) identify that physically oriented measures are dominant in Sweden, which account for around 60 per cent of the measures identified. Environmental measures are the second most frequently mentioned measures, and hardly any social and economic measures were found (ibid). It seems therefore that there is a need to complement structural flood risk management measures in Kristianstad and for Sweden in general.

Issues of flood risk are traditionally considered an engineering problem (Halbe et al., 2013). In Sweden, at municipal level the rescue service and technical departments are often responsible for risk issues, as Kristianstad illustrates. In Europe, it is often the same department that coordinates response and recovery that also coordinates risk reduction (European Commission [EC], 2014). It has been observed that due to a lack of mainstreaming, flood adaptation in Sweden is typically managed in separate sectors with competing interests and without inter-sectoral learning and communication (Wamsler & Brink, 2014).

6.2. *Urban flood alleviation well developed for internal floods but not for external floods*

Experience shows that reliance on absolute safety through engineered solutions may in the long run create other vulnerabilities due to the inherent risk in technical deficiencies, in design construction, and the need for adequate maintenance (Tobin, 1995). The city planners' complete reliance on embankments in Kristianstad allows them to continue development as business as usual, and so increase the amount of people and property at risk. In the spatial planning culture in Sweden, land and water are not functional spaces, but valuable in terms of contributing to "attractiveness, character and beauty" (Uggla, 2010). Thus, although regulations stipulate otherwise, in practice Swedish municipalities have a long standing tradition of offering attractive near-shore areas for development to stimulate an influx of people (and taxpayers), and as such increasing exposure to floods (Statens Offentliga Utredningar [SOU], 2007, p. 60).

6.3. Flood abatement in the river basin is not an active measure

Kristianstad municipality does not have the wetland flood buffering capacity as part of the official flood risk strategy; however climate change may increasingly require such capacity. The reason for this seems to be that only extreme floods are considered a risk to the city, and green infrastructure has been regarded as insufficient to protect the city against these. It is surprising that there are no mechanisms in Kristianstad, Sweden, or even Europe, to compensate farmers for providing and maintaining a flood buffering ecosystem service (Dworak, Berglund, Grandmougin, Mattheiss, & Holen, 2009). It is only in a few countries like Australia, with its massive problems of drought that have implemented paying for ecosystem services in practice (Ling Tan et al., 2008). However, with projected sea level rise, farmland bordering the Helge river will increasingly lie under water, and in places where there are agricultural embankments there will be increasing risk for breaching, and some will either need to be strengthened or removed.

Planning at a larger scale would open up the opportunity to identify strategic places for potential changes in land use where the abatement of floods in the landscape could be most effective. The suggestion made in the interviews that there should be a river-basin-level comprehensive plan is in line with future implementation of the FD (EU, 2012). Such planning would need to address the extension of the mandate for the municipalities at a river basin scale, and/or delegate this to the River Basin Authorities, which do not currently address flood risks. Chosen measures would have to build on dialogue with a diversity of landowners and several municipalities. Cooperation with neighbouring municipalities for the management of shared rivers is already ongoing in Sweden (Wamsler & Brink, 2014). Such dialogue would need to navigate a thin line between top down decisions to benefit the common good with maintaining landowners' rights and investments – a concern expressed in the interviews.

6.4. Slow integration between flood risk reduction and river basin management

The FD stipulates that the delivered plans have to contain "appropriate objectives" for the management of flood risks (Mostert & Junier, 2009). Because these plans do not seem to be binding and the FD does not set any priorities (ibid) this puts emphasis on an informed Swedish strategy with active priorities. Sweden is one of the few countries in Europe where the coordination of the FD and WFD is located at different agencies (EU, 2012) which has implications for integration of these issues. Key to finding solutions and synergies will be cooperation between MSB and SwAM, where the District Water Authorities (under SwAM) are already looking at such synergies. The discussion on synergies will be partly facilitated at European level (EU, 2012). Given the upcoming schedule it is surprising that not more dialogue between the national agencies MSB and SwAM and other stakeholders is ongoing to arrive to mutual insights, a process which is seen in other European countries (Environment Agency, 2013). The dialogue between the flood risk agendas on the one hand and the environment agenda on the other seems divided as seen since the end of the Cold War (Groven, Aall, van den Berg, Carlsson-Kanyama, & Coenen, 2012). In Sweden,

an illustration of this is that only the more extreme and more infrequent flows are interesting for MSB, and the smaller and more frequent flows important for ecosystems only interest SwAM. This disregards the fact that these flows are part of the same continuum acting over a river basin scale. On the other hand in Kristianstad, there exists cooperation between the local rescue service and the Biosphere office on flood risk issues (Johannessen & Hahn, 2012), but not extending to a cross-sectoral issue in the comprehensive planning. In Sweden, it is up to the municipalities to decide what type of risk reduction measure they want to apply. At the same time there is little national guidance on a systematic and broad set of adaptation measures (Wamsler & Brink, 2014) with MSB mainly providing maps of flood risk to municipalities. This indicates a gap where a national dialogue on strategy and clear priorities have a role to play in triggering and guiding local departments in working better together and having a broader set of measures to choose from.

6.5. Expert opinion rather than stakeholder dialogue

An observation in this study is that the municipality of Kristianstad relies strongly on expert information to inform decisions concerning flood risk, in absence of a more inclusive dialogue with local stakeholders. This may have limited the options for flood risk reduction measures. However, dialogues may not come without issues. For example farmers if asked how to reduce flooding would have advocated in favour of dredging. On the other hand, they may also have advocated for payments for flood buffering ecosystem services or measures in forestry. In Sweden, there are hardly any tools and structures for adaptation planning that actively involve citizens in Swedish municipalities (Wamsler & Brink, 2014). In Europe, the WFD has in general been criticised as relying heavily on expert assessment and not on stakeholder participation (Steyaert & Ollivier, 2007). In terms of stakeholder participation, there may be a role to play for the Swedish Water Councils, but currently it was not seen to provide an adequate platform or channel for influence, also observed in the Lule river basin in Sweden (Lundmark & Jonsson, 2014). More applied research to further improve local stakeholder participation seems appropriate.

7. Conclusions

This paper has investigated gaps in adaptive river basin management in Kristianstad, and the barriers and opportunities to achieving it. It also points to implications that this case study may have for Sweden as a whole. This study indicates that Kristianstad takes a traditional approach to flood risk management. Local flood control measures dominate over more resilient measures of flood alleviation and flood abatement in the river basin.

There may be several barriers to why the Kristianstad municipality has not adopted a broader set of risk measures:

- Flood risk is not seen as a cross-sectoral issue. National level coordination of FD and WFD implementation by different agencies reinforces this approach.

- The flood buffering capacity of the wetland (green infrastructure) is not part of the official flood risk strategy.
- Unclear mandates in flood risk governance, where on the one hand the local level has a strong planning mandate for flood risk, while on the other only water quality is governed under the WFD at the river basin scale. MSB is mandated to provide information about flood risk to municipalities but is not responsible for guidance on measures for implementation.
- Flood risk management is informed primarily by technical expertise and lacks an inclusive approach to stakeholder engagement.

We conclude that the spatial planning approach at the local level concerned with flood risks needs to extend to include the river basin scale. For this, the local planning level needs guidance on a broader set of measures to manage flood risk across sectors, including more integrated and adaptive approaches. To access a cross-sectoral set of measures, there is also a need for a strengthened platform for dialogue with stakeholders at the river basin scale to identify and prioritise issues, and for this to be included in the spatial planning process. Applied research could further improve the concrete models for such engagement.

Many opportunities exist to enable adequate provisions for adaptive river management in the Swedish governance framework through implementation of the WFD and FD, guided by national priorities to be developed by relevant agencies such as MSB and SwAM.

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