

Managing coastal risks at the Wadden Sea: a societal perspective

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Received 5 April 2017
Revised 30 August 2017
Accepted 31 August 2017

Abstract

Purpose – The trilateral Wadden Sea Region (WSR), extending from Den Helder in the Netherlands, along the German North Sea coast, to Esbjerg in Denmark, constitutes a unique but vulnerable coastal landscape. Vulnerability to environmental and societal risks is expected to increase in coming decades with encompassing new challenges such as demographic changes and conflicting uses of space, both on land and at sea. Meeting these challenges will require a shift toward an understanding of risk management as a social process, marking a significant departure from the dominant technical risk management paradigm. The paper aims to discuss these issues.

Design/methodology/approach – In practice, this paradigm shift requires participatory stakeholder engagement, bringing together multiple and diverse perspectives, interests and concerns. This paper aims to support the implementation and expansion of enhanced social processes in coastal risk management by presenting a case study of participatory risk management process. Implemented in collaboration with a trilateral stakeholder partnership, the authors present a mixed-method approach which encouraged a joint, deliberate approach to environmental and societal risks within an overall framework.

Findings – The results enable the authors to deduce implications of participatory risk management processes for the WSR, wherein the partnership can act as a communicator and ambassador for an improved understanding of risk management as a social process.

Originality/value – In this context, the trilateral dimension, discussed here for the first time in relation with coastal risk management processes in the WSR, is emphasized as an efficient level that offers room for enhanced participatory and negotiation processes that are crucial for enhanced risk management processes.

Keywords Risk management, Risk perception, Participatory approach, Multi-risk situation, Wadden Sea Region

Paper type Research paper

1. Introduction

Coastal regions face both increased socio-economic pressures (Nicholls *et al.*, 2012) and escalating stresses derived from natural hazards (Adger *et al.*, 2005), resulting in new challenges for coastal risk management. These new challenges are emerging from the joint

The authors would like to thank all Wadden Sea Forum members for the fruitful and inspiring discussions without which the insights and derived conclusions would not have been possible. The research underlying this paper received funding from the EU's Seventh Framework Programme (FP7/2007-2013) under grant agreement No. 308438 (ENHANCE: Enhancing risk management partnerships for catastrophic natural hazards in Europe).



occurrence of these multifaceted risks both spatially and temporally. Joint occurrence as much as interlinkages between these risks from multiple sources call for enhanced forms of collaborative governance and integrative policymaking (Ballinger, 2015). In this regard, scientific and policy debates already call for enlarged integration of multiple interests and perspectives, the analysis of all available scientific and policy knowledge and increased sensitivity to the complexity of coastal risk management processes amongst all parties concerned (Ballinger, 2015; Hinkel *et al.*, 2015). This focus on widening risk management toward broader participatory and collaborative approaches is also underscored by disaster risk management initiatives, in particular by the recently adopted Sendai Framework for Action 2015-2030 (UNISDR, 2015). All these activities put increased demands on addressing its practical implementations rather than on theoretical discussions.

In this paper, we present an empirical case study in a deliberate attempt to highlight challenges and potentials of participatory risk management in practice, addressing the challenge of a need for greater differentiation between normative and positive arguments in collaborative environmental management (Benson *et al.*, 2013). Following the conceptual rationale of enhanced social risk management processes (Section 2), we present a mixed-method approach with the objective of facilitating participatory risk management processes within an inclusive framework, considering both socio-economic and environmental risks. Applying the framework in the trilateral Wadden Sea Region (WSR) (Section 3) contributes to empirically informed insights on participatory risk management in practice, moving toward an understanding of risk management not as a purely technical endeavor but as a social process (Section 4). Besides demonstrating the capacity of the framework, we were able to deduce potential perspectives and policy options for enhanced risk management processes for the WSR. Thereby particular attention is paid to the benefit of the cross-national dimension, which received little attention in the WSR's risk management processes to date (Section 4.4). We conclude with assessing the contribution of a participatory risk management process for an enhanced practical implementation of broader and more people-centered approaches (Section 5).

2. Why risk management as a social process?

The call for increased social processes brings to light the role of integrative and participatory structures and its mindset within risk management. The term social underlines a differentiation from purely technical risk management processes and emphasizes the enhanced inclusion and evaluation of risk perceptions^[1] and societal frames. Understanding risk to be a mental construct, emerging in the human mind and shaped by social, political, economic and cultural contexts (Douglas and Wildavsky, 1982; Luhmann, 1993), risk management should be understood as the process of dealing with issues perceived as risky by the society. These issues might include single events such as natural hazards, as much as uncertain short- and long-term developments such as uncertain environmental and socio-economic processes of change. From a conceptual perspective, increased complexity in (coastal) governance regimes requires collaborative and participatory processes where different interests held by scientists, different sectors and contrasting institutions are balanced and negotiated (Ballinger, 2015; Renn, 2008; Stirling, 2010). Besides the normative objective to include all relevant agents in a democratic process (Stringer *et al.*, 2006), collaborative and participatory processes mediate between values, norms and regulative structures (Beierle, 2002) facilitate more robust decision making under uncertainty (Hinkel *et al.*, 2015) and offer an opportunity to collect more ideas or alternative viewpoints on how to minimize human impacts (Bell *et al.*, 2013; de Jonge and Giebels, 2015). These endeavors reflect on the need to strengthen mutual debate and recognition of different risk-rationales driven by different knowledge regimes, taking into account the pressing challenges to bridge the gap between knowledge development and translation into

disaster risk reduction policies and practices (Aven, 2016; UNISDR, 2015; Weichselgartner and Pigeon, 2015). A social process perspective recognizes the need to combine scientific and technical expertise with locally embedded forms of situated knowledge derived from the practical experiences of stakeholders. This implies recognition that risk management and collaborative governance processes more generally are embedded within a specific socio-environmental context (Healy, 2006, p. 29). Facilitating knowledge exchange and mutual learning can thus lead to the development of greater understanding of societal processes and more “actionable” knowledge for all stakeholders (Weichselgartner and Pigeon, 2015). Stakeholders in this context are understood as representatives of different interest groups or institutions that are directly affected, have an interest in the decision or with legal responsibility and authority relative to a decision (Mitchell, 2002).

Consequently, we argue that successful coastal risk management processes need to bring together both technical and social processes. This is in clear contrast with the predominance of technical processes in current risk management. Following, we present an already applied methodological framework that offers the opportunity to expand social processes in coastal risk management and to benefit from it.

3. New impulses for risk management activities in the trilateral WSR

The participatory risk management framework presented here was developed and implemented in the trilateral WSR. A particularly striking feature of this case study is a situation of simultaneous occurrence of natural hazards, environmental and societal risks. The following section will show why this multi-risk situation in particular requires enhanced implementation of social processes in its coastal risk management scheme.

3.1 *The case study region*

The WSR is a cross-national coastal region along the Dutch, German and Danish North Sea coast (see Figure 1) which includes the low-lying, tidal coastal regions of the North Sea, the marshlands and part of the low-lying geest[2] along the mainland. It encompasses approximately 3.8 million inhabitants, of which approximately 80,000[3] live on the 21 inhabited islands. Since the tenth century, the region has been subject to systematic embankment, drainage and related continuous development of protection and management (Lotze *et al.*, 2005; Knottnerus, 2005). These activities induced a large-scale transformation of the Wadden Sea’s ecosystem (Enemark, 2005) and thereby strengthen the need to cope with sea level rise (Wahl *et al.*, 2011) and with increased natural hazards in terms of storm surges up until today (Hofstede, 2005). Although regional differences in the historic and current development of marsh settlement and dyke constructions are evident (Lotze *et al.*, 2005), as well as differences in development between the mainland and the barrier island, today all three Wadden Sea countries primarily focus on technical and construction measures. These measures are expected to suitably deal with storm surges and sea level rise under current and changing climate conditions in the near to mid-term future (The Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, 2014; Ministry of Energy Agriculture the Environment and Rural Areas Schleswig-Holstein, 2013; Lower Saxony Water Management Coastal Defence and Nature Conservation Agency, 2007). This development is accompanied by a current spirit of deep trust in technical engineering coastal protection solutions across the WSR (Dronkers and Stojanovic, 2016; González-Riancho *et al.*, 2017).

It is clear that in the next decades new challenges will arise due to increased sea level rise (Katsman *et al.*, 2008) and the foreseen intensified effect on storm surge events (Weisse *et al.*, 2014). Under these circumstances, technical measures may reach their limits of construction feasibility in the not too distant future. New impulses are required to prevent society from exclusive investment in technical measures, which in the long-term perspective will hinder adaptation of risk management to supplementary non-technical solutions.



Figure 1.
The trilateral Wadden Sea Region (large picture) and its location in Europe (small picture, red marking)

Notes: The colored areas highlight dune, beach and sand (yellow); rural areas and marshland (green) within the intertidal areas (gray areas); and marshes, geest and peatland on the mainland (light green)

Source: Common Wadden Sea Secretariat (large picture) and open street map (small map)

Furthermore, enhanced challenges in risk management will be established by new and enhanced social and economic uncertain developments affecting the WSR communities. These challenges will be related to demographic changes (van Dijk *et al.*, 2016), economic crises and an imbalanced development between competing interests in the WSR, both on the mainland and islands.

In the longer term, the simultaneous occurrence of natural hazards, environmental and societal risks in time and space as much as the interlinking and cascading effects between them represents an exacerbated challenge. Cascading effects are understood as impacts or events that occur as a direct or indirect result of an initial event or its impacts. In this situation, management of risks on an individual, sectoral basis will no longer be a viable option. Instead, the resulting overlap of risks imply an overlap of different multiple land uses, interests and competing demands (from various sectors, local, regional and national administrative bodies) and the need to combine different types of risk management schemes (technical vs non-technical). Although strategic sustainable development activities are already acknowledging the importance of managing the Wadden Sea in a larger coastal context addressing the relationship issues (Enemark, 2005) and advocating an integrated social-ecological systems approach (as in Integrated Coastal Zone Management (ICZM)), coastal risk management strategies still pay little attention to cumulative processes and to their effective spatial dimension.

3.2 Multi-stakeholder collaboration in the WSR

In the face of these challenges, increased scientific information and knowledge on its own seems to be insufficient to reach sustainability and effective disaster risk prevention in

coastal zones; on the contrary, participatory activities are needed to facilitate integration of formal and informal knowledge (Puente-Rodríguez *et al.*, 2015) and facilitate “divergence” as well as “convergence” of ideas, options and solutions in the management process (de Jonge and Giebels, 2015). Over the years, political decision makers, administrators and scientists in the WSR have recognized the importance of cross-national exchange of experience, mutual learning, discussion and joint strategic development, mainly with regard to sustainable development (Wadden Sea Forum, 2005). As a result, cooperation between governmental authorities has been established in 1978 in the Trilateral Wadden Sea Cooperation, which is active to protect and preserve the Wadden Sea as an ecological entity by implementing shared policies and management strategies focusing on conservation issues (Common Wadden Sea Secretariat, 2010). In this spirit, a further cooperative multi-stakeholder partnership in form of the Wadden Sea Forum (WSF) was established in 2002. The WSF is an independent, advice-giving platform of governmental and non-governmental Dutch, German and Danish stakeholders representing the sectors of agriculture, energy, fisheries, industry and ports, nature conservation, tourism, as well as local and regional governments; the national governments are represented as observers (Wadden Sea Forum, 2005).

The trilateral, multi-stakeholder setting of the WSF provides highly promising prerequisites to facilitate increased social processes in the WSR. It provides a platform for discussion across jurisdictional and sectoral boundaries facilitating stakeholders to expand the range of their risk perceptions and their relative prioritization of those risks. Given the diversity of approaches to environmental management and related governance cultures found across the WSR, attention to the particularities of local and regional context is critically important.

Against this background, the participatory risk management framework discussed below was implemented in collaboration with the WSF. By introducing the WSF to the topic of risk management, the new feature of multi-stakeholder activities on a cross-national level has been introduced to the risk management discussion. Both social and technical cross-national, trilateral activities, which are similar to the transboundary nature of the WSR, are still at the initial stages. The presented empirical study exhibits a deliberate attempt to highlight benefits and potentials of additional trilateral work in risk management practices and to support the WSF in developing this new role in coastal risk management as it has been put on the WSF’s agenda on the 12th Trilateral Governmental Conference on the Protection of the Wadden Sea (Common Wadden Sea Secretariat, 2014).

4. Methodological implementation of social risk management processes – insights from the WSR

From a methodological perspective, the challenge to implement and foster social risk management activities does not lie in providing more information but rather in listening to and including stakeholders’ (and society’s) concerns, allowing time for stakeholders to communicate and evaluate their perspectives and to provide space for a mutual learning process. In view of these objectives, a series of methods had been applied, whose combination was appropriate to deal with these different aspects. Following the overall objective of facilitating exchange and discussion between multiple stakeholders, the mixed-method approach was carried out as a series of three, one and a half day collaborative stakeholder workshops, spread over a period of one year. The workshop participants were drawn from the WSF network of stakeholders, whereby between 13 and 20 WSF stakeholders participated in the workshops, seven of them participated in all three workshops. The multi-stakeholder community of the WSF is characterized by wide-reaching expertise from sectoral institutions, NGOs and local, regional and national governmental authorities. Although the composition of stakeholders changed, each workshop portrayed a balanced picture of most of the sectors and administrative levels from the three countries represented in the WSF.

Each stakeholder workshop comprised a combination of small working groups and plenary discussions, to provide room for information exchange and feedback and stimulate active stakeholder involvement. Each workshop was conducted in English. The first workshop was dedicated to the identification of different risk perceptions and stakeholders' awareness of current risks and risk management processes and their demands for improved risk management activities. By combining individual and group responses, the placemat method was employed to a structure group discussion in an equitable manner and fosters the discussion of different positions (Sliwka, 2004). The core activity of commenting on the other participants' statements complements one's own perspective and fosters a constructive reflection of the discussed topic (Reich, 2006). This activity should be completed by all stakeholder awarding priority points to the resultant list of risks and uncertainties (Section 4.1).

Building on the resulting multi-risk picture, the second workshop focused on collaborative identification of and differentiation between the risk management system's elements and the objective of increasing awareness on interlinkages between different risks. Methodologically, this step was facilitated by a bow-tie analysis, a structural tool to assess causes and consequences and to visualize cause-effect-pathways in bow-tie diagrams (International Organisation for Standardization, 2009). Shaped like a bow-tie, the bow-tie diagram visualizes cause-effect-relationships between a central event/challenge (knot), issues causing this challenge displayed in the left side and consequences of the event displayed in the right side of the diagram. Regarding the specific needs identified in the participatory risk management framework, the analysis has been implemented in a slightly amended bow-tie process. By using exclusively input from stakeholder perceptions in the bow-tie process, the focus is explicitly on including stakeholders' individual level of knowledge, including expert knowledge as well as experimental knowledge and practical reasoning as equal knowledge sources, rather than evaluating the factual or logical validity of stakeholders' arguments (Gerkensteiner and Ratter, 2016). The bow-tie exercise enabled stakeholders to detect obstacles and barriers in the current risk management process and provided a starting point for the stakeholder group to discuss the capability of common, trilateral activities in the WSR (Section 4.2).

In addition to the previous activities, a discussion of possible futures, an essential element of enhanced social risk management processes, is fostered in order to align risk management activities with the societal needs and visions in the long-term perspective. This challenge was addressed using a qualitative scenario approach, understanding scenario development as one way of providing a negotiated future vision about a certain area or sector based on experiences, regional cultural frameworks and a visionary dialogue process (Possekel, 1999) and anticipating possible outcomes of actual discussions. The Future Search Method (Weisbord and Janoff, 2008) was used to develop future scenarios that closely approximate the diverse interests and concerns of society to the major risks as perceived by WSR stakeholders (Section 4.3).

4.1 Identification and integration of different risk perceptions

Applying the placemat activity provided a diagnosis of the stakeholders risk perception and identified potential points of incoherence between the current approach of risk management policies and stakeholders' perceptions. In this activity, it is less important to find consensus than to identify and present different perspectives in order to enhance awareness about the variety of existing risk perceptions. Guided by the questions "what risks and uncertainties do stakeholders identify for the WSR" and "are they content with the current management of the risk and uncertainties in the WSR" the activity was implemented in five working groups with four participants each. The participants brought together their statements (in writing), discussed jointly the key messages for the working groups and finally

presented all key messages and mentioned risks together in a final plenary discussion. Finally, the stakeholders prioritized the risks according to their level of urgency by awarding priority points.

As a result, the following overview of perceived risk and demands for improved risk management activities (in descending order) has been developed:

- (1) storm surges/sea level rise:
 - well managed, however climate change (including increased natural hazard events and change in climate parameters) will cause future challenges which need improved management;
- (2) demographic change/aging society:
 - lack of management, need for management strategies and strategies for regional development;
- (3) changes in society including emigration of young people; risks on maintaining services; increased migration to the WSR, impact on the regional cultural identity:
 - lack of management, need of improved activities;
- (4) conflicting spatial uses between different user interest, e.g. environmental protection and economy:
 - need of improved management.

Further risks (in descending order): shipping and oil tanker accidents; economic crises (global and regional level) and their impacts of decreasing economic activities; emissions (especially CO₂) and pollution of rivers and the North Sea; loss of biodiversity and increase of alien species; energy: availability and sustainable management of energy supply; outside events: meteor strike, impacts of wars (outside the WSR) on WSR, nuclear power accident.

The stakeholders perceive that the WSR faces multiple risks from different natural hazards as well as socio-economic developments. Storm surges represent the most significant risk; however, in the stakeholders' view, these risks are reduced to a socially tolerable degree in all three countries. More significantly, increasing challenges resulting from uncertain socio-economic developments are clearly highlighted: risks deriving from socio-demographic changes are the second most important – but are of highest priority with regard to immediate need of risk management action. The activity underlined that most of the risks discussed above were perceived by stakeholders from different sectors, administrative institutions and NGOs to affect the whole, cross-national WSR. The resulting understanding of similar perceptions and joint or overlapping concerns encourages a collaborative sensitization process, whereby shared concerns can stimulate the exchange of different viewpoints, experiences and knowledge between stakeholders.

4.2 Increasing awareness of the complexity of risk pathways in a multi-risk situation

Improved social risk management activities strengthen the focus on balancing multiple interests and a joint prioritization of management needs in order to comprehensively assess the multi-risk situation. These activities will further sensitize involved stakeholders toward causes and consequences of perceived risk to provide guidance for further risk management activities. In practice, the bow-tie process was applied to support this process. Three bow-tie diagrams were developed related to the major challenges: “demographic change,” “climate change resulting in environmental changes” and “imbalanced development”; each bow-tie visualizes a breakdown of the stakeholders' input on causes, consequences and adaptive or mitigating measures and visualize the links identified between the bow-ties at the decisive points.

In the context of social risk management process, the bow-tie process is of particular importance to facilitate societal understanding of cause-effect-pathways, rather than evaluate whether the arguments and interlinkages between causes and consequences are logical or factually correct or wrong (Gerkenmeier and Ratter, 2016). In this sense, the bow-tie process on the risk of “demographic change” specifically highlights stakeholders’ concern regarding a lack of balanced development as a major driving force of demographic change, negatively affecting the coastal communities. Stakeholders already observe increased inward migration of elderly people and assume a further increase in the next decades, leading toward an aging society in the region. Moreover, emigration of young people as well as increased migration from other regions and countries to the WSR was mentioned as having an uncertain impact on regional cultural identity. This is a good example of how the bow-tie facilitates and supports the disclosure of most urgent risks and provides a basis for discussion of risk management activities. Discussions pertaining to the second bow-tie on “climate change resulting in environmental changes” highlight the imbalance between a high number of applied adaptive measures (e.g. coastal defense measures, long-term monitoring programs to adjust the defense systems) and fewer mitigating measures (e.g. pumping to mitigate rising ground water level in low-lying areas behind the dikes). This detailed overview enabled the stakeholders to detect if new or improved measures and strategies need to be discussed and evaluated, and also to locate potential barriers in the current management processes. The third bow-tie process highlighted stakeholders’ major concerns regarding an “imbalance development” between different lines of social, economic and ecological development. Facilitated by the bow-tie analysis, stakeholders were able to reflect on applied risk management strategies and detect obstacles hampering the implementation process of existing strategies. In the case of the WSF’s own ICZM strategy, the bow-tie activity highlighted that the strategy is not sufficiently known and needs improvement in terms of visibility.

Overall, the bow-tie process highlights the fact that risk management is more than just implementing technical measures, but it is important to investigate and understand the source of risk, and how social processes cause and lead to stagnating development and increased vulnerability to disasters in coastal communities. The bow-tie process opens up the risk assessment processes toward a broader, more people-centered discussion. Once applied to the context of the WSR, the bow-tie approach brought to light that the effects and impacts of risks and uncertainties often go beyond current national perspectives which is why activities, measures and strategies have to be designed on the local, regional, national, as well as on the cross-national (trilateral) level. In this sense, the trilateral spatial dimension provides the urgently needed “bird’s eye view” on interlinkages between multiple risks.

4.3 Negotiating future visions

In strategic risk management, joint discussions on future societal visions can play a vital role to adjust risk management activities to societal perspectives and visions in the long term. We addressed this challenge by using a qualitative scenario approach, paying special attention to the major risks as perceived by WSF stakeholders. The following three scenarios had been worked out by stakeholders in working groups, consisting of members from different countries and sectors. Stakeholders were asked to imagine themselves in the year 2030, describe the anticipated threats and impacts of the crisis for the society and the region, focus on how to handle gaps in management and discuss the (new) role of the WSF in these situations. The three scenarios were:

- (1) A very low-pressure system heading toward the WSR (addressing storm surge risks):
 - Starting position: a severe low-pressure system makes landfall in the Wadden Sea Area and causing damage across the region.

- Scenario enhanced by stakeholders: the coastal defense system still provide safety; however, the decentralized energy supply system at that time based on renewable energies would have been particularly affected, leading to difficulties in energy supply and mobility along the coast.
 - Recommendations derived by the stakeholders: increase effectiveness of coordinated risk management at the regional level, especially in spatial planning, and broad-based engagement to reduce anticipated impacts. The WSF facilitate discussion about infrastructure emergencies on a trilateral level, raise awareness regarding existing risks and develop recommendations on mitigation and adaption.
- (2) Shutdown of grocery shops in peripheries creating a supply issue (addressing risks of demographic change and aging society):
- Starting position: closure of grocery shops in peripheries causing special problems of provision especially for the rural WSR.
 - Scenario enhanced by stakeholders: many people had left the area and subsequently many traditional shops and other facilities had closed. Spaces which combine the changing needs of society and overcome the obstacles of decreasing infrastructure have been developed for local communities to come together in order to shop and run errands, to socialize and for recreational activities. New technologies support the interconnection between village inhabitants and facilitate people coming together, contributing to the development of new solutions particularly in terms of collective action.
 - Recommendations derived by the stakeholders: the WSF could initiate action and promote role models; it could identify already existing and possible best practice projects and communicate promising ideas to the other parts of the region, becoming a shared best practice project.
- (3) Oil tanker crashing on an offshore wind farm and producing leaks (risk related to conflicting spatial uses):
- Starting position: an oil tanker crashing into an offshore wind farm, whereby several cargo tanks on board exploded and thousands of liters of oil were leaking.
 - Scenario enhanced by stakeholders: severe consequences in the form of extensive onshore and offshore oil pollution, losses in the fishing and tourism sectors, blocked waterways disrupting the transport of goods and damages on connector cables of the wind farm, resulting in a hampered electricity supply.
 - Recommendations derived by the stakeholders: call for different prevention measures including an integrated trilateral approach and transnational control systems. A sound marine traffic management system should be mandatory, emergency capacities, e.g. for towing, should be increased and available recommendations with regard to shipping safety require implementation and application. The stakeholders see the WSF in its capacity as a communicator and ambassador.

All scenarios underpinned multiple interlinkages between risks and their impacts across different sectors and across different spatial dimensions – and consequently future strategies required paying more attention to these interrelations. Stakeholders' different experiences and cultural backgrounds were found to be of particular relevance when developing clear ideas about cross-national activities. As a result of the scenario activity, the WSF identified itself as a communicator and ambassador in risk management that can profitably use its networks to communicate new developments at the political level and to

the decision makers while supporting the implementation of already existing strategies as well as emerging new ones. In this function, the WSF will improve activities on awareness raising, knowledge exchange as well as communication especially at the cross-national level – a mission statement emphasizing once again the significance of improved social processes in risk management in contrast to purely technical activities.

4.4 The trilateral dimension in risk management processes – perspectives for the WSR

The collaborative workshop activities emphasized enhanced awareness to the fact that several risks in the WSR and their multifaceted impacts do not occur within areas of clearly defined spatial scope of specific governance institutions, but occur as large-scale, sometimes cross-national transboundary phenomena. In order to cope with this situation, the work presented here indicate clear policy recommendations: The cross-national, multi-stakeholder institution (WSF) could serve as a platform to exchange experiences and knowledge, with a particular emphasis on integration of different knowledge source as well as facilitating a hearing of stakeholders practical reasoning on risks and uncertainties in the risk management debate. In this situation, bringing together different kinds of scientific and practical bodies of knowledge allows and strengthens the process of joint analysis of existing knowledge (compare Healy, 2006; Aven, 2016). This enhanced interrelation of knowledge sources and practical reasoning increase societal understanding of cause-and-effect relationships. In this function, the WSF acts as a mouthpiece to highlight and address pressing questions in risk management derived out of these improved knowledge structures and strives for enhancing its relevance in decision-making processes in policy and practice. As such, the cross-national trilateral spatial perspective plays a significant role to maintain a bird's eye view on the complex multi-risk situation and encourages special attention to those risks that need to be considered beyond the extent of current national boundaries. In addition, this bird's eye view may facilitate increased mutual learning processes providing new perspectives on interlinkages and cascading effects.

Enhanced participatory processes on the trilateral scale should primarily be understood as informal activities, providing an additional perspective without undermining the scope of responsible institutions on the local, regional and national level in WSR. Activities on the trilateral scale will pay less attention to the structure of authorities responsible and far more on the interaction processes, exchange between responsible authorities and directly and indirectly affected sectors and contribute to ensure social involvement and consideration of social interests in risk management discussions. Existing legislative or administrative institutions could benefit from the learning processes and output of activities on the informal trilateral scale. In this spirit, the WSF's future role in risk management, as most of the members see it (from within), should lie primarily on awareness rising and defining and asking relevant questions at the political level. The WSF is expected to have sufficient capacity to emphasize communication and commitment in a trilateral context, which will be a decisive trigger to overcome the limits of purely technical perspectives in risk management processes. In doing so, the WSF directly addresses the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015), wherein an important part of the guiding principles call for partnerships to achieve improved risk management aiming to improve how different institutions and sectors (jointly) cooperate to develop and implement disaster risk reduction measures.

5. Conclusion

Risk management in the trilateral WSR is confronted with new challenges emerging not only from increasing natural hazards but also from socio-economic developments, in particular demographic change and conflicting spatial uses. Meeting these challenges will

include a shift in understanding risk management processes not as a purely technical process. Rather risk management is to a great extent a social process, directly and indirectly facilitating stakeholders from different involved sectors easier access and making their concerns heard as much as to balance and negotiate different interests and concerns.

Based on the rationale of enhanced social risk management, we presented a mixed-method approach to implementation of such enhanced social risk management processes in the trilateral WSR. Applied with the multi-stakeholder setting of the WSF participatory activities demonstrated that individual risk perceptions and stakeholder risk awareness are decisive to adjust risk management processes to societal needs and concerns. Unraveling the risk perceptions demonstrated that for the WSR “widening risk management towards broader and more people-centred approaches” (UNISDR, 2015) in concrete terms means to consider the multi-risk situation in the WSR within coastal risk management processes. Building on this, a bow-tie process and a qualitative scenarios exercise underline the importance of intuitive, social judgment of risks and the capacity of negotiated future visions to further support the integration of different perceptions, knowledge and experiences in a long-term perspective. Experiences from the case study highlighted a sensitization process understood as learning process for stakeholders and for decision makers involved, learning with and from each other. In this function, a participatory risk management framework constitutes a first but important step to overcome the current negligence of societal risk perception and participatory processes. Based on the common discussions, the proposed recommendation on further, trilateral risk management activities come from within the (stakeholder) community and are therewith grounded in the communities’ ownership. Accordingly, the trilateral scale has proven to be an appropriate spatial dimension to transfer this broadened perspective of risk management into practice, and providing new impulses to handle risks in the trilateral WSR.

Notes

1. Perception is defined as “the organization, identification and interpretation of a sensation in order to form a mental representation” (Schacter *et al.*, 2012, p. 123).
2. Raised moraine landscape in Northern Germany, shaped in the ice age which lies above the marsh.
3. Including approx. 23,000 inhabitants on 5 Dutch islands; approx. 53,000 inhabitants on 13 German islands; approx. 5,000 inhabitants on 3 Danish islands (source: Danmarks Statistik; Regional datenbank Deutschland; CBS Statistics Netherlands).

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Further reading

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