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Managing Coastal Risks at the Wadden Sea: A Societal Perspective

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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 towards an understanding of risk management as a social process, marking a significant departure from the dominant technical risk management paradigm.

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 we present a mixed-method approach which encouraged a joint, deliberate approach to environmental and societal risks within an overall framework.

Findings:

The results enable us 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.

1 Introduction

33 Coastal regions face both increased socio-economic pressures (Nicholls *et al.*, 2012) and escalating
34 stresses derived from natural hazards (Adger *et al.*, 2005), resulting in new challenges for coastal risk
35 management. These new challenges are emerging from the joint occurrence of these multifaceted risks
36 both spatially and temporally. Joint occurrence as much as interlinkages between these risks from
37 multiple sources call for enhanced forms of collaborative governance and integrative policy-making
38 (Ballinger, 2015). In this regard, scientific and policy debates already call for i) enlarged integration of
39 multiple interests and perspectives, ii) the analysis of all available scientific and policy knowledge and
40 iii) increased sensitivity to the complexity of coastal risk management processes amongst all parties
41 concerned (Ballinger, 2015; Hinkel *et al.*, 2015). This focus on widening risk management towards
42 broader participatory and collaborative approaches is also underscored by disaster risk management
43 initiatives, in particular by the recently adopted Sendai Framework for Action 2015-2030 (UNISDR,
44 2015). All these activities put increased demands on addressing its practical implementations rather
45 than on theoretical discussions.

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

61 **2 Why risk management as a social process?**

62 The call for increased social processes brings to light the role of integrative and participatory
63 structures and its mindset within risk management. The term *social* underlines a differentiation from
64 purely technical risk management processes and emphasizes the enhanced inclusion and evaluation of
65 risk perceptions [1] and societal frames. Understanding risk to be a mental construct, emerging in the
66 human mind and shaped by social, political, economic and cultural contexts (Douglas and Wildavsky,
67 1982; Luhmann, 1993), risk management should be understood as the process of dealing with issues
68 perceived as risky by the society. These issues might include single events such as natural hazards, as
69 much as uncertain short- and long-term developments such as uncertain environmental and socio-
70 economic processes of change. From a conceptual perspective, increased complexity in (coastal)
71 governance regimes requires collaborative and participatory processes where different interests held
72 by scientists, different sectors and contrasting institutions are balanced and negotiated (Ballinger,
73 2015; Renn, 2008; Stirling, 2010). Besides the normative objective to include all relevant agents in a

74 democratic process (Stringer *et al.*, 2006), collaborative and participatory processes mediate between
75 values, norms and regulative structures (Beierle, 2002) facilitate more robust decision-making under
76 uncertainty (Hinkel *et al.*, 2015) and offer an opportunity to collect more ideas or alternative
77 viewpoints on how to minimize human impacts (Bell *et al.*, 2003; de Jonge and Giebels, 2015). These
78 endeavors reflect on the need to strengthen mutual debate and recognition of different risk-rationales
79 driven by different knowledge regimes, taking into account the pressing challenges to bridge the gap
80 between knowledge development and translation into disaster risk reduction policies and practices
81 (Aven, 2016; UNISDR, 2015; Weichselgartner and Pigeon, 2015). A social process perspective
82 recognizes the need to combine scientific and technical expertise with locally embedded forms of
83 situated knowledge derived from the practical experiences of stakeholders. This implies a recognition
84 that risk management and collaborative governance processes more generally are embedded within a
85 specific socio-environmental context (Healey, 2006, 29). Facilitating knowledge exchange and mutual
86 learning can thus lead to the development of greater understanding of societal processes and more
87 ‘actionable’ knowledge for all stakeholders (Weichselgartner & Pigeon, 2015). Stakeholders in this
88 context are understood as representatives of different interest groups or institutions that are directly
89 affected, have an interest in the decision, or with legal responsibility and authority relative to a
90 decision (Mitchell, 2002).

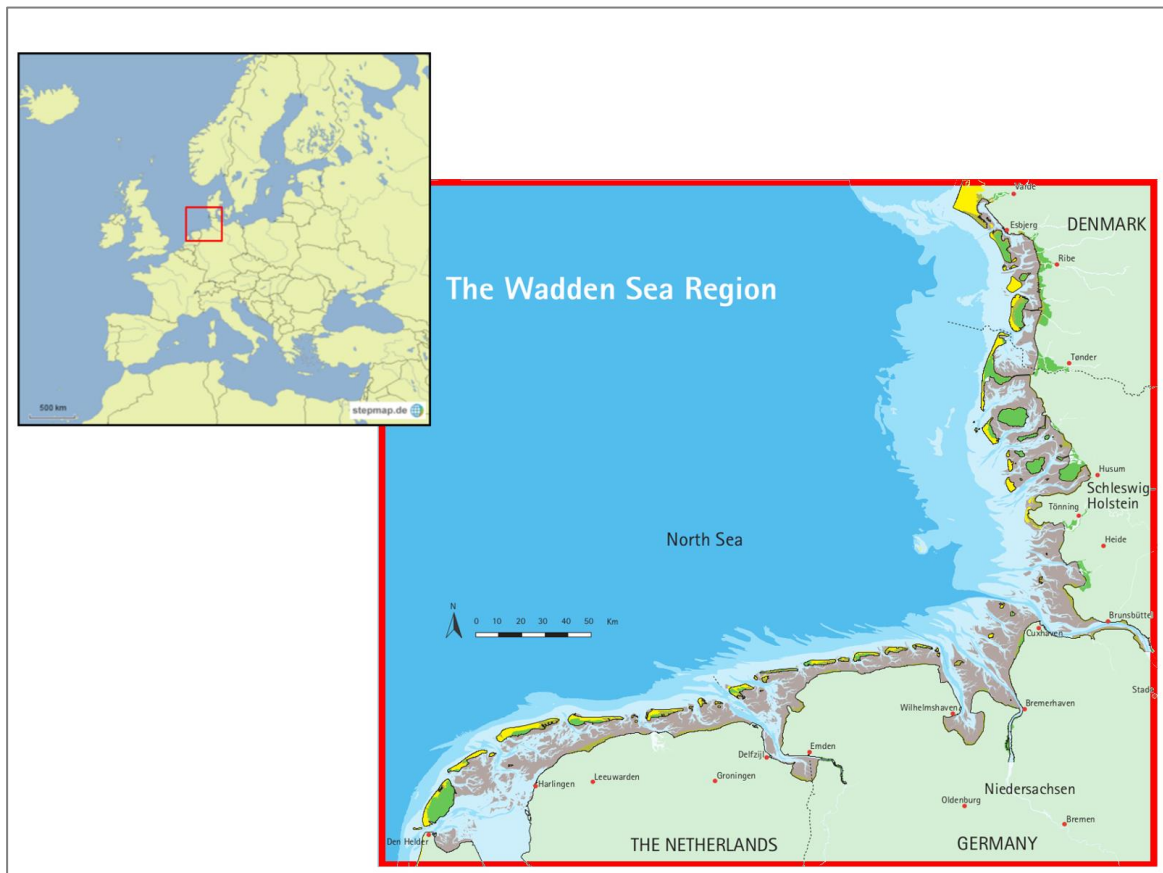
91 Consequently, we argue that successful coastal risk management processes need to bring together both
92 technical and social processes. This is in clear contrast with the predominance of technical processes
93 in current risk management. Following, we present an already applied methodological framework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

95 **3 New impulses for risk management activities in the trilateral Wadden** 96 **Sea Region**

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

102 *3.1 The case study region*

103 The WSR is a cross-national coastal region along the Dutch, German and Danish North Sea coast (see
 104 figure 1) which includes the low-lying, tidal coastal regions of the North Sea, the marshlands and part
 105 of the low-lying *Geest*[2] along the mainland. It encompasses approximately 3.8 million inhabitants,
 106 of which approximately 80.000[3] live on the 21 inhabited islands. Since the 10th century the region
 107 has been subject to systematic embankment, drainage and related continuous development of
 108 protection and management (Lotze *et al.*, 2005; Knottnerus, 2005). These activities induced a large-
 109 scale transformation of the Wadden Sea's ecosystem (Enemark, 2005) and thereby strengthen the need
 110 to cope with sea level rise (Wahl *et al.*, 2011) and with increased natural hazards in terms of storm
 111 surges up until today (Hofstede, 2005). Although regional differences in the historic and current
 112 development of marsh settlement and dyke constructions are evident (Lotze *et al.*, 2005), as well as
 113 differences in development between the mainland and the barrier island, today all three Wadden Sea
 114 countries primarily focus on technical and construction measures. These measures are expected to
 115 suitably deal with storm surges and sea level rise under current and changing climate conditions in the
 116 near to mid-term future (The Ministry of Infrastructure and the Environment and the Ministry of
 117 Economic Affairs 2014; Ministry of Energy Agriculture the Environment and Rural Areas Schleswig-
 118 Holstein, 2013; Lower Saxony Water Management Coastal Defence and Nature Conservation Agency,
 119 2007). This development is accompanied by a current spirit of deep trust in technical engineering
 120 coastal protection solutions across the WSR (Dronkers and Stojanovic, 2016; González-Riancho *et al.*,
 121 2017).



122 **Figure 1: The trilateral Wadden Sea Region (large picture) and its location in Europe (small picture, red marking);**
 123 **the colored areas highlight dune, beach and sand (yellow), rural areas and marshland (green) within the intertidal**
 124 **areas (grey areas), and marshes, geest and peatland on the mainland (light green); source: Common Wadden Sea**
 125 **Secretariat (large picture) and open street map (small map)**

126 It is clear that in the next decades new challenges will arise due to increased sea level rise (Katsman *et*
127 *al.*, 2008) and the foreseen intensified effect on storm surge events (Weisse *et al.*, 2014). Under these
128 circumstances technical measures may reach their limits of construction feasibility in the not too
129 distant future. New impulses are required to prevent society from exclusive investment in technical
130 measures, which in the long-term perspective will hinder adaptation of risk management to
131 supplementary non-technical solutions. Furthermore, enhanced challenges in risk management will be
132 established by new and enhanced social and economic uncertain developments affecting the WSR
133 communities. These challenges will be related to demographic changes (van Dijk *et al.*, 2016),
134 economic crises, and an imbalanced development between competing interests in the WSR, both on
135 the mainland and islands.

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

148 *3.2 Multi-stakeholder collaboration in the WSR*

149 In the face of these challenges, increased scientific information and knowledge on its own seems to be
150 insufficient to reach sustainability and effective disaster risk prevention in coastal zones; on the
151 contrary participatory activities are needed to facilitate integration of formal and informal knowledge
152 (Puente-Rodríguez *et al.*, 2015) and facilitate ‘divergence’ as well as ‘convergence’ of ideas, options
153 and solutions in the management process (de Jonge and Giebels, 2015). Over the years, political
154 decision-makers, administrators and scientists in the WSR have recognised the importance of cross-
155 national exchange of experience, mutual learning, discussion and joint strategic development, mainly
156 with regard to sustainable development (Wadden Sea Forum, 2005). As a result, a cooperation
157 between governmental authorities has been established in 1978 in the Trilateral Wadden Sea
158 Cooperation, which is active to protect and preserve the Wadden Sea as an ecological entity by
159 implementing shared policies and management strategies focusing on conservation issues (Common
160 Wadden Sea Secretariat, 2010). In this spirit, a further cooperative multi-stakeholder partnership in
161 form of the Wadden Sea Forum (WSF) was established in 2002. The WSF is an independent, advice-
162 giving platform of governmental and non-governmental Dutch, German and Danish stakeholders
163 representing the sectors of agriculture, energy, fisheries, industry and ports, nature conservation,
164 tourism, as well as local and regional governments; the national governments are represented as
165 observers (Wadden Sea Forum, 2005).

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

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

181 **4 Methodological implementation of social risk management** 182 **processes – Insights from the Wadden Sea Region**

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

197 Each stakeholder workshop comprised a combination of small working groups and plenary
198 discussions, to provide room for information exchange and feedback and stimulate active stakeholder
199 involvement. Each workshop was conducted in English. The first workshop was dedicated to the
200 identification of different risk perceptions and stakeholders' awareness of current risks and risk
201 management processes and their demands for improved risk management activities. By combining
202 individual and group responses, the placemat method was employed a to structure group discussion in
203 an equitable manner and fosters the discussion of different positions (Sliwka, 2004). The core activity
204 of commenting on the other participants' statements complements one's own perspective and fosters a

205 constructive reflection of the discussed topic (Reich, 2006). This activity should be completed by all
206 stakeholder awarding priority points to the resultant list of risks and uncertainties (section 4.1).

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

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

232 4.1 Identification and integration of different risk perceptions

233 Applying the placemat activity provided a diagnosis of the stakeholders risk perception and identified
234 potential points of incoherence between the current approach of risk management policies and
235 stakeholders' perceptions. In this activity it is less important to find consensus than to identify and
236 present different perspectives in order to enhance awareness about the variety of existing risk
237 perceptions. Guided by the questions 'what risks and uncertainties do stakeholders identify for the
238 WSR' and 'are they content with the current management of the risk and uncertainties in the WSR' the
239 activity was implemented in five working groups with four participants each. The participants brought
240 together their statements (in writing), discussed jointly the key messages for the working groups and
241 finally presented all key messages and mentioned risks together in a final plenary discussion. Finally,
242 the stakeholders prioritised the risks according to their level of urgency by awarding priority points.

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

- 245 1. Storm surges / sea level rise
- 246 → **Well managed**, however climate change (including increased
- 247 natural hazard events and change in climate parameters) will cause
- 248 **future challenges which need improved management**
- 249 2. Demographic change / aging society
- 250 → **Lack of management, need for management strategies and**
- 251 **strategies for regional development**
- 252 3. Changes in society including emigration of young people; risks on
- 253 maintaining services; increased migration to the WSR, impact on the
- 254 regional cultural identity
- 255 → **Lack of management, need of improved activities**
- 256 4. Conflicting spatial uses between different user interest, e.g. environmental
- 257 protection and economy
- 258 → **Need of improved management**
- 259 Further risks (in descending order): Shipping and oil tanker accidents;
- 260 economic crises (global and regional level) and their impacts of decreasing
- 261 economic activities; emissions (especially CO₂) and pollution of rivers and
- 262 the North Sea; loss of biodiversity and increase of alien species; Energy:
- 263 Availability and sustainable management of energy supply; outside events:
- 264 meteor strike, impacts of wars (outside the WSR) on WSR, nuclear power
- 265 accident

266 The stakeholders perceive that the WSR faces multiple risks from different natural hazards as well as

267 socio-economic developments. Storm surges represent the most significant risk, however in the

268 stakeholders' view these risks are reduced to a socially tolerable degree in all three countries. More

269 significantly, increasing challenges resulting from uncertain socio-economic developments are clearly

270 highlighted: risks deriving from socio-demographic changes are the second most important– but are of

271 highest priority with regard to immediate need of risk management action. The activity underlined that

272 most of the risks discussed above were perceived by stakeholders from different sectors,

273 administrative institutions and NGOs to affect the whole, cross-national WSR. The resulting

274 understanding of similar perceptions and joint or overlapping concerns encourages a collaborative

275 sensitization process, whereby shared concerns can stimulate the exchange of different viewpoints,

276 experiences and knowledge between stakeholders.

277 4.2 *Increasing awareness of the complexity of risk pathways in a multi-risk situation*

278 Improved social risk management activities strengthen the focus on balancing multiple interests and a

279 joint prioritization of management needs in order to comprehensively assess the multi-risk situation.

280 These activities will further sensitize involved stakeholders towards causes and consequences of

281 perceived risk to provide guidance for further risk management activities. In practice, the bow-tie

282 process was applied to support this process. Three bow-tie diagrams were developed related to the

283 major challenges: 'demographic change', 'climate change resulting in environmental changes', and

284 ‘imbalanced development’; each bow-tie visualizes a breakdown of the stakeholders’ input on causes,
285 consequences and adaptive or mitigating measures and visualise the links identified between the bow-
286 ties at the decisive points.

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

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

319 *4.3 Negotiating future visions*

320 In strategic risk management joint discussions on future societal visions can play a vital role to adjust
321 risk management activities to societal perspectives and visions in the long-term. We addressed this
322 challenge by using a qualitative scenario approach, paying special attention to the major risks as
323 perceived by WSF stakeholders. The following three scenarios had been worked out by stakeholders
324 in working groups, consisting of members from different countries and sectors. Stakeholders were

325 asked to imagine themselves in the year 2030, describe the anticipated threats and impacts of the crisis
326 for the society and the region, focus on how to handle gaps in management and discuss the (new) role
327 of the WSF in these situations. The three scenarios were:

328 a) **A very low pressure system heading towards the WSR** (addressing storm surge risks)

329 Starting position: A severe low-pressure system makes landfall in the Wadden Sea Area and
330 causing damage across the region.

331 Scenario enhanced by stakeholders: The coastal defense system still provide safety; however
332 the decentralized energy supply system at that time based on renewable energies, would have
333 been particularly affected, leading to difficulties in energy supply and mobility along the
334 coast.

335 Recommendations derived by the stakeholders: Increase effectiveness of coordinated risk
336 management at the regional level, especially in spatial planning, and broad-based engagement
337 to reduce anticipated impacts. The WSF facilitate discussion about infrastructure emergencies
338 on a trilateral level, raise awareness regarding existing risks and develop recommendations on
339 mitigation and adaption.

340 b) **Shutdown of grocery shops in peripheries creating a supply issue** (addressing risks of
341 demographic change and aging society)

342 Starting position: closure of grocery shops in peripheries causing special problems of
343 provision especially for the rural WSR

344 Scenario enhanced by stakeholders: Many people had left the area and subsequently many
345 traditional shops and other facilities had closed. Spaces which combine the changing needs of
346 society and overcome the obstacles of decreasing infrastructure have been developed for local
347 communities to come together in order to shop and run errands, to socialize, and for
348 recreational activities. New technologies support the interconnection between village
349 inhabitants and facilitate people coming together, contributing to the development of new
350 solutions particularly in terms of collective action.

351 Recommendations derived by the stakeholders: The WSF could initiate action and promote
352 role models; it could identify already existing and possible best practice projects and
353 communicate promising ideas to the other parts of the region, becoming a shared best practice
354 project.

355 c) **Oil tanker crashing on an offshore windfarm and producing leaks** (risk related to
356 conflicting spatial uses)

357 Starting position: an oil tanker crashing into an offshore windfarm, whereby several cargo
358 tanks on board exploded and thousands of liters of oil were leaking.

359 Scenario enhanced by stakeholders: severe consequences in form of extensive onshore and
360 offshore oil pollution, losses in the fishing and tourism sectors, blocked waterways disrupting

361 the transport of goods, and damages on connector cables of the wind farm, resulting in a
362 hampered electricity supply.

363 Recommendations derived by the stakeholders: Call for different prevention measures
364 including an integrated trilateral approach and transnational control systems. A sound marine
365 traffic management system should be mandatory, emergency capacities, e.g. for towing,
366 should be increased and available recommendations with regard to shipping safety require
367 implementation and application. The stakeholders see the WSF in its capacity as a
368 communicator and ambassador.

369 All scenarios underpinned multiple interlinkages between risks and their impacts across different
370 sectors and across different spatial dimensions – and consequently future strategies required paying
371 more attention to these interrelations. Stakeholders’ different experiences and cultural backgrounds
372 were found to be of particular relevance when developing clear ideas about cross-national activities.
373 As a result of the scenario activity the WSF identified itself as a communicator and ambassador in risk
374 management that can profitably use its networks to communicate new developments at the political
375 level and to the decision-makers while supporting the implementation of already existing strategies as
376 well as emerging new ones. In this function, the WSF will improve activities on awareness raising,
377 knowledge exchange as well as communication especially at the cross-national level – a mission
378 statement emphasizing once again the significance of improved social processes in risk management
379 in contrast to purely technical activities.

380 *4.4 The trilateral dimension in risk management processes - Perspectives for the Wadden Sea* 381 *Region*

382 The collaborative workshop activities emphasized enhanced awareness to the fact that several risks in
383 the WSR and their multifaceted impacts do not occur within areas of clearly defined spatial scope of
384 specific governance institutions, but occur as large-scale, sometimes cross-national transboundary
385 phenomena. In order to cope with this situation, the work presented here indicate clear policy
386 recommendations: The cross-national, multi-stakeholder institution (WSF) could serve as a platform to
387 exchange experiences and knowledge, with a particular emphasis on integration of different
388 knowledge source as well as facilitating a hearing of stakeholders practical reasoning on risks and
389 uncertainties in the risk management debate. In this situation, bringing together different kinds of
390 scientific and practical bodies of knowledge allows and strengthens the process of joint analysis of
391 existing knowledge (compare Healy 2006; Aven 2015). This enhanced interrelation of knowledge
392 sources and practical reasoning increase societal understanding of cause-and-effect relationships. In
393 this function the WSF act as a mouthpiece to highlight and address pressing questions in risk
394 management derived out of these improved knowledge structures and strive for enhancing its
395 relevance in decision-making processes in policy and practice. As such the cross-national trilateral
396 spatial perspective play a significant role to maintain a bird’s eye view on the complex multi-risk
397 situation and encourages special attention to those risks that need to be considered beyond the extent
398 of current national boundaries. In addition, this bird’s eye view may facilitate increased mutual
399 learning processes and providing new perspectives on interlinkages and cascading effects.

400 Enhanced participatory processes on the trilateral scale should primarily be understood as *informal*
401 activities, providing an *additional* perspective without undermining the scope of responsible
402 institutions on the local, regional and national level in WSR. Activities on the trilateral scale will pay
403 less attention to the structure of authorities responsible and far more on the interaction processes,
404 exchange between responsible authorities and directly and indirectly affected sectors and contribute to
405 ensure social involvement and consideration of social interests in risk management discussions.
406 Existing legislative or administrative institutions could benefit from the learning processes and output
407 of activities on the informal trilateral scale. In this spirit, the WSF's future role in risk management, as
408 most of the members see it (from within), should lie primarily on awareness rising and defining and
409 asking relevant questions at the political level. The WSF is expected to have sufficient capacity to
410 emphasise communication and commitment in a trilateral context, which will be a decisive trigger to
411 overcome the limits of purely technical perspectives in risk management processes. In doing so the
412 WSF directly addresses the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR,
413 2015), wherein an important part of the guiding principles call for partnerships to achieve improved
414 risk management aiming to improve how different institutions and sectors (jointly) cooperate to
415 develop and implement disaster risk reduction measures.

416 **5 Conclusion**

417 Risk management in the trilateral WSR is confronted with new challenges emerging not only from
418 increasing natural hazards but also from socio-economic developments, in particular demographic
419 change and conflicting spatial uses. Meeting these challenges will include a shift in understanding risk
420 management processes not as a purely technical process. Rather risk management is to a great extent a
421 social process, directly and indirectly facilitating stakeholders from different involved sectors easier
422 access and making their concerns heard as much as to balance and negotiate different interests and
423 concerns.

424 Based on the rationale of enhanced social risk management we presented a mixed-method approach to
425 implementation of such enhanced social risk management processes in the trilateral Wadden Sea
426 Region. Applied with the multi-stakeholder setting of the WSF participatory activities demonstrated
427 that individual risk perceptions and stakeholder risk awareness are decisive to adjust risk management
428 processes to societal needs and concerns. Unravelling the risk perceptions demonstrated that for the
429 WSR 'widening risk management towards broader and more people-centred approaches' (UNISDR,
430 2015) in concrete terms means to consider the multi-risk situation in the WSR within coastal risk
431 management processes. Building on this, a bow-tie process and a qualitative scenarios exercise,
432 underlines the importance of intuitive, social judgment of risks and the capacity of negotiated future
433 visions to further support the integration of different perceptions, knowledge and experiences in a
434 long-term perspective. Experiences from the case study highlighted a sensitization process understood
435 as learning process for stakeholders and for decision-makers involved, learning with and from each
436 other. In this function, a participatory risk management framework constitutes a first but important
437 step to overcome the current negligence of societal risk perception and participatory processes. Based
438 on the common discussions the proposed recommendation on further, trilateral risk management
439 activities come from within the (stakeholder) community and are therewith grounded in the
440 communities' ownership. Accordingly, the trilateral scale has proven to be an appropriate spatial

441 dimension to transfer this broadened perspective of risk management into practice, and providing new
442 impulses to handle risks in the trilateral Wadden Sea Region.

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448 catastrophic natural hazards in Europe).

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, 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. 5000 inhabitants on 3 Danish islands (source: Danmarks Statistik; Regionaldatenbank Deutschland; CBS Statistics Netherlands)

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