



Universiteit Utrecht



ENCORES Literature Review: Coastal Resilience Against Climate Change Related Hazards in Current Scientific Literature

A literature review from three different perspectives to inform the concept of Integrated Coastal Zone Governance

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Introduction

As sea levels continue to rise with climate change, coastal zones are experiencing more frequent hazards and disasters. Complexity and uncertainty due to climate change are key challenges of coastal areas, especially the coastal urban and surrounding areas. To prepare for a climate-proof future, it is important to create resilient coastal zones by stimulating societal transformation towards a resilient society.

In recognition of abovementioned challenges to coastal settlements in Europe, Utrecht University, together with 12 European-wide partner organisations have developed an H2020 proposal entitled: **ENCORES (ENhancing COastal RESilience - Integrated Coastal Zone Governance as a Novel Framework for Assessing and Designing Pathways for Resilient Coastal Urban Agglomerations)**. The main objective of ENCORES is to contribute to the development of appropriate future-oriented pathways towards resilient coastal urban agglomerations in Europe and implement long-term robust adaptation plans and cost-effective measures in order to enhance overall resilience. The project focuses on processes of adaptive and transformative pathways development for integrated coastal zone governance (ICZG) and pays attention to regional and local projections, stakeholder engagement and knowledge dissemination and utilisation.

This report is the first key step towards the development of the ENCORES project proposal. The purpose of this report is to provide an overview of the current state-of-the-art of scholarly works on 5 bodies of literature used in ENCORES: integrated coastal zone management, socio-ecological and socio-technical systems, disaster risk reduction, ecosystem-based approach, and climate adaptation planning. This report combines three different, but interlinked perspectives, namely ecosystem (see Chapter 1), governance (see Chapter 2), and legal (see Chapter 3), and seeks to identify early lessons from the 5 bodies of literature and the shortcomings to be addressed in ENCORES project proposal and implementation.

1 Chapter 1: Ecosystems & Economics Perspective

Charlotte Stijnen

1.1 Introduction

To support the development of the concept Integrated Coastal Zone Governance, this review investigates literature on coastal resilience through five bodies of literature that are significant to enrich the understanding of coastal resilience from an ecosystems and economics perspective. These bodies of literature include; integrated coastal zone management (and governance), disaster risk reduction, climate adaptation planning, ecosystem-based adaptation, socio ecological systems and socio technical systems. The objective was to abstract the key messages on coastal resilience for each individual body of literature from an ecosystems and economics perspective. Additionally, this literature review aims to highlight literature that adds insights for the assumptions on coastal resilience mentioned within the ENCORES proposal. The main assumptions of the proposal were used as a frame of reference for this entire research project, these assumptions include; complexity and uncertainty as key challenges of coastal resilience, coastal urban agglomerations being most vulnerable to climate change, different trajectories and rationales are needed for resilience thinking, and a new ICZG framework is needed to enhance coastal resilience. In the next sections of this chapter, the methodology for the systematic literature review will be explained, followed by a summary of findings from each body of literature through either an ecosystems or economics perspective, and lastly an overall reflection of the main findings.

1.2 Methodology

The methods used to find the key points and relevant information on coastal resilience for the ENCORES projects was conducted through a systematic literature review of the five bodies of literature that are central to the ENCORES project. The main assumptions of the project were used as a frame of reference for the entire research project. For each body of literature, a separate search for academic literature was carried out. Additionally, the literature review on each body of literature was carried out using an ecosystems or economics perspective, separately. An overview of the research framework can be seen in Figure 1.1.

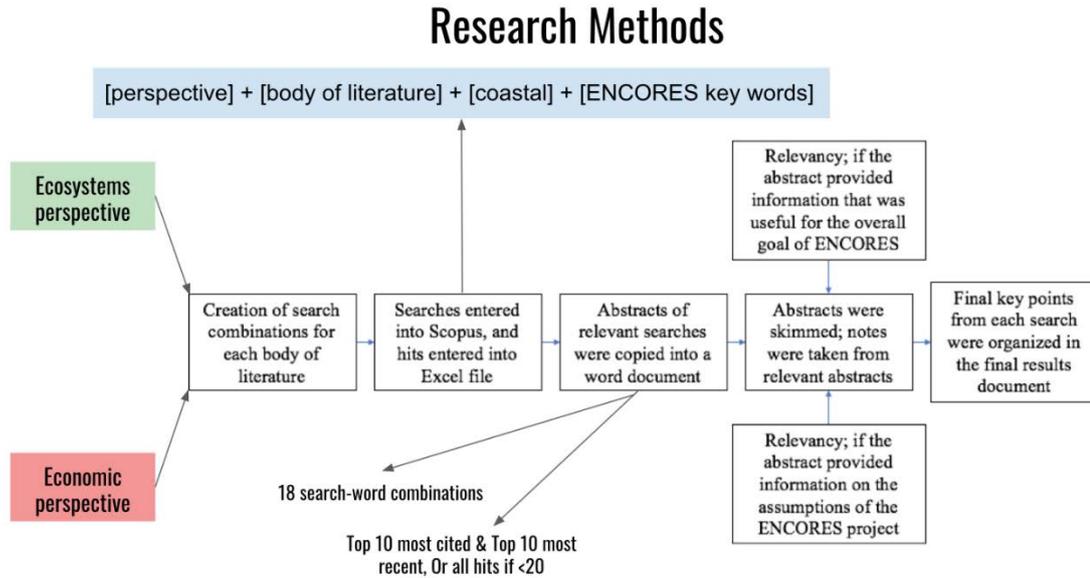


Figure 1:1 Research methods.

To search for the literature, a variety of different combinations of key words were used for each body of literature. The ENCORES project proposal document provided inspiration for key words to add in the searches to enhance the relevancy of the literature to the ENCORES project, these terms included; resilience, coastal hazard, sea-level rise, flooding, coastal erosion. Additionally, the searches for each body of literature were adapted with supplementary key words specifically for an ecosystems perspective and economics perspective. Key terms that were used for the ecosystems perspective included ecosystem and biodiversity, and the key terms used for the economics perspective included economics, cost, benefit, and finance. With all the key terms, different combinations were used as searches for each body of literature, using a variation of the terms, also varying the searches using AND, OR, and pre/O between terms to see if this would result in a difference in search hits. Finding the key words, and the combinations of searches was an iterative process, trying out different combinations and adapting search combinations based on the number of literature hits.

These searches were conducted using the Scopus online search engine. After each combination of search terms were entered into Scopus, the hits were exported into a CSV file, including all the citation information and the abstract of the article, excluding the EID and the access type. The data from all the searches was collected in an Excel file, each unique key word search was placed in a separate sheet in the Excel file. The searches from the ecosystems and economic perspective were collected in separate Excel files. Once all the searches were entered into the Excel file, an overview of the number of hits for each search was created in a separate Excel file. This was to create an oversight of the results, and to assist in deciding which searches and corresponding literature would be analysed. For key word searches that provided more than 20 hits, the top 10 most cited and top 10 most recent

papers were analysed, whereas for searches that had 20 or less hits, all the papers were analysed. In the first weeks of the research period, several key word searches for each body of literature were examined, towards the end of the research period only one or two key word searches were selected to analyse the literature due to time constraints.

Once the academic papers from the searches were selected, the citation information and abstracts were placed into a Word file to make the research more convenient. The information of each academic paper was added into a table format, including the title of the paper, the year published, the journal, the number of citations, and the abstract. Three additional columns were added to make notes on the geographic area each paper covered, the relevance of the paper for ENCORES, and additional important notes on the paper. The abstracts of each paper were read, and notes for key points were made based on information extracted from the abstract. If papers were deemed relevant for the ENCORES project, based on the overall goal of the project, or if the abstract touched upon one of the assumptions of the ENCORES project, this was noted in the relevance column. If a paper was not deemed relevant based on these same criteria, 'NOT RELEVANT' was added into the column. For those papers that were relevant, the geographic area covered in the paper was noted (if the paper was an overview of literature 'lit. review' was noted), the relevance of the paper for the ENCORES project, and additional key points were written down in the 'notes' column. Once the relevant papers had been filtered out, the abstracts had been analysed and the key notes had been written down, the notes were compiled into an overarching literature review document. The notes and key points were separated for each body of literature, clarifying the perspective used. Within each body of literature that used both perspectives, findings were separated for the ecosystems and economics perspective. For each body of literature, the findings for each unique key word search were compiled. Lastly, for each body of literature, information from the collective searches that touched upon the assumptions of ENCORES was noted down.

One of the limitations of the research was the time constraint due to the fixed duration of the research. This caused a lot of literature gathered in the searches not to be reviewed, and thus the final literature review report may be missing key points for ENCORES. However, using the top 10 most cited and top 10 most recent papers was a strategy used in the research to cover the main papers in the different bodies of literature. Adding on, due to the time constraint, most bodies of literature were reviewed only using an ecosystems perspective, with the exception of the body of literature on EbA which only used an economics perspective (since it is inherently already an ecosystems perspective), and the literature on SES and STS used both perspectives. Additionally, due to the method to place each key word search into a separate excel sheet it became difficult to filter out duplicates during the process. Therefore, duplicates were only filtered out during the stage of compiling all key points,

whereas if duplicates could have been filtered at an earlier stage it would have provided more room for new academic papers. Additionally, a challenge was to filter through and determine which papers presented information deemed relevant. Reading the ENCORES project proposal, and the assumptions of ENCORES, created guidance for selecting information. Nonetheless, it was challenging to decide whether information would add new insights for the project, or if this additional information would make the literature review too complex and undefined for the purposes of ENCORES. Lastly, although the literature review provided key insights for the proposal, the research was limited to reading abstracts. At times the abstracts were in depth and could provide clear and detailed information, on the other hand, some abstracts were not able to provide detailed information on the findings of the paper without reading the entire paper, yet, due to time constraints this was not possible. Thus, although the research was constrained by available research hours, this literature review was able to cover a broad range of key points from each body of literature for the development of the ENCORES project.

1.3 Summary of findings

In this section a brief summary of the main findings for each body of literature will be provided.

1.3.1 Integrated coastal zone management (Ecosystems)

Current research on an Integrated Coastal Zone Management framework is missing the incorporation of an ecosystems perspective (Forst, 2009). Focus needs to be placed on preserving the ecological health of coastal areas (Iftekhar & Islam, 2004). This ecosystems perspective needs to be incorporated into the ICZM framework because the health of coastal ecosystems supports the ecosystem services that can be provided by coastal zones, and these are important for the protection of coastal areas and the protection of coastal communities (Mathew et al., 2020; Primavera, 2006). Human activities in coastal areas are causing negative effects for the health of coastal ecosystems especially through land-use changes, and thus, land-use planning, environmental indicators and environmental monitoring need to be incorporated into the ICZM framework (Luisetti et al., 2011; Yanes, et al., 2019; Morais et al., 202). Literature on ICZM through an ecosystems perspective also points to the socio-economic factors and systems that need to be incorporated into coastal resilience decision-making for more effective processes and outcomes (Fabbri, 1998). Suchley & Alvares-Filip (2018) highlight that economic activities and the diversity of coastal ecosystem services affect one another, for example with overfishing, and thus the existence of economic activities and their impact on the health of ecosystems needs to be considered within ICZM to promote positive synergies. Lastly, sources point to the adverse impacts of grey coastal infrastructure on the health of coastal ecosystems, thereby highlighting the impacts of socio-ecological systems which need to be included in ICZM to preserve the ecological services within coastal areas (Li et al., 2019; Roy et al., 2017). Overall, the

literature on ICZM from an ecosystems perspective points to the need to focus on preserving the health of coastal ecosystems to protect the ecosystem services that coastal zones can provide. This needs to be in tangent with human activities, such as economic activities in coastal areas, to integrate both the health of coastal ecosystems and economic activities into the process of making resilient coastal zones.

1.3.2 Integrated coastal zone governance (Ecosystems)

In order to preserve the ecological health of coastal ecosystems and fill the current gaps in effective governance of coastal resources, there is a need for a greater and more diverse stakeholder involvement (Vaidianu et al., 2020). There is great importance placed on the incorporation of an ecosystem services perspective in the governance of coastal areas because the livelihoods of coastal communities depend on the ecosystem services of coasts, providing protection from coastal hazards, but also provide opportunities for economic activities to sustain livelihoods (Nicholls et al., 2016). There is a complex relation between coastal ecosystem services and socio-economic systems since communities may be dependent on these services for economic activities, but these human economic activities are often also damaging the health of these ecosystems (Pittman et al., 2019). The complexity to govern coastal resilience and preserve coastal ecosystem services because of the effects of socio-ecological activities, therefore, requires a clear consensus on what is meant with concept of coastal ecosystem services. For effective integration of this concept into the governance of coastal areas, a participatory approach for governance should be in place, and governance should be carried out at the municipal level for governance outcomes to fit to the local context (Solidoro et al., 2010; Green et al., 2014; Kvalvik, et al., 2020). The literature review for ICZG shows that in order to govern for coastal resilience, while accounting for the complexity of the socio-ecological activities that affect the health of coastal ecosystem services requires a broad and diverse stakeholder involvement. The stakeholders should also be diverse in the vertical and horizontal levels of governance, with a clear consensus on the definition of ecosystem services.

1.3.3 Disaster risk reduction (Ecosystems)

Looking at coastal disaster risk reduction strategies from an ecosystems' perspective, literature points to the importance of Eco-DRR as strategies that should be promoted and implemented (Takagi, 2019). The use of nature-based solutions for coastal DRR, such as the use of coastal dunes and coastal mangroves, have several benefits including the protection of coastal communities from sea level rise, which in return protects the health of these communities, and also provides functions such as carbon storage and sequestration (Fernandez-Montblanc et al., 2020, Takagi, 2019). The multiple benefits provided by Eco-DRR both help to mitigate and adapt to climate change effects in coastal areas. These Eco-DRR strategies can enhance the adaptive capacity of coastal communities, but in order to do so, there is a need for a broad integration of stakeholders at both vertical and horizontal levels (Islam,

2012). The main challenges for mainstreaming Eco-DRR into coastal protection strategies is the lack of political and technical guidance, which must be complemented through a participatory approach, which will also lead to more innovative Eco-DRR solutions (Furuta & Shimatani, 2018). This review of disaster risk reduction from an ecosystems perspective highlights the need to place attention on Eco-DRR measures due to the multiple benefits these provide for the health of ecosystems, and adaptation and mitigation of coastal hazards, and the provision of protection for coastal communities.

1.3.4 Climate adaptation planning (Ecosystems)

The literature on climate adaptation planning for coastal areas from an ecosystems perspective identifies that there is a gap in the literature due to the lack of inclusion of this perspective. It is important to incorporate ecosystems services (ES) into coastal adaptation planning, to preserve the ecological health of coastal zones to provide protection measures against hazards and thus reduce the vulnerability of the coastal communities (Myers et al., 2019). To incorporate coastal ES into coastal adaptation planning, spatial data on coastal ecosystems and the vulnerabilities of specific locations must be collected. This information needs to be integrated into the planning to make plans fit to the specific characteristics of each coastal area. The spatial information required for adaptation planning includes data on the ecological sensitivities of coastal areas (which areas are most vulnerable to climate change hazards), where coastal ES are located, information monitoring land subsidence, and flooding of certain coastal areas (Okey et al., 2015; Mandle et al., 2017; Cian et al., 2019). An emphasis has also been placed on the collaborative approach to developing adaptation plans, through the engagement of local government, civil society, the research community and non-profits to make plans sensitive to the local decision-making context (Giampieri et al., 2019; Closet et al., 2017; Langridge et al., 2014). Overall, climate adaptation planning can profit from the inclusion of coastal ES into plans, through the use of detailed information collected on ecological sensitivities of specific local coastal area conditions. Additionally, to make climate adaptation plans fit the local context, a diverse range of stakeholders needs to be involved in the planning process, especially stakeholders with expertise on the local context.

1.3.5 Ecosystem-based adaptation (Economics)

Looking at the economics of Ecosystem-based Adaptations in coastal areas, the general assumption is that coastal EbA costs less compared to grey infrastructure projects, and that generally speaking EbA is cost-effective, however there still remains a gap in the literature on the specific information on these costs to make an empirical claim (Ellison, 2018; McVittie et al., 2018). To make EbA projects cost-effective, a significant proportion of the budget of these projects needs to be placed into investments in a process-based model of the coastal areas, and high resolution elevation data that will ensure the EbA project will be resilient to the projected sea level rise change (Runting et al., 2013).

It remains difficult to estimate the cost-effectiveness of EbA projects due to the uncertainty of future climate change impacts, therefore more research needs to be placed on coastal risk valuation through high resolution topography and long-time series data of cyclones, and comparing EbA projects against artificial (grey) structures under the same predicted environmental conditions (Menendez et al., 2019; Morris et al., 2018). Although Reguero et al. (2018) mention that the cost-effectiveness of a nature-based coastal solution will increase as climate change effects increase, compared to grey infrastructure. Literature also mentioned the lack of information on how EbA will affect the distribution of social costs and benefits for coastal communities and how this will impact the adaptive capacity of specific communities (Richerzhagen et al., 2019). Overall, more data needs to be collected on coastal EbA to make complete claims about the cost effectiveness of these projects, both in terms of financial costs and social costs of coastal communities, but this is challenging due to the complexity and uncertainty of climate change.

1.3.6 Socio-ecological systems (Ecosystems and Economics)

From an ecosystems perspective, there seems to be a strong focus on socio-ecological systems within coastal ecosystems resilience, a topic that has also been addressed in previous bodies of literature. Coastal ecosystems provide flood protection, food production, recreational activities, but also support some business activities, and many rural coastal communities are dependent on coastal ecosystem services for their income (Hoggart et al., 2014; Nautiyal et al., 2016). Some literature points to the ability to restore the health of ecosystems while improving services for the coastal communities, as is exemplified with coastal agroecology systems (Roy et al., 2019). However, to improve the adaptive capacity of social socio-ecological systems, the management of these systems needs to fit the contextual factors of a community, and thus there is a need for effective governance, participatory decision-making and exchange of knowledge between local government and scientists (Schwarz et al., 2011; Dutra et al., 2015; Carro et al., 2018).

The research on coastal social-ecological systems through an economics perspective was centered around the inclusion of economic tools and strategies to be included in the management of coastal areas. For example, the Coastal Erosion Adaptation Strategies approach from Roebeling et al. (2018) is an environmental-modelling approach that identifies efficient (welfare maximizing) coastal erosion adaptation strategies. Another interesting finding from this perspective is that the effects of climate change will affect different socio-economic sectors differently, including the tourism industry, the fishing industry and aquaculture, and this will have an effect on an unbalanced geographic revenue flow (Weatherdon et al., 2016).

1.3.7 Socio-technical systems (Ecosystems and Economics)

Overall, there was a lack of literature specifically on the topic of socio-technical systems in relation to coastal resilience for both the ecosystems and economics perspective. The main findings from the ecosystems perspective is that the availability of technical resources and technical expertise for marine protected areas can increase through the establishment of strong social networks (Nelson et al., 2019). Only using technical knowledge on coastal protection will not be effective, instead, technical knowledge needs to be incorporated with local knowledge through governance networks and participatory approaches (France, 2016).

From an economics perspective on socio-technical systems in coastal areas, the literature pointed to the need to consider and incorporate the socio-economic context into the planning of flood protection strategies to make plans more appropriate and effective (Chui et al., 2006; Apel et al., 2006).

1.4 Overall reflection

Looking systematically at the different bodies of literature analyzed for coastal resilience from an ecosystems and economics perspective, it seems that a main point being repeated is the lack of an ecosystems (ecosystem services) focus in coastal protection measures, and the need for advocacy to incorporate it (Figure 1.2). Coastal ecosystem services provide many benefits to coastal communities, including the protective measures from coastal hazards through natural mitigation and adaptation features. Therefore, a focus on preserving the health of ecosystem services in coastal zones should be a priority within plans for coastal protection. Nature-based coastal disaster risk, or Eco-DRR reduction strategies are therefore being promoted since these strategies tend to preserve the health of coastal ecosystems and are deemed more cost-effective compared to grey infrastructure projects for coastal protection. Overall, preserving the health of coastal ecosystem services makes coastal zones more resilient to natural hazards, and should therefore be a point of focus within ICZM.

In order to ensure that Eco-DRR projects for coastal resilience are more cost-effective, more research needs to be placed on gathering detailed information comparing the costs of grey infrastructure projects and nature-based solutions in different climate change scenarios. These costs should include the financial costs of projects over time, but also the distribution of social costs for coastal communities. Moreover, to ensure that nature-based solutions preserve the health of coastal ecosystem services, investments need to be placed in collecting data on ecological sensitivities and vulnerabilities of specific geographic coastal zones, in combination with detailed modelling technologies to be incorporated within coastal zone planning. This research needs to be detailed for each coastal zone specifically, to ensure that plans meet the specific conditions of the coastal area to be truly cost-effective.

Besides the technical factors that need to be incorporated in the planning for coastal resilience, one point that has been repeatedly mentioned through the literature review is the need for a broad and diverse involvement of stakeholders. This diversity of stakeholders is needed to account for the complexity of the socio-ecological relations that affects the health of coastal ecosystem, these include economic activities and land-use changes in coastal areas. The group of stakeholders should expand beyond simply municipal or governmental actors, to include also research communities, NGO's, and the local citizens. This is important because a broader stakeholder involvement at horizontal and vertical levels are needed for nature-based solutions of Eco-DRR and EbA to account for the specific ecological conditions and social needs of the coastal community. Broader social networks can also help to promote technical knowledge on coastal resilience, which needs to be combined with local knowledge on the coastal area.

Body of Literature	Key Points	Points for Future Research
ICZM	Strong relation between ecosystem services (ES) of coastal zones and communities Need to integrated land-use planning in ICZM	More emphasis needs to be placed on the health of ecosystems in ICZM
ICZG	Governance at municipal level to account for local context of coastal areas Need clear consensus on the meaning of ES	Lack of effective governance of coastal zones, this requires broad stakeholder diversity
DRR	Eco-DRR, nature-based, adaptive solutions Technical and political guidance to mainstream eco-DRR	Broad integration of stakeholders at horizontal and vertical levels
CAP	Spatial planning, ecological sensitivities, and vulnerabilities of specific geographic coastal zones Collaborative approach to planning with diverse stakeholders	Need to incorporate ES into CAP
EbA	Coastal EbA projects are cost-effective, adapting to rising sea levels Effective EbA projects require investment into high quality modelling technologies	More data needs to be collected to validate the cost-effectiveness of EbA Distribution of social costs from EbA
SES	Communities depend on coastal ES (protection, income), but also cause damage Need to include economic tools in management, EbA can improve ecosystems and livelihoods	Management needs to fit the contextual factors of the community
STS	Social networks can expand technical resources and expertise Technical knowledge needs to be incorporated with local knowledge	Socio-economic perspective in coastal resilience is missing

 = ecosystem perspective  = economic perspective

Figure 1:1 Key points and future research for bodies of literature (ecosystems and economics perspective).

Overall, the literature shows that Eco-DRR, EbA, and nature-based solutions for coastal resilience should have a greater focus within coastal protection projects. These solutions may be more cost-effective and preserve the ecosystem services of coastal areas which in turn protects the livelihoods of coastal communities. Planning for natural coastal resilience projects needs to include

detailed information on specific environmental conditions of the coastal area and take into account the socio-ecological relations which exist in order to ensure for positive synergies. This can be strengthened with governance that includes a broad and diverse stakeholder group, and with a consensus on the meaning and importance of ecosystem services. This literature review thus also recommends a general means for coastal resilience governance. However, the next chapter will provide more detailed information on this by taking a closer look into governance for coastal resilience.

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2 Chapter 2: Governance Perspective

Mira Piel

2.1 Introduction

This chapter examines different bodies of literature from a governance perspective and like this adds another angle to the conducted literature review. The aim of this chapter is to depict what knowledge can be found in current scientific literature concerning the governance of coastal areas. The respective bodies of literature are integrated coastal zone management (ICZM), climate change adaptation (CCA), socio-technical and socio-ecological systems (STS/SES), disaster risk reduction (DRR), and ecosystem-based adaptation (EbA). This chapter provides an overview about the current state of the art of how the different bodies of literature treat coastal systems particularly with a focus on how aspects of governance are addressed. In the following, I will describe my methodology, present the main findings of the literature review and reflect on reoccurring themes found across the different literature bodies.

2.2 Methodology

To gather literature relevant for the literature review, I conducted several online searches with Scopus, using different sets of search terms. The search terms were all chosen in connection to the five bodies of literature, governance and coastal areas. In total, this resulted in 60 searches conducted. All searches have been saved in an excel file. I then summarised all important information concerning the searches (body of literature, search terms, number of results in total, number of results 5 most recent years) in a table. I also indicated how relevant I considered each search, based on the number of hits and how specific the search terms are. This resulted in an overview of possible literature lists to choose from. In the end, the decision which lists to use followed the goal to be specific enough (to have relevant papers for the topic of interest) but at the same time not be too narrow (to exclude possibly relevant papers that do not include all search terms). From the lists chosen, the results were further narrowed down to the most recent papers (2015-2020), with the exception of the search for ICZM and EbA, where I also looked at the most cited papers. Furthermore, as my search in STS literature only gave very limited results, I consulted the most cited literature for coastal resilience. Due to lack of time, it was not possible to do this for each body of literature. Additionally, I searched for integrated coastal zone governance explicitly, but as Scopus did not show many results, I also searched Google Scholar for this concept. As the literature review emerged as a prework for the ENCORES project, I furthermore checked research conducted on living labs in a coastal context. This however only played a minor part in the literature review.

Next, I excluded some papers that did not reach a certain number of citations, depending again on the body of literature. The remaining papers were then included in the literature review. For the review, I limited myself to reading the abstracts due to time constraints. The findings can be consulted in. An additional excel file was made, that indicates amongst others, which papers were read and from which I drew information for the literature review.

The literature was read through with regard to key assumptions made by the ENCORES project. I paid attention to whether and how the concepts of complexity and uncertainty are treated, whether the paper focuses more on social/societal or technical change and what insights can be gained for the concept of coastal agglomerations (see ENCORES Consortium, 2020). I furthermore looked for general lessons that could be learned from the research conducted.

2.3 Findings literature review

2.3.1 Integrated coastal zone management

The review for this body of literature is based on 69 abstracts. These papers seldomly refer to the concepts of complexity and uncertainty but several papers use the idea of socio-ecological systems which usually takes these concepts into consideration (Garcia-Ayllon, 2018; Zaucha et al., 2016). Also, Soriani et al. (2015) acknowledge that governance in coastal systems needs to deal with issues of complexity (Soriani et al., 2015). Zaucha et al. (2016) suggest that an integrated approach like ICZM that is drawing on different disciplines helps to improve the management of complex social-ecological systems. Empirical applications of ICZM are only very rarely set in an urban context, and instead ICZM as a policy tool is often being implemented and researched on a wider scale in national policies (e.g. Barragán and Lazo (2018) synthesised information about ICZM in Peru and Gerhartz-Abraham et al. (2016) write about shortcomings in Cuban ICZM initiatives from a policy and legal perspective) or supranational policies (e.g. Billé and Rochette (2015) and Malvárez et al. (2015) write about the Mediterranean ICZM protocol - the first ever supranational legal instrument to govern coastal zone management – or Kosyan and Velikova (2016) who take ICZM in Eastern Europe, more specifically in the states surrounding the Black Sea, under review). Nevertheless, there are also exceptions from this geographical focus area, one can for instance be found in the work of Khakzad et al. (2015) who apply their research in an urban context in the city of Ostend, Belgium. Papatheochari and Coccossis (2019) see in ICZM an approach that can respond to increasing pressure from growing urbanisation in coastal areas. ICZM is also perceived as a tool to gain insights into the interplay between the ecological and the socioeconomic systems present in coastal areas (Papatheochari & Coccossis, 2019; van Dijk et al., 2016).

It has been argued that ICZM on a higher political level has only limited influence on local coastal law development (Billé & Rochette, 2015). Yet, Ballinger (2015) proposes that by using ICZM, policies that are more adaptable to local communities can emerge. Thus, even though ICZM practices

often refer to a wider scale like the Mediterranean Sea, the Black Sea or the Wadden Sea, the research field provides prospects for application on a smaller scale as well. Contrastingly, other scholars like Portman (2018) and Rosendo et al. (2018) call for more activity on higher political levels in ICZM to provide better support for local policies. Additionally, Soriani et al. (2015) point out that research needs to address the mismatch “between the local scale of coastal governance and the complex multi-scale nature of coastal systems” (p. 143).

Literature on ICZM often focuses on change in more technical terms, with some authors suggesting that a cultural/social dimension of change has been neglected in practical implementations of ICZM (Khakzad et al., 2015; Soriani et al., 2015). With regard to technical change, a limitation to ICZM found in several studies is a lack of technical capacity (Hassanali, 2017; Torresan et al., 2016; Verutes et al., 2017). However, social change is not completely absent, many abstracts also mention the relevance of social, economic or cultural factors in relation to ICZM (Abelshausen et al., 2015; Khakzad et al., 2015; Le Gentil & Mongruel, 2015; Soriani et al., 2015). ICZM also mentions the need for eco-engineering and natural infrastructure and thus, links the research field to EbA (Jacob et al., 2018; Whelchel et al., 2018).

This is also reflected in the call for more inter- and transdisciplinary expressed by a large number of authors (Arkema & Ruckelshaus, 2017; Carter et al., 2015; Le Gentil & Mongruel, 2015; Marignani et al., 2017; Mazé et al., 2017; van Dijk et al., 2016; Walsh, 2019). Furthermore, many scholars mention stakeholder involvement as crucial for successful ICZM (Abelshausen et al., 2015; Buono et al., 2015; Dovie, 2017; Soriani et al., 2015; Verutes et al., 2017). Abelshausen et al. (2015) propose the idea of creating a platform for more participatory ICZM, and similarly Dovie (2017) talks about a body that integrates and coordinates local interests and actors. Another reoccurring topic in the consulted ICZM literature is multi-level governance. Here, opinions about which level of governance should dominate differ. An older, but well cited paper by Shipman and Stojanovic (2007) also addresses this question ambiguously, as they state that “a policy vacuum is constraining implementation from national to local scales” (p. 375) (see also Rosendo et al., 2018). Besides this problem, they mention three other limitations to successful ICZM: unclear division of responsibilities in coastal areas, a deficit in communication between science and policymakers (see also Portman et al., 2015), and a lack of power of local stakeholders (see also Abelshausen et al., 2015).

Integrated coastal zone governance as a concept has been rarely used in the literature even though “the discussions towards more integrated coastal governance mark a relatively recent shift in policy discourse” (van Assche et al., 2020, p. 2).

2.3.2 Disaster risk reduction

The review for this body of literature is based on 25 abstracts that were most cited in the last five years. The papers barely mention uncertainty and complexity as characteristics of coastal

governance. Solely Freire et al. (2016) mention that challenges for flood risk management “are particularly complex in estuarine and coastal systems” as hazards there “interact in a dynamic socio-economic context” (p. 1705). Further, uncertainty is only mentioned in the context of how DRR action is perceived by local people (Dalimunthe, 2018).

Concerning the geographical focus, DRR studies are often set in coastal communities/ coastal regions (Bukvic, 2015; Chang et al., 2018; Costas et al., 2015; Faulkner et al., 2018; Gerkenmeier & Ratter, 2018; Haigh et al., 2018). Chang et al. (2018) indicate that these coastal communities include a range from highly urbanised cities to remote areas. Hayat (2016) studies DRR in coastal cities. According to him urban areas located at the coast are particularly vulnerable to severe damage by rising water levels and storm surges as they are characterised by high population density and economic activity (Hayat, 2016). DRR is stated as important for governance in coastal cities – to ensure that interests of the citizens stay at the heart of governance and DRR, Hayat (2016) mentions the importance of involving stakeholders. Also, other authors like González-Riancho et al. (2017) and Lei et al. (2015) argue for the importance of stakeholder involvement.

DRR literature often mentions the use of technical tools (Alberico & Petrosino, 2015; Bukvic, 2015; Espada et al., 2017; Frick-Trzebitzky et al., 2017; Haigh et al., 2018; Maanan et al., 2018; Rahman et al., 2019). Popular are especially spatial tools like GIS. However, some studies see the lack of including a social dimension as one limitation to DRR (Espada et al., 2017; Gerkenmeier & Ratter, 2018). Gerkenmeier and Ratter (2018) argue that “scientific literature calls for a shift from exclusively technical towards enhanced social processes in risk management to cope with the challenges of increased complex governance regimes” (p. 144). Nevertheless, attention to social aspects is not completely absent in DRR literature. Some suggestions on how to integrate a social dimension to technical solutions include the use of bottom-up generated information on household-specific concerns (Bukvic, 2015), institutional partnership (Haigh et al., 2018), transformation of twilight institutions (Frick-Trzebitzky et al., 2017), and social research techniques (Rahman et al., 2019).

A prominent topic in DRR of coastal areas is flood risk management (Chang et al., 2018; Espada et al., 2017; Freire et al., 2016; Frick-Trzebitzky et al., 2017; Handayani et al., 2019; Maanan et al., 2018). This might be due to floods being the hazard that results from sea level rise in coastal areas (Freire et al., 2016; Maanan et al., 2018).

Finally, the concept of governance is only seldomly addressed in the abstracts, however more information can possibly be found in the papers. Authors that talk about governance in their abstracts include Gerkenmeier and Ratter (2018), Hayat (2016), Lei et al. (2015), and Stelljes et al. (2018). This might be resulting from an overlap between the concepts of management and governance, that can be understood quite similarly to each other.

2.3.3 Climate change adaptation

The review for this body of literature is based on 27 abstracts that were most cited in the last five years. Uncertainty is usually taken into consideration in adaptive management approaches, which are part of CCA (Kuklicke & Demeritt, 2016). Kuklicke and Demeritt (2016) argue that this stands in contrast to risk-based management approaches – part of DRR – where the goal is to turn uncertainty into calculatable risks. This stands in line with the findings of the review of DRR literature and might explain, why uncertainty was not mentioned in the literature. Sea level rise raises significant uncertainties for coastal communities even though “impacts are familiar, and the nature of the phenomenon is unambiguous” (Butler et al., 2016, p. 319). Consequently, Butler et al. (2016) argue for a low-regret strategy in the governance of coastal communities, where decisions taken are resulting from confidence in planning as well as from previous experience with the consequences of sea level rise.

The application of CCA does not explicitly target urban contexts, the papers rather talk about coastal communities/ coastal zones or coastal areas (Campos et al., 2016; Gibbs, 2016; Lazarus et al., 2016; Mitchell et al., 2015; Nunn & Kumar, 2018; Schliephack & Dickinson, 2017). The literature shows that research in an US context (Butler et al., 2016; Fatorić & Seekamp, 2017; Kashem et al., 2016; Paterson et al., 2017; van der Voorn et al., 2017) and Australia (Metcalf et al., 2015; Nalau et al., 2015; Serrao-Neumann et al., 2015) is quite dominant. Furthermore, several papers conducted a theoretical research or research that is not covering a specific area (Gibbs, 2016; Lazarus et al., 2016; Mitchell et al., 2015). Even though an urban focus is not dominant in this body of literature, Paterson et al. (2017) argue that the scale of a coastal city influences its adaptive capacity and Metcalf et al. (2015) suggest that the higher populated an area is, the higher is its adaptive capacity.

In general, CCA seems to be more sensible to social change than other bodies of literature. Campos et al. (2016) state that CCA “has to go far beyond the technical dimension and take into account those affected (in the present and the future) by decisions made” (p. 537). While several papers also refer to technical solutions (Joffre et al., 2015; Lazarus et al., 2016; Torresan et al., 2016; Wamsler et al., 2016), many papers stress the social dimensions of CCA taking different perspectives, e.g. the emotional connection to a place (Amundsen, 2015), the relevance of individual and social behaviour in decision-making (Lazarus et al., 2016), societal change as a way to enhance adaptive capacity (Metcalf et al., 2015), the perception of adaptation strategies in stakeholder groups (Schliephack & Dickinson, 2017) or the impact of adaptation on cultural heritage (Fatorić & Seekamp, 2017). Accordingly, many of the methods chosen in CCA are of participatory nature (Broto et al., 2015; Campos et al., 2016; Joffre et al., 2015; van der Voorn et al., 2017).

CCA is often linked to vulnerability (Campos et al., 2016; Flannery et al., 2015; Hernández-Delgado, 2015; Kashem et al., 2016; Metcalf et al., 2015; Mitchell et al., 2015). This might also explain

the large number of results in the literature search (see Appendix A) – coastal areas are particularly vulnerable to climate change.

Like in ICZM, also in CCA there are conflicting views on how different levels of governance should interact: For instance, Flannery et al. (2015) find that higher level governance restricts local governance in terms of contextuality, while Nalau et al. (2015) criticise that local CCA is not always appropriate due to the complex multi-level governance systems in place in many countries. This is causing an “unclear division of responsibility” (Nalau et al., 2015, p. 89) which could be solved by a “greater appreciation by researcher and practitioners for the interactions between local actors and those at higher levels of governance” (Nalau et al., 2015, p. 89). This is supported by Hernández-Delgado (2015) who stresses the importance of multi-level responses for successful CCA.

2.3.4 Socio-ecological systems and socio-technical systems

The review for this body of literature is based on 34 abstracts that were most cited in the last five years. The topic of uncertainty and complexity is more dominant in this body of literature than in the others. This was expected as these concepts are part of the SES theory. Coastal areas are described as particularly vulnerable to climate change, which makes these systems highly complex and uncertain (Bradley et al., 2015; Dutra et al., 2015; Heslinga et al., 2017; Li et al., 2017; Murphy, 2015; Sheaves et al., 2016). However, in STS studies this is not as visible with the exceptions of the work of Heidkamp and Morrissey (2018) and Morrissey and Heidkamp (2018).

Further, transition studies often take an aspatial approach (Heidkamp & Morrissey, 2018). This might be a reason why it was difficult to find relevant STS literature for a coastal context. Coastal SES are influenced by various factors, transcending urban boundaries. Thinking of coastal systems from an SES perspective can hence help to link an urban area with the wider environment in which it is embedded in. Likewise, Garcia-Ayllon (2018) argues that coastal SESs are heavily influenced by various human factors like tourism, agriculture, mining, fishing or infrastructure.

SES literature is often connected to ecosystem-based management; the latter is perceived as a tool to follow ecological as well as economic interests simultaneously (Rocchi et al., 2017). It combines poverty, biodiversity and ecosystem services and hence, includes societal change in the governing of coastal systems (Scarano, 2017). This link is missing in STS literature but has been argued as an opportunity for science and policy making (Scarano, 2017). In general, different scholars stress the importance of interdisciplinarity, e.g. between natural science, engineering and social sciences (Carey et al., 2015) or across an environmental, economic, social, political, legal, and technological perspective (Sridhar et al., 2016).

Overall, an SES perspective is suggested to be important for governance of coastal areas (Heslinga et al., 2017), while at the same time effective governance is expected to maintain the functioning of SES (Dutra et al., 2015).

2.3.5 Ecosystem-based adaptation

The review for this body of literature is based on 22 abstracts, the six most cited papers and 16 most recent papers. It also takes into consideration the findings of the ecosystem perspective from the preceding chapter but lays the focus on governance.

Brink et al. (2016) conducted a literature review on urban EbA and found that research mostly looks at EbA from a biogeophysical perspective but does seldomly take social or economic values into consideration. Followingly, they find a lack of practices to manage ecological structures, respectively existing practices build on integration into institutional structures (Brink et al., 2016). The literature points to different ideas how EbA could be mainstreamed. Pasquini et al. (2013) argue that barriers for mainstreaming EbA include a lack of understanding, party politics as institutional barrier or lack of interest as socio-cultural barrier. To address these, they point towards e.g. “changing planning and other laws by which local governments operate” (p. 225). Wamsler et al. (2014) suggest that mainstreaming strategies should base on the idea that ecosystem service planning and climate change adaptation strategies reinforce each other. This could be done with strong leadership in the integration process. Also, Khan and Amelie (2015) mention leadership as relevant. Additionally, the lack of integration of different policies might hinder scalability (Scarano, 2017). Another proposition on how to mainstream EbA is to make ecological structures and their related ecosystem services more visible (Wamsler et al., 2016). Overall, it becomes clear that inter- and transdisciplinary approaches are needed to reach a better integration of EbA policies in the general policy landscape (Anderson, 2008; Peart, 2019; Pedersen Zari et al., 2020).

Many authors point towards the importance of stakeholder involvement, e.g. in the form of community engagement and local stakeholder inclusion (Carro et al., 2018; Furuta & Shimatani, 2018; Peart, 2019; Pedersen Zari et al., 2020), by including public actors also across different scales (Carro et al., 2018; Pasquini et al., 2013; Scarano, 2017; Wamsler et al., 2014) and across sectors (Capili et al., 2006; Wamsler et al., 2014), and include scientists (Anderson, 2008; Carro et al., 2018; Khan & Amelie, 2015).

Again, the divide between local and national governance becomes visible in the literature. While Carro et al. (2018), Pasquini et al. (2013), Scarano (2017), and Wamsler et al. (2014) argue for more support for local governments from national governments and Nagy et al. (2019) and Pinto et al. (2018) even call for more control on higher decision-making levels like national governments. Further, Carro et al. (2018) and Khan and Amelie (2015) stress the importance of local government capacity.

Other suggestions on how to enhance adaption by using EbA include removing institutional barriers that hamper communication (Pinto et al., 2018) or with regard to urban areas take an SES perspective to be able to put in place EbA holistically (Pedersen Zari et al., 2020).

2.3.6 Living labs in the coastal context

The concept of coastal living labs has not been applied in the literature so far, nevertheless there is a project of a living lab in connection to coastal systems that searches for solutions for building with nature (Dalvit et al., 2012; Khane et al., 2012; Pade-Khene et al., 2010). It takes a very technocratic approach; governance does not seem to be a topic. A literature search for urban living labs could provide some more relevant insights.

2.4 Summary of findings and reflections

The literature on ICZM showed that even though different elements of governance are addressed within the body of literature, e.g. stakeholder involvement (Abelshausen et al., 2015; Buono et al., 2015; Dovie, 2017; Verutes et al., 2017) or multi-level/multi-sectoral government mechanisms (Ballinger, 2015; Billé & Rochette, 2015; Portman, 2018; Rosendo et al., 2018), there is no explicit use of integrated coastal zone governance. This might be due to difficulties in the conceptualisation of management and governance – without defining both terms it can be hard to distinguish between the two. This also holds true for the other bodies of literature: In connection to coastal systems, research often speaks of management (Brink et al., 2016; Carey et al., 2015; Espada et al., 2017; Freire et al., 2016; Gerkensmeier & Ratter, 2018; González-Riancho et al., 2017; Rocchi et al., 2017). CCA seems to be an exception however, several papers speak about the influence of different governance systems in relation to adaptation (Flannery et al., 2015; Mitchell et al., 2015; Nalau et al., 2015; van der Voorn et al., 2017; Wamsler et al., 2016).

There are several topics reoccurring throughout the different bodies of literature. Stakeholder participation as a strategy to improve the governance/management of coastal systems is found relevant through all bodies of literature. Even though many papers call for more stakeholder involvement, the question of how this can be done is seldomly addressed (e.g. Boumaour et al., 2018). This leaves open questions that seem to be crucial to take into account when working from a governance perspective. Yet, it is important to mention that for the literature review only the abstracts of the papers were read; more information about how to approach stakeholder inclusion might be found in the papers.

Further, disagreement about the interplay between local, national and supranational government appears consistently in the different research areas. Particularly, a divide between the need for contextuality and the need for guidance became visible. Further research from a governance perspective should take this debate into consideration, especially because the degree of integration between different levels of governance can differ greatly across different places.

Next, the need for inter- and transdisciplinary approaches has been articulated by many authors across the bodies of literature. This not only addressed academic collaboration between social science, natural science and also engineering, but also included better collaboration between science

and practitioners, public actors and people affected by coastal governance. This also partly translated into improving the science-policy interface for a better understanding of risks in coastal areas.

Finally, also fragmentation in the policy landscape of coastal communities has been mentioned as a barrier to effective coastal governance. Policy integration between the different policies related to the different bodies of literature seems therefore crucial. Figure 1 provides an overview about which body of literature addresses the mentioned themes.

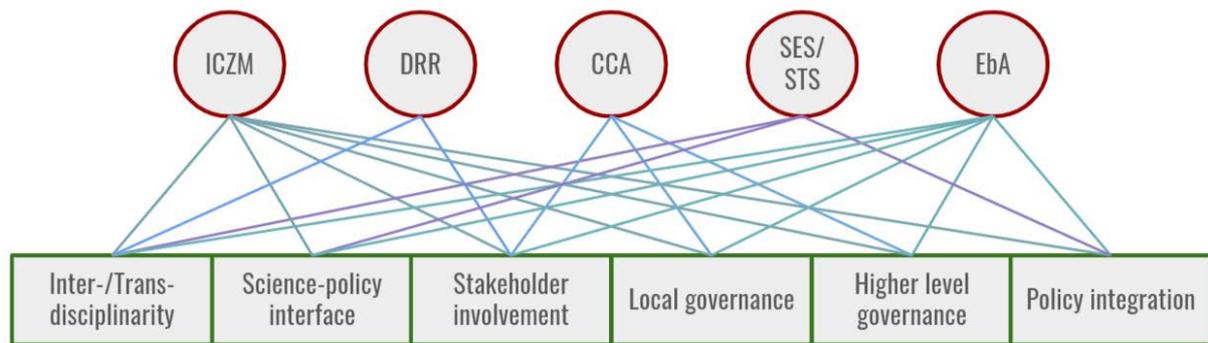


Figure 2:1 Overview of popular topics addressed by the different bodies of literature.

In general, different degrees of integration and fragmentation across the bodies of literature can be found. DRR and CCA are often linked (Bukvic, 2015; Carey et al., 2015; Espada et al., 2017; Faulkner et al., 2018; Flannery et al., 2015; Freire et al., 2016; González-Riancho et al., 2017; Kuklicke & Demeritt, 2016; Lei et al., 2015; Mitchell et al., 2015; Nalau et al., 2015; Rahman et al., 2019; Renaud et al., 2016; Torresan et al., 2016), while some connections also exist between DRR and EbA (Dalimunthe, 2018; Furuta & Shimatani, 2018; Renaud et al., 2016; Whelchel et al., 2018). Whelchel et al. (2018) address ICZM and DRR. There is also some linkage between EbA and SES literature (Pedersen Zari et al., 2020; Rocchi et al., 2017; Scarano, 2017), STS however, Scarano (2017) argues, is isolated from EbA. Even though SES/STS literature shares many concepts with DRR and CCA, the link is only made with the latter (Bradley et al., 2015; Dutra et al., 2015; Sheaves et al., 2016). ICZM is often linked to EbA (Maccarrone et al., 2015; Pittman & Armitage, 2016; Stori et al., 2019; Whelchel et al., 2018) but less so to DRR (Rosendo et al., 2018; Whelchel et al., 2018) and CCA (Flannery et al., 2015; Rosendo et al., 2018; Torresan et al., 2016). Some connections can also be found to SES literature (Garcia-Ayllon, 2018). There are also some other research fields that are often reoccurring, like (marine) spatial planning e.g. in EbA (Peart, 2019) and ICZM (Arkema & Ruckelshaus, 2017; Ballinger, 2015; Jacob et al., 2018; Khakzad et al., 2015; Papatheochari & Coccossis, 2019; Torresan et al., 2016; Verutes et al., 2017). For a visual illustration of the connections between the different bodies of literature see figure 2.

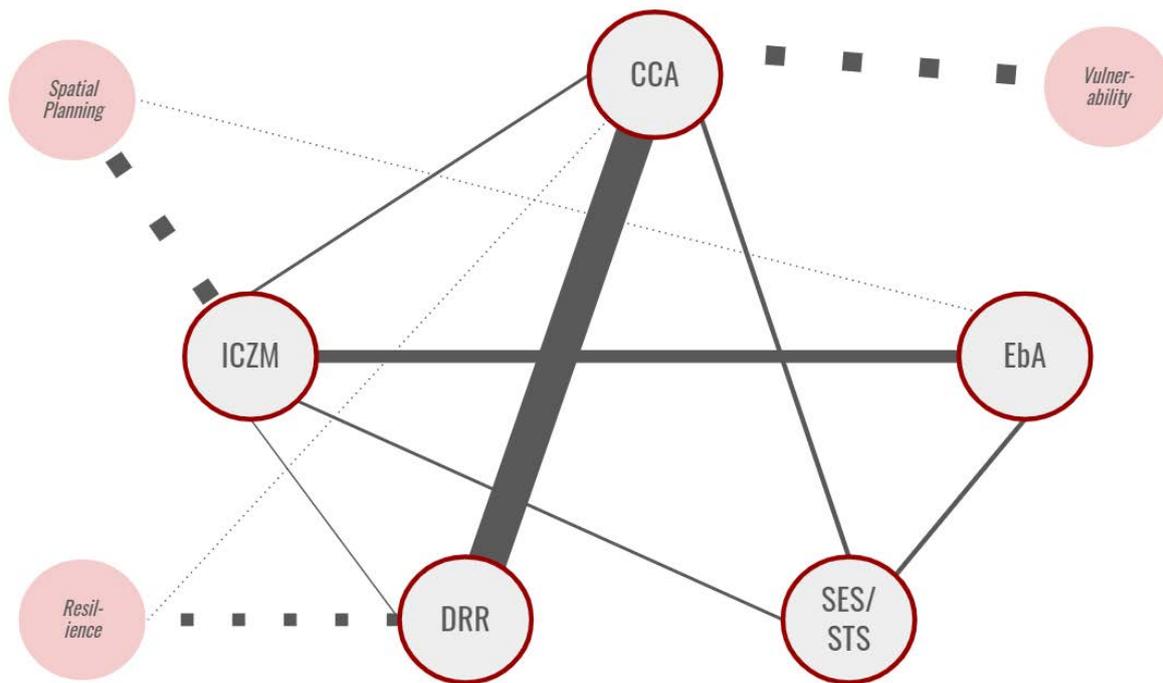


Figure 2:2 Illustration of interlinkages between the different bodies of literature.

Considering the interconnectedness between some bodies of literatures and the missing thereof between others, finding an approach to integrate all of these bodies seems useful. Many papers call for stronger interdisciplinarity (Arkema & Ruckelshaus, 2017; Carey et al., 2015; Carter et al., 2015; Le Gentil & Mongruel, 2015; Marignani et al., 2017; Mazé et al., 2017; van Dijk et al., 2016; Walsh, 2019). Accordingly, Rosendo et al. (2018) call for a better integration between ICZM, DRR and CCA literature. While CCA for instance emphasises more on social, DRR takes a more technocratic approach, and ICZM draws on spatial planning and marine spatial planning. Using insights from all these bodies of literature under the umbrella of an integrated coastal zone governance approach could help to foster interdisciplinarity in governing coastal systems.

2.5 References

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3 Chapter 3: Legal Perspective

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3.1 Introduction

This report presents the results of an extensive literature review of approximately 140 scientific articles which were analysed in order to gain an overview of the current state of the art knowledge on five predefined bodies of literature: socio-ecological and socio-technical systems (SES&STS), ecosystem-based adaptation (EbA), disaster risk reduction (DRR) and climate adaptation planning (CAP).

The research aims at investigating the different factors at play in the five bodies of literature predefined by the ENCORES proposal (descriptive aspect). Additionally, it also aims at generating suggestions for future research, which can provide input for future proceedings of the project (prescriptive aspect).

This chapter first briefly centres on methodology and the use of search terms, before presenting the research results. These results are structured in four parts: concepts that can be identified within the body of literature, constraints, conducive factors and future research. The chapter concludes with an overall conclusion, as well as general suggestions for future research.

3.2 Methodology

While governance scholars strongly distinguish between the individual bodies of literature, the distinction is somewhat artificial regarding legal doctrinal research and the corresponding literature. This leads to some overlaps between the search queries. For example, queries investigating ecosystem-based adaptation also yielded results for disaster risk reduction, and vice versa. However, the results are presented using the bodies of literature approach in order to achieve a more uniform, and thus more workable document for the overall ENCORES project. Although this report focuses on reporting on legal literature in the four fields, legal and governance-related literature often overlap. This is not only due to the lack of law-specific research in the field, but also due to the interrelatedness of the topics. Therefore, most of the literature included in this research has at least some reference to governance or governance-related principles. While it has proven to be problematic to find purely legal literature, the intertwining of the different disciplines does substantiate the need for a more comprehensive approach to governing the coastal regions.

At the onset of the research, several search terms were generated based on the ENCORES proposal and a preliminary literature review. However, these terms were partly modified during the research itself, in order to fit the bodies of literature and generate more results.

The literature research was mostly done through *WorldCat* and *Google scholar*, as these search engines can find the most important legal publications and journals available online. As the research targeted not only the most recent results (2016 – present), but also the most significant, or highly cited ones, two search queries were run per search term, in order to filter for both recent as well as overall high-ranking results. Search terms were first run on WorldCat, with a pre-selection for academic articles and peer-reviewed articles and journals. As WorldCat does not allow for a sorting according to citation index, a fair amount of trust had to be put in the search engines' ability to present the most relevant search results first. In order to not blindly have to trust this search engines, all results were run in Google Scholar for a second time. Hence, every search term was run at least four times in total.

The research employed Boolean search terms and the snowballing method. After having exhausted a search term (meaning that no more significant new results were generated), it was entered into a table and marked as completed. This resulted in a table of 35 generated search terms, and therefore 140 total search queries. Although the search terms are written down in the order that they were used, and the results were entered in the table in the order in which they were found, it is therefore not possible to link the terms to the individual search results directly. This effect is enhanced by the fact that search terms targeted at one body of literature sometimes generated results that matched another body of literature. While this shows the interconnectedness of the individual fields, it also further complicates the linking of search terms to the results generated.

The search terms, recorded in figure 1, mostly refer to the intersection of law and the specific bodies of literature that are used in the ENCORES research. An example is the term “socio-ecological systems” AND law, or “socio-ecological systems’ AND policy-making OR law”. Specific attention was also paid to the mentioning of key terms in the articles themselves. Higher citing articles often contained valuable key words that then inspired the drafting of search terms. Additionally, as previously mentioned, the results inspired the change of search terms. While working on socio-ecological systems, it became apparent that much of the past research had been done on forest ecosystems. As the present research centres around coastal (eco) systems, forests were excluded to make the research more relevant.

Another example of this is the overlap with governance. As mentioned, the literature on law is very interwoven with the literature on governance. In order to find results that were more related to law than governance, control searches were run that excluded governance (e.g. "ecosystem-based adaptation" AND policy NO governance). However, this again confirmed the previously mentioned impression that most of the literature contained at least some elements from governance, meaning that it was difficult to find literature related exclusively to legislation or law.

Socio-ecological systems	socio technical-systems	ecosystem based adaptation	Climate adaptation	Disaster Risk Reduction	Water
"socio-ecological systems" AND law	"socio-technical systems" AND law	"ecosystem-based adaptation"AND law	kw:("climate") AND ti:(adaptation) AND au:(law)	ti:("Disaster risk reduction") AND ti:(Law)	"adaptation"AND coast lines AND legislation
"socio-ecological systems" AND policy	"socio-technical systems" AND policy	"ecosystem-based adaptation"AND law NO forest	kw:("climate") AND ti:(adaptation) AND au:(policy)	ti:("Disaster risk reduction") AND ti:(Netherlands)	"adaptation" AND water AND legislation AND coast -governance
"socio-ecological systems" AND "policy-making"	"socio-technical systems" AND "policy-making"	"ecosystem-based adaptation"AND policy NO governance	kw:("climate") AND ti:(legislation) AND au:(adaptation)	ti:("Disaster risk reduction") AND ti:(policy)	climate adaptation AND water AND legislation
"socio-ecological systems" AND adaptation	"socio-technical systems" AND adaptation AND water	"ecosystem-based adaptation"AND policy AND stakeholders	kw:("climate change") AND ti:(adaptation) AND law AND Netherlands	ti:("Disaster risk reduction") AND kw:(law) AND coast	kw:("water") AND ti:(adaptation) AND ti:(implementation)
"socio-ecological systems" AND governance	"socio-technical systems" AND flood AND governance	"ecosystem-based adaptation"AND policy AND implementation	kw:("climate change") AND ti:(adaptation) AND law AND planning	ti:("Disaster risk") AND kw:(legislation)	
	socio-technical systems AND coastal AND governance	"ecosystem-based"AND "adaptation"AND legislation	kw:("climate change") AND ti:(adaptation) AND law AND challenges		Temperature
			kw:("climate change") AND ti:(policy) AND ti:(implementation)		kw:("temperature") AND ti:(adaptation) AND ti:(climate change) AND law
			kw:("climate change") AND ti:(law) AND ti:(coast)		

Figure 3:1 Search terms.

The search terms were run on both the title as well as key words within the article. Especially the terms in the field of disaster risk reduction make that explicit, as the table presents the exact search query, instead of merely the keywords used. The choice on whether to include an article in the findings was made based on the abstract as well as a short read-through of the article itself. Articles were also read quickly (beyond the abstract and the conclusions) to ensure that they did indeed fit the chosen topic. Regarding older, highly cited articles, an amount of 150 or more citations was deemed necessary to include an article in the results. This was mainly based on the experience during the preliminary research in which it became apparent that articles were either barely cited or more than 150/200 times. However, as some fields were not as highly researched as others, fewer cited articles were also included. This is especially applicable in the field of ecosystem-based adaptation, as not much literature could be found on this subject in general, and with relation to law.

The results generated by the search queries explained above were included in an excel sheet and were assigned specific key words. These key words were based partly on the key words provided by the authors, and partly on key words generated after reading the abstracts and conclusion (as well as the entire paper, in most cases). On the base of these keywords, clusters of literature were made (where possible) within the individual bodies of literature that are presented below. Grouping the results into these clusters not only increases the readability and accessibility of the overall report but allows for an easier comparison of the results.

The clusters (marked in bold) are structured on the basis of four different topics within the body of literature: **predominant concepts that can be found in the body of literature, conducive factors, that can increase the effectiveness of measures within the specific fields, constraints or hindering factors, that hinder the effectiveness of measures within a specific field and suggestions for future research.** These miscellaneous concepts do not fit within the main clusters but appear to be important in the respective bodies of literature. Hence, they were included in the search results, in order to give a complete overview of the bodies of literature and generate more suggestions for future research.

3.3 Ecosystem-based adaptation (EbA)

3.3.1 Concepts

Ecosystem-based adaptation was the body of literature that yielded the least results. Due to this, clear clusters of concepts can be identified throughout the literature rather easily. These are mixing policies (Scarano, 2017), mainstreaming of different policies (Sierra-Corea & Kintz, 2015; Wamsler & Pauleit, 2016; Wamsler et al., 2014) and integrated governance approaches (Scarano, 2017; Kabisch et al. 2016; Filho et al. 2018).

As **mainstreaming** appeared to be the predominant concept in that body of literature, an overview of how mainstreaming is conceptualized in the literature and the benefits that it potentially offers needs to be made. Mainstreaming, in general is the idea of integrating policies from one field into already existing policies, and combining policies from different sectors, to achieve effective results (Scarano, 2017). In EbA, mainstreaming appears to not only be linked beneficially to policy effectiveness, but also to increased acceptance and long-term funding (McVittie et al., 2018; Sierra-Corea & Kintz, 2015). Therefore, mainstreaming policies has more benefits than the acceptance of the policies itself.

Additionally, it has been suggested that “systematic mainstreaming of sustainability issues is a promising avenue for initiating and promoting sustainable transitions” and that the potential to bridge gaps with socio-technical research and practices ought to be considered as well (Wamsler et al., 2014). However, mainstreaming can be difficult, therefore, it has been shown that previous experience in mainstreaming in other sectors can increase the efficiency of EbA mainstreaming as well (Wamsler & Pauleit, 2016).

3.3.2 Conducive factors

The literature identifies a few conducive factors, that are closely related to the constraints previously mentioned. First, **stakeholder involvement** can mitigate some of the constraints identified. (McVittie, Cole & Wreford, 2018; Langlet & Rayfuse (Ch. 5), 2019). This is closely linked to a deliberative

style of democracy and deliberative institutions (Woolley, 2014). Second, **strong leadership** on a local level can be beneficial, as it mitigates the lack of structure and coherence of efforts on a higher governance level (Wamsler et al., 2014). Third, it has also been mentioned that **nodal governance** might lead to more interconnectedness and EbA efforts (Ziervogel et al., 2017). Lastly, the literature stressed the **ecosystem-centred approaches**, as it should be “essential that processes are oriented towards the protection of the health of ecosystems” (Woolley, 2014). Herein, legal systems must be designed flexibly to handle changing conditions and adapt accordingly (Gipperth & Elmgren, 2005). Feedback mechanisms can serve as important tools to guarantee that legal measures remain adequate to protect the ever-changing ecosystems.

3.3.3 Constraints

The most important constraints that have been recognized are **institutional constraints** (Lukasiewicz et al., 2016), meaning that they are related to the institutions involved in policy making and execution. These do not only relate to property rights and social norms, but also to institutional instability, fragmentation, as well as knowledge constraints (Nalau et al., 2018) and a resulting resistance to incorporate environmental criteria into policymaking (Woolley, 2014). Capacity (financial and human resources) also plays a role here (Wamsler et al., 2020). Additionally, the lack of citizen and community participation (and thus **stakeholder involvement**) have also been mentioned as a constraint (Wamsler et al., 2020).

3.3.4 Future research

Three suggestions for future research were made. These include the need for stronger evidence of **nature-based solutions**, the interconnectedness with **socio-environmental justice** and social cohesion as well as potential linkages and the connection with **climate policy and mitigation** (Kabisch et al. 2016). Additionally, a more systematic overview that goes beyond individual case studies appears to be necessary (Brinks et al., 2016).

3.4 Socio-ecological and socio-technical systems (SES & STS)

3.4.1 Concepts

The literature in this category yielded more results, which makes the distinction of few general concepts more difficult. The most important concepts within socio-ecological and socio-technical systems center around adaptation, resilience and robustness, vulnerability and adaptability, cooperation as well as transformative and multi-level governance. It is notable that most of the literature found centered on SES, and excludes STS

Regarding **adaptation**, the terms adaptation and transformation (Barnes & Nel, 2017), as well as flexibility (Kundis Craig et al., 2018), stability (Kundis Craig et al., 2017; Kundis Craig et al., 2018) and

adaptive capacity/ adaptive governance (Angeler et al., 2019; Folke et al., 2016; Cosens et al., 2017) seem to play an important role.

Resilience (Adger et al., 2005, Gersonius et al., 2016, Nelson & Brown, 2007) and **robustness** are conceptualized as the “capacity to cope with uncertainty and surprise” (Gersonius et al., 2016) and are closely related to the resistance of SES as well (Capano & Woo, 2017). However, attention needs to be paid to excessive robustness / rigidity, as this can hamper the success of measures (Gunderson et al., 2018). It appears as if a balance needs to be struck between adaptability on the one hand, but also a certain robustness on the other hand. However, it is unclear how this balance is exactly conceptualized. Additionally, the concepts of (ecological) vulnerability and adaptability appear to be related to resilience (Young et al., 2006) and therefore need to be considered when researching SES.

Similar to EbA, **cooperation** (between sectors and scientific domains) appears to play an important role (Dutra et al., 2015). Especially integrated knowledge (for example through so-called knowledge-policy interfaces) can be a way to meaningfully incorporate knowledge from different sectors (Puente et al., 2015). Social learning (Evers et al., 2016) and socio-political links (Armitage et al., 2009) as well as the alignment of different perspectives and stakeholders (Roelich & Giesenkamp, 2019) can also be ways to integrate knowledge and use existing resources efficiently. Additionally, again like the literature on EbA, stakeholder participation and transformative governance (governance that spans multiple levels and transcends institutional boundaries) seem to play an important role (Chaffin et al., 2016; Gersonius et al., 2016; Folke et al., 2011)

Some articles also mentioned different miscellaneous concepts. Although no direct link is visible, the different concepts seem to somehow connect to the main concepts of e.g. stakeholder involvement and should therefore be kept in mind when pursuing research on these main concepts. The miscellaneous concepts include the connection to social systems (Folke et al., 2016), leadership (Dutra et al., 2015) as well as “time, trust and interdependence” (Ansell et al., 2008). Trust, for example, can be influenced by face-to face dialogue, which might also influence the relation with stakeholders, and thus increase the likelihood of policy acceptance.

3.4.2 Conducive factors

Three conducive factors can be identified from the literature. These are deliberation and stakeholder involvement, adaptive management/governance and robustness/ resilience.

Deliberation and stakeholder involvement are related to both open and closed deliberation processes to create awareness (van Putten et al., 2016), the inclusion of stakeholders (Sijtsma et al., 2019, Lebel et al., 2006) and participatory processes (Kundis Craig et al., 2017; Valve, 2018). Open deliberation processes, for example, can take local needs into account, which then influence the

outcomes (van Putten et al., 2016). Additionally, joint social learning and the combination of various sources of knowledge appears to play a role as well (Gersonius et al., 2016; Olsson et al., 2004).

Adaptive management and governance are able to create more effective policy responses (through adaptive management, anticipatory governance and co-management) which is also more cost-efficient. (Hulbert & Gupta, 2016). The role of law herein is to accommodate flexible and adaptive governance (Cosens et al., 2018) that also legitimizes government measures. Additionally, flexible governance, and ultimately should also be connected to the biosphere (Folke et al., 2011; Garmestani et al., 2019). Herein, the connection with ecosystem-based adaptation is visible.

Robustness and resilience, especially robustness, appear to play an important role when assessing socio-economic systems, and seem to be related to the success of measures. However, it is unclear which one of the two concepts should be used to assess measures, as some authors focus more on robustness (e.g. Capani & Woo, 2017). Here, ecological resilience and social benefits appear to be interlinked and should be matched (Sapkota et al., 2019) and factors such as resilience and vulnerability of the ecological system need to be considered in more detail (Waylen et al., 2019).

3.4.3 Constraints

Two main constraints can be identified from the literature. These are monitoring and fragmentation. **Monitoring** (and the lack of it) seems to be related to lack of political support as well as ongoing long-term funding (Waylen et al., 2019; Buono et al., 2015). **Fragmentation** appears to be related to the different stakeholders that are involved in the process and their often-conflicting interests (Ariza, Pons & Breton, 2016; Hulbert & Gupta 2016) as well as directional shifts of policy leaders (Gunderson et al., 2018). Fragmentation is seen as a constraint, as it hinders both effective policymaking and, more importantly, successful implementation. Additionally, awareness for parts of the community that are not automatically involved as well as the overall institutional design needs to be given (Sapkota et al., 2019), as these factors can constrain successful implementation measures. Constraints in changing the existing institutional design have been identified, the awareness of which can contribute to more successful policy making as well (Gersonius et al., 2016).

3.4.4 Future research

Only few direct suggestions for future research have been identified. These center on empirical research on **the relationships between agents and stakeholders** (Borras & Edler, 2014), as well as legitimacy of measures (Borras & Edler, 2014). Additionally, research should go beyond the traditional financial and political pitfalls, to establish a **comprehensive framework** (Triyanti & Chu, 2018). Especially the suggestion on legitimacy is interesting, as this is usually closely related to stakeholder involvement, which seems to play an important role in the management and governance of SES and

policymaking in this domain. Additionally, Garmestani et al. (2019) argue that policymakers should be more aware of the ongoing **underlying SES**.

3.5 Disaster risk reduction (DRR)

3.5.1 Concepts

The field of disaster risk reduction allows for the distinction of two distinct main concepts, as well as multiple miscellaneous terms that have appeared throughout the literature. First, **collaboration** appears to play an important role. This does not only include the collaboration of different levels of the administrative through inter municipal planning (van Popering-Verkerk et al., 2017; Söderholm et al., 2018), but also the sharing of information (Vernier & Capone, 2019) and the integration of different domains, such as science and policy making (Whelchel, et al., 2018). Disaster representation in the UN, for example, shows that there are (albeit limited) possibilities to conceptualize disasters in a holistic way. These are, however, currently limited as the UN focuses more on the protection of people from hazards and the mitigation of consequences, than the underlying factors that cause the hazards (Berg & de Majo, 2017). Hence, an overall, more radical holism could be beneficial. This relates also to the idea of a 'single official voice' proposed by Silingardi & Samuel (2019). The authors argue that effective DRR can be improved by having a 'single official voice' (either horizontally or vertically) that informs the public of decisions made. The authors link this single official voice to the coherence of "DRR law, policy and practice" as well as early warning systems.

Second, focusing on **local resources, awareness and involvement** seems to be conducive to effective DRR policies (Setten & Lein, 2019; Whelchel et al., 2018; Bracken et al., 2016; Eburn et al., 2019; Sudmeier-Rieux et al., 2016).

Next to the clusters, multiple miscellaneous terms can be identified, that cannot be easily grouped together. One of these is adaptiveness (Bracken et al., 2016). Additionally, concepts such as mitigation (Sudmeier-Rieux et al., 2016), public health (Kundis Craig, 2018) and the management of natural resources (Sudmeier-Rieux et al., 2016) seem to be related to the field of DRR. This shows that this field cannot be seen as isolated. From a legal point of view, it is also interesting that the concept of legitimacy has been mentioned (Hartman & Spit, 2016), as well as the relationship to human rights (Hesselman, 2019).

Additionally, a brief criticism on existing frameworks focuses mostly on governance and institutions, as well as governance and accountability, so it appears as if these concepts also play a role, but ought to be expanded upon (Almutairi et al., 2020; Raju & Da Costa, 2020).

3.5.2 Conducive factors

Three major conducive factors can be identified in the area of disaster risk reduction. The first one is **holism**, or an overall, integrative approach. An example of a good holistic cooperation is the Regional Seas Programme, which should be used as a model for other governance approaches (Cubie, 2019). Structurally speaking, inter-municipal planning can contribute to a more holistic approach (Kvalvik & Robertsen, 2017).

Additionally, **local stakeholder involvement** seems to be one of the key conducive factors (Hegger et al., 2016). While research in the Netherlands shows that mechanisms for stakeholder participation, legitimacy and accountability are enshrined in the legal system, “public participation tends to be limited” (Kaufman et al., 2015). Stakeholder involvement appears to influence community preparedness and meaningful local action (Kerstholt et al., 2017; Eburn et al., 2019). Additionally, local knowledge is pivotal in emergency situations and should be heard. This can be facilitated by so-called “bridging institutional agreements” (Setten & Lein, 2017). Gilissen et al., (2016) argue that especially in countries with low flood risk management, tailor-made solutions that take local level needs into account but are steered by national authorities can be beneficial to effective DRR measures.

Thirdly, **policy integration** appears to be a vital conducive factor. This does not only include the inclusion of DRR into climate change policy (Kelman, 2017), but also into human rights approaches (Hesselman, 2019), spatial planning (Wiyaya et al., 2017) ecosystem-based approaches (Faivre et al., 2018) as well as the development process of policies (Amaratunga et al., 2017). When it comes to integration, however, praxis-based preparedness seems to be important for the success of any measure (De Majo & Olsson, 2019). Bridging mechanisms can also play an important role in countering the fragmentation of policy approaches (Gilissen et al., 2016).

Miscellaneous concepts, also related to stakeholder involvement, include risk-communication (Silingardi & Samuel, 2019; Vernier et al., 2019), mitigation (Sudmeier-Rieux et al., 2016) and public-health constraints (Kundis Craig, 2018).

3.5.3 Constraints

The constraints identified can be linked to the conducive factors mentioned in the previous sector. Gonzales Riancho et al. (2017) identify the **lack of coordination** and as well as the lack of effective risk communication strategies that include stakeholders “as one of the major factors that can hinder effective DRR. Additionally, including local communities and stakeholders insufficiently (Bracken et al., 2016) appears to a vital constraint. Vink et al. (2014) point out that especially vulnerable groups within society, such as children, older adults or minorities, are often insufficiently addressed and supported on all levels of flood risk management law- and local policymaking. Grounding DRR

insufficiently in other areas of international law also appears to pose a challenge to the success of DRR efforts (Kelman, 2017)

3.5.4 Future research

Suggestions for future research mainly center on three gaps at governance level. These are knowledge gaps, institutional gaps and strategic gaps (Albris et al., 2020). Additionally, **accountability** issues are addressed (Raju & Da Costa 2018). Moreover, **personal connections** with citizens and communicating risks to them appears to be an interesting field for further research (Kerstholt et al., 2017). Especially the accommodation of the needs of vulnerable stakeholders needs to be considered in this regard (Vink & Takeuchi, 2013). These vulnerable stakeholders should also be included in the process of establishing rights, in order to guarantee that their rights are respected and considered adequately in law-making (Vink, 2014). Lastly, it appears as if little direct research on the relationship between **DRR and the law** has been made. Hence, future research in this area appears necessary (Aronsson et al., 2019).

3.6 Climate adaptation planning (CAP)

3.6.1 Concepts

The most noticeable fact regarding the field of climate adaptation planning is that there seems to be the least amount of consensus compared to the other bodies of literature. Consequently, there are multiple, often diverging concepts that can be identified. The most prominent concepts are stakeholder involvement, policy integration and interdisciplinarity, adaptation, mainstreaming and the involvement of local level stakeholders and administrators. Adaptation to climate change has been characterized as complex and uncertain (Huntjens et al., 2012) and it is therefore unsurprising that multiple, intertwining factors are at play in this area.

Stakeholder involvement can take place through citizen involvement (Brink & Wamsler, 2018), individual and collective action (Knieling & Kindworth, 2016) as well as participation in adaptation efforts managed by the government (Runhaar et al., 2016). Social networks can play a role in this process (Calliari et al., 2019). It is visible herein that both individual and collective interests need to be considered and accounted for (Knieling & Kindwort, 2016). Participation can either be bottom-up or top-down (Urwin & Jordan, 2008; Dai et al., 2018). Especially in the Netherlands, stakeholder involvement is important due to the division of public and private responsibilities under, amongst others, the Dutch water act (Runhaar et al., 2016).

Policy integration (Sorensen et al., 2018) and interdisciplinarity (Auerswald et al., 2011) refer to integration of adaptation planning measures in other policy domains. This is closely related to the phenomenon of mainstreaming mentioned in the literature on ecosystem-based adaptation (e.g.

Dovers & Hezri, 2010; Runhaar et al., 2019; Tanner et al., 2019). Again, bridging mechanisms can play an important role here, as these mechanisms counter fragmentation and lead to more coherent policies (Gilissen et al., 2016).

Additionally, this concept seems to be linked with the concept of **transformative governance** (Bosomworth, 2018). In this, local-level authorities seem to play an important role (Klein et al., 2017). Local-level involvement appears to be targeted towards the coordination of local and regional strategies (Antonson et al. 2016) and the coordination of local and regional efforts. (Pinto et al., 2018; Huitema et al., 2018). Herein, taking measures on a local level appears to be preferred, however, they must be integrated in a broader context. This is especially relevant, as climate change impacts different regions in a different way (Verschuuren et al., 2013).

A link has also been made with **adaptation and mitigation** efforts. Goepfert et al (2019) coined the term “adaptigation”, or the interplay of adaptation and mitigation efforts with regards to these concepts. Others see the two as more separate concepts (Fleig et al., 2017; Berrand-Ford et al., 2019) that are assessed and evaluated individually (Alves et al., 2020). Again, a link has been made with transformative governance (Hölscher et al., 2019) as well as socio-economic systems (Keessen, 2018).

It is interesting that most of the literature focuses on the effectiveness of measures, and less on “legally relevant” concepts and principles. Specific legal concepts that appear throughout the literature appear to be awareness of measures and issues, their appropriateness and their explicitness, as well as transparency and legitimacy of measures (Gilissen et al., 2017). The principles of effectiveness and equity also factor into this process (Adger et al., 2004). It is interesting to note that legitimacy is defined in different ways (e.g. as good governance, as flexibility, learning and governance capacity (van Buuren et al., 2014). Therefore, attention needs to be paid to the fundamental concepts and their definition, before assessing measures themselves. Additionally, the connection to administrative traditions (Klein & Juhola, 2018) and institutional logic (Bosomworth, 2018) and the influence of these traditions on policy implementation might be important concepts that needs to be considered.

It is noticeable, however, that the last concepts only appear individually throughout the literature and cannot be clustered easily. However, they might be important from a legal point of view. Additionally, it has been mentioned that the Dutch approach of soft law policy might be insufficient to achieve effective adaptation efforts (Kamperman & Biesbroek, 2017). The need for possibly hard law or financial incentives is therefore stressed (Kundis Craig, 2019).

3.6.2 Conducive factors

Five main conducive factors can be identified regarding CAP planning. However, it is noticeable that many of the concepts are not as far-developed as in the other bodies. These are resilience, mainstreaming, stakeholder involvement, transformative governance and interdisciplinarity/integration.

Resilience is mainly related to adaptation and the accommodation to necessary changes in a sustainable fashion (Saledi et al., 2019).

Mainstreaming efforts ought to be systematic in order to contribute to successful CAP (Brink & Wamsler, 2018; Tanner et al., 2019).

Stakeholder involvement has emerged as one of the main conducive factors in both adaptation and mitigation measures (Goepfert et al., 2019). Especially regarding adaptation to changing amounts of precipitation due to climate change, research has shown that stakeholder involvement should not be approached haphazardly. Stakeholder involvement can, for example, run counter to traditional administrative measures, such as transparency (van Buuren et al., 2019), if employed incorrectly. Additionally, too broad stakeholder involvement can create deadlocks and fragmentation in the implementation process, which ought to be avoided (Margerum & Robinson, 2015). Stakeholder involvement should be transparent, and responsibilities should be divided transparently and comprehensively (Runhaar et al., 2016). Additionally, pro-active engagement is important (Brink & Wamsler, 2018), and participation should be promoted “cross sectors and scales”, leading to effective, co-creating relationships between on the one hand the administrator, and on the other hand, various stakeholders (Wenta et al., 2019; van Buuren et al., 2019). Moreover, a link to nature-based approaches is also visible (Brink & Wamsler, 2018).

The concept of **transformative governance** appears to be linked to the enabling of mitigation and adaptation of climate change, while achieving sustainability and resilience in the long term (Hölscher et al., 2019). It has been argued that policy entrepreneurship can contribute to bridging different institutional sectors in order to address complex problems (Faling et al., 2019). However, issues regarding competition, trust and authority need to be considered when engaging in such bridging processes.

Lastly, **interdisciplinarity** is one of the few factors where law is directly mentioned. On the one hand, measures should include different fields of law (Bosomworth, 2019), on the other, they should also be integrated within both international and national law. Taking the adaptation to precipitation as an example, this relates back to a “governance network” with multisector needs and multi-level actors (thus, both horizontal and vertical integration of stakeholders and the

administrative) that consider the different applicable frameworks in a long-term approach (Tortajada, 2016).

3.6.3 Constraints

The constraints that could be identified most clearly are all linked to features of the administrator (**administrative constraints**). A lack of leadership and information, and miscoordination, for example, can hamper adaptation efforts (Moser & Ekstrom, 2010; Calliari, et al., 2019). This fits into the idea of a problem that needs to be addressed in an interconnected way. Moreover, limited horizontal interactions, administrative fundamental values and beliefs and unpreparedness for mainstreaming and cross-sector and cross-level cooperation can contribute to this phenomenon. Trust within the organization of the state and institutions also plays an important role (Termeer & van den Brink, 2013). Fundamental values and beliefs do not only relate to the values of the administrator, but also the reasons that underlie adaptation measures (Adger et al., 2009). Herein, the lack of resources as well the level of knowledge which administrators have also plays an important role (Simonet & Leser, 2019; Biesbroek et al., 2011). Additionally, whether formal and informal institutions match each other in their workings can influence the success of adaptation measures (Williams, 2011).

When it comes to resilience of communities, which also seems to play an important role, **underlying risk factors** such as gender, ethnicity or land ownership also come into play and should be considered when taking adaptive measures (Saledi et al., 2019).

Another factor, with regards to mitigation, however, has been mentioned, the so-called **crowding out effect**. According to this theory, mitigation of one country can reduce efforts by other countries (Auerswald, Konrad & Thum, 2011). Although this appears unrelated, such theories should not be rejected immediately, as mainstreaming of adaptive measures, and thus the integration within mitigation and other policy domains has proven to be very beneficial. Lastly, the **complexity and uncertainty** of climate change itself appears to influence the success of adaptation measures (Huntjens et al., 2012). This uncertainty relates to future costs, but also to benefits that arise from taking adaptation measures (Biesbroek et al., 2011).

3.6.4 Future research

The literature gives various direct suggestions for future research. Next to research in the concepts mentioned above and how they are directly interrelated, future research should then also focus on **comparative adaptation research** (Lebowski et al., 2019), as different countries use different adaptation strategies, which makes it difficult to focus on specific types of policy. Other authors argue that more explicit definitions and a unified framework of adaptation research should be found to make

better syntheses and policy recommendations (Runhaar et al., 2018). Additionally, the options available for **public institutions** should be investigated in more detail (McGuire, 2011).

3.7 Summary of findings and reflections

This report presents an overview of the factors and concepts that are at play in the bodies of literature on ecosystem-based adaptation, disaster risk reduction, socio-ecological and socio-technical systems and climate adaptation planning. These concepts were drawn from the analysis of the abstracts (and main texts) of roughly 140 scientific articles, and are grouped in clusters of concepts, as well as miscellaneous concepts that were in play in each body of literature. Multiple main concepts, conducive factors, constraints and suggestions for future research could be identified in each of the four bodies of literature. These results are also summarized in a tabular overview in figure 2 (the miscellaneous concepts are omitted from this table for the sake of clarity).

Regarding ecosystem-based adaptation, mainstreaming, mixing policies and integrated governance seem to be important concepts. Herein, stakeholder involvement, strong leadership, nodal governance and ecosystem-centred approaches appear to be conducive. Lack of citizen involvement and institutional challenges were identified as constraints in this area.

In the field of socio-ecological and socio-technical systems, multiple main concepts can be identified. However, these are mostly related to SES, as the information on socio-technical systems is scarce. These are adaptation, resilience and robustness, vulnerability and adaptability, cooperation and transformative governance. Stakeholder involvement, adaptive management and robustness and resilience act as main conducive factors that can enhance the success of measures. Monitoring and fragmentation are the two main constraints in this field.

In the field of disaster risk reduction, three main concepts can be identified: collaboration and local resources, awareness and involvement. Using a holistic approach, involving stakeholders and integrating policies seem to be conducive to successful disaster risk reduction. The constraints are directly opposite to these benefits, as a lack of coordination of measures and insufficient or inadequate stakeholder involvement can hamper disaster risk reduction efforts.

The field of climate adaptation planning appears to be the most diverse, which makes it more difficult to identify clear concepts. Stakeholder involvement, policy integration, transformative governance, as well as adaptation and mitigation appear to play an important role. However, other miscellaneous concepts are very much interrelated in this field. The main conducive factors are resilience, mainstreaming, stakeholder involvement, transformative governance and interdisciplinarity. Constraints are related to these conducive factors, as they include administrative

constraints, the complexity and uncertainty of the problem, the relationship to mitigation and pre-existing risk factors.

	EbA	SES & STS	DRR	CAP
Concepts	Mainstreaming, mixing policies, integrated governance	Adaptation, resilience & robustness, vulnerability & adaptability, cooperation, transformative governance	Collaboration, focusing on local resources, awareness and involvement + miscellaneous	Stakeholder involvement, policy integration and interdisciplinarity , adaptation, mainstreaming, local-level involvement
Conducive	Stakeholder involvement, strong leadership, nodal governance, ecosystem-based approaches	Stakeholder involvement, adaptive management, robustness & resilience	Holism, local stakeholder involvement, policy integration (+ miscellaneous), Bridging agreements	Resilience, mainstreaming, stakeholder involvement, transformative governance, interdisciplinarity , Bridging agreements
Constraints	Lack of citizen involvement, institutional challenges	Monitoring, fragmentation	Lack coordination, local inclusion and grounding DRR in international law insufficiently	Administrative constraints, lack of trust & coordination, uncertainty, underlying risk factors, crowding out,
Future Research	Nature-based solutions, socio-environmental justice, climate policy and mitigation	Relation agents & stakeholders, comprehensive framework, underlying SES	Institutional Gaps, citizen involvement, accountability & relation with law	Public institutions and comparative adaptation research

Table 3:1 Tabular overview research results (main concepts).

The research that has been conducted over the past months also identifies multiple points for future research. Next to the specific focus points within each body of literature, the interrelatedness between the different bodies should be researched in more detail. The report has also made apparent that law-specific literature seems to be lacking. Although specific concepts are mentioned, for example legitimacy, it is unclear how they are conceptualized from a legal (for example constitutional law) point of view. Here, the literature review should also be conducted in the separate languages of the individual countries, in order to get a clear overview of the applicable national law. This is also important as the findings show the importance of tailor-made solutions to national contexts. Additionally, especially with regards to climate adaptation planning, the literature seems to be

fragmented, and it is difficult to identify main concepts and lines of thoughts. Systematization of the literature therefore appears necessary. This is another point that research could focus on in later stages.

Overall, the findings point towards a close interrelatedness between the different bodies of literature, which has not been researched yet. This points towards the need for a more comprehensive framework and supports the aim of the ENCORES project.

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Conclusion

The presented literature review was conducted in order to support the ENCORES proposal through a holistic review on the state-of-the-art literature on coastal resilience against hazards. The findings give an indication for further research within the scope of the ENCORES project. The literature review was conducted from three different perspectives (Ecosystems & Economics, Governance and Legal Research) and across six different bodies of literature (integrated coastal zone management (and governance), ecosystem-based adaptation, socio ecological systems, socio-technical systems, disaster risk reduction and climate adaptation planning/climate change adaptation).

The literature review shows that similar factors regarding coastal resilience seem to be at play from all the perspectives investigated in this research.

The first similarity between the Ecosystems & Economics and the legal perspective is the importance of cost-effectiveness. However, more data needs to be collected regarding cost-effectiveness to make valuable and complete conclusions, and this data gathering should also include the social costs of coastal resilience measures. In the governance perspective, cost-effectiveness did not play a dominant role and was barely mentioned.

Second, the research shows that measures should be appropriate to the local context. Tailor-made solutions might be a way to fulfil this need for local adaptation. However, some literature also mentions the effectiveness of general approaches for coastal resilience, so more research into this topic is necessary. Especially concerning governance, there appears to be conflicting opinions on the effectiveness between local and higher-level governance. This relationship needs to be addressed in more detail in future research, as there are arguments for both the effectiveness of local as well as higher-level approaches, deeper insights into this relationship can thus, help to guide successful coastal resilience.

This is also connected with the third important point of focus: stakeholder participation. All three perspectives demonstrate that stakeholder participation is important and should not be neglected when taking measures to increase coastal resilience. Specifically, the timing of stakeholder engagement and the way in which this is done are crucial to its success. Stakeholder involvement should therefore be approached with careful consideration, and more research needs to be conducted to create guidelines for how stakeholders can be incorporated into the process of coastal resilience projects.

Fourth, the collaboration of different research disciplines appears to be conducive to the success of measures to increase coastal resilience. Both the concepts of integration and mainstreaming of policies have been mentioned throughout the literature. Additionally, science-policy interfaces, and the involvement of scientists in policy making appear to be a way to increase the effectiveness of

policies. However, it is unclear how law-making factors into this process. Most of the literature focuses on governance and policies, and little is mentioned on “hard” law. This is therefore a point for consideration in future research.

Finally, the literature review shows that the bodies of literature in themselves, but also from an overall viewpoint, are fragmented. While some connections can be made in-between disciplines, other concepts appear to be completely different. Whether this fragmentation is due to under-researching of a specific body of literature (e.g. in the case of climate adaptation planning), or due to the lack of interdisciplinary research is unclear. Nevertheless, the literature reviewed suggests that policy integration and integration of different disciplines can support a more holistic approach to coastal adaptation.

Nevertheless, there are some limitations to the literature review conducted that need to be considered for further research. First, the knowledge provided is only based on the information given in the abstracts of the consulted papers. Even though this approach allowed us to review a large quantity of material in a structured manner, some important information might have been lost by only taking the abstracts into consideration. Like this, we were able to provide a general overview of the topics addressed, however the input lacks some in-depth understanding of how our findings are treated in the actual research. Due to time-constraints, combining both approaches were not possible. Therefore, future research should focus on an in-depth reading of scholarly literature, as well as practical review of their application to the coastlines under study.

Second, all three perspectives used different methodologies. While the Ecosystem & Economics perspective and the Governance perspective used a similar set of keywords as well as the same search engine (Scopus). For the legal perspective however, Google Scholar was used to conduct the literature review. Different methodologies might negatively influence the comparability of our results. This way, not only key words and number of articles included in the literature review varied but also the decision whether to focus on the most recent articles or the most cited ones. However, by using different methodologies, we were able to consult a more diverse set of articles compared to the results we would have received by using the same methodology.

Third, the language of this research also limits its scope. This is especially relevant for the legal perspective. As much research in the Netherlands has been done in the national context, many of the articles written on Dutch law are in Dutch. While this was taken into consideration in the field of Climate Adaptation planning (especially relating the adaptation to changing levels of precipitation) the limited time frame in which this research was conducted did not allow for a throughout research with Dutch terms, or terms in other languages. The limited amount of hits that some search terms generated supports the hypothesis that there might be more legal literature that cannot be discovered with an English search strategy. As the ENCORES project is set out to be a multilateral project, a

research in both, English as well as local languages (and the comparison thereof) would mitigate this concern.

The conducted literature review helps to understand and depict a holistic picture of academic research in the area of coastal resilience and adaptation. While the review includes three different angles, there are nevertheless some themes present in all perspectives which therefore seem to be crucial to address in further work on the governance of coastal areas. Considering the existing fragmentation within the literature an overall encompassing approach, such as the one taken in the ENCORES proposal, is not only interesting from an academic perspective, but also valuable from a practical point of view. The present literature research therefore strongly supports the ideas postulated in the ENCORES proposal.