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Mangroves in Indonesia and India

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Mangroves in Indonesia and India



Annisa Triyanti

GOVERNING ECOSYSTEM-BASED DISASTER RISK REDUCTION: MANGROVES IN INDONESIA AND INDIA

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CHAPTER 1

Introduction

Chapter 1 : INTRODUCTION

1.1 PURPOSE

This study focuses on the potential for governing coastal disaster risks in developing countries through an ecosystem-based approach, more specifically through a mangrove ecosystem-based approach. It examines the nature of the coastal problem, the properties of the socio-ecological system, the governing system, the governing interactions, and the capacity and quality to properly govern an ecosystem-based approach for disaster risk reduction in two case study settings (see Chapter 5, 6, 7, and 8). Furthermore, this research also aims to identify factors which could improve the governability of the problems. By looking at the ecosystem-based disaster risk reduction approach and incorporating the theory of interactive governance and governability assessment (see Chapter 3 and 4), this thesis addresses the overarching question, "What factors contribute to the success of coastal ecosystem-based disaster risk reduction (Eco-DRR) by means of mangrove replanting in Indonesia and India?" It addresses this question by analyzing case studies in Demak District, Central Java Province, Indonesia, and the Parangipettai Block, Tamil Nadu, India; in both regions mangrove ecosystems are being rebuilt to directly or indirectly reduce coastal risks.

This introductory chapter first discusses the real-life problem of the increasing risk of coastal disaster and the available gap in knowledge (see 1.2). This chapter presents the research objective and research question (see 1.3) and focus and limit of this thesis (see 1.4); the concept of Eco-DRR and Ecosystem-based Adaptation (EbA), its definition, benefits and limitations (see 1.5)[1]; the global policy content related to Eco-DRR and EbA (see 1.6). The chapter concludes by outlining the structure of the thesis (see 1.7).

1.2 PROBLEM STATEMENT

I now discuss the real-life problem of coastal disaster risk (see 1.2.1) and the gap in knowledge that this thesis aims to address (see 1.2.2).

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[1] Section 1.5 has been partially based on an earlier publication from Triyanti et al. (2017). Triyanti, A., Walz, Y., Marfai, M. A., Renaud, F., & Djalante, R. (2017). Ecosystem-based disaster risk reduction in Indonesia: unfolding challenges and opportunities. In *Disaster Risk Reduction in Indonesia* (pp. 445-467). Springer, Cham.

1.2.1 Real life problem

Globally, coastal areas are facing the threat of increased incidence of natural disasters (Adger et al., 2005; Dilley, 2005; IPCC, 2013: 13; CRED and UNISDR, 2016). Climate change can potentially exacerbate the magnitude and intensity of disasters (IPCC, 2014; Wong et al., 2014) to heavily populated vulnerable coastal areas, especially in developing countries (CRED and UNISDR, 2016; Wong et al., 2014: 365). Rising frequencies of disaster events is a global phenomenon and continuously causing loss of human lives, livelihoods, and investments. The Emergency Events Database (EM-DAT) from the Centre for Research on the Epidemiology of Disasters (CRED) and the United Nations International Strategy for Disaster Reduction (UNISDR) report on "The human cost of weather-related disasters 1995-2015", states that there were on average 335 weather-related disasters per year between 2005 and 2014, an increase of 14% from 1995-2004 and almost twice the level of the weather-related disaster frequency recorded during 1985-1994 (CRED and UNISDR, 2016: 5). The economic consequences of disaster, including earthquakes and tsunamis, is calculated at being between USD 250 billion and USD 300 billion annually.

Prior to 2005, coastal protection focused mainly on developing hard infrastructures such as dams, dunes, and dikes (Charlier et al., 2005). This strategy is increasingly being complemented by soft, cost-effective, socially friendly, and sustainable infrastructure that relies on ecosystems to provide coastal protection (Borsje et al., 2011; Renaud et al., 2016).

The risk of coastal disasters is increasing (Wong et al., 2014). Climate change has led to both sea level rise and increased occurrence of extreme weather events (IPCC, 2013; Wong et al., 2014; CRED and UNISDR, 2016). Climate variability and change threaten coastal areas (IPCC, 2013). Many efforts to protect coastal areas have been conducted. Technical and highly engineered measures have been undertaken in many coastal cities all over the world. These include the construction of coastal structures such as dikes, groynes, breakwaters (Glavovic, 2013). Until recently, the Dutch government has made use of a similar approach to keep its lands dry (Klein et al., 1998). However, although such hard structures are beneficial, there are growing concerns over the effectiveness, cost efficiency, and environmental impact of hard measures. In response, soft, nature-based coastal protection measures have been introduced where these may flourish. This includes using existing ecosystems such as mangroves, coral reefs and other vegetations for coastal protection. A hybrid approach, which combines the hard and soft coastal structures, or so-called ecological engineering can additionally enable effective protection in different geographical locations (see van den Hoek, 2012 and van Slobbe, 2013).

Hard measures can provide instant protection (see Kato et al., 2012; Renaud et al., 2013). They have been relied upon for many decades as the safest protection against coastal threats such as erosion, flooding, and storm surges. The 2011 earthquake and tsunami in Tohoku, Japan, has, however, provided a wake-up call that hard measures are not always effective (Kato et al., 2012). Research has shown that although hard coastal structures can protect countries, they often damage local ecosystems and develop unwanted on-site and off-site risks. Examples of these risks includes erosion to neighbouring coastal areas and blocking local fishers' access to the sea (see Daigneault et al., 2016). The ecosystem-based approach is cost-efficient and environmentally friendly and has been endorsed by the Convention on Biological Diversity (CBD) in 2004 (Secretariat CBD, 2004) and other international agreements (see 1.6). Scholars (Renaud et al., 2013) and environmental-based NGOs (Wong, 2009; Noguchi et al., 2012; DasGupta and Shaw, 2014) recommend the use of ecosystem-based approaches as a human-made natural barrier to coastal disasters to complement other systems of disaster relief. However, the ecosystem-based approach is also no panacea: it cannot be the solution for all types and magnitudes of hazards, exposures, and vulnerabilities. There are still limitations, including lack of data and research on the benefit of ecosystem services, and uncertainty due to global environmental change and climate change, especially to reduce disaster risk and to mitigate climate change impact in the future (see Estrella and Saalisma, 2013). This leads to a dearth of decision-making tools to implement the Eco-DRR and EbA (see 1.3.2.2)

Furthermore, the poor operationalization of natural resources-based management in disaster risk reduction efforts is often seen to be caused by a lack of effective and efficient interaction of governance actors to increase adaptiveness (see Ahrens and Rudolph, 2006; Tierney, 2012). This research, therefore, focuses on the governance of Eco-DRR.

1.2.2 Gaps in knowledge and theoretical problem

Chapter 2 includes a structured literature review of governance approaches to ecosystem-based disaster risk reduction. It shows that the ecosystem-based approach is covered in theories on governance of socio-ecological systems and resilience, adaptive governance, climate change, and risk governance, transformative governance, and ecological economics approaches. It lists and briefly discusses a series of research methods used to analyse ecosystem-based disaster risk reduction. This includes decision support tools, integrated management and network analysis, economic assessment, spatial tools and knowledge generation tools, the mainstreaming approach, and the transdisciplinary approach.

The literature review shows that many disciplines are not adequately covered in the existing approaches. Existing approaches have a strong natural and ecological science approach; their inclusion of socio-political analysis especially at the local level is quite limited except in the case of adaptive governance. Second, most analysis is highly constructive and not adequately critical and reflective or systemic. Third, the methods do not allow for a thorough analysis of local situations, either in themselves or in the way they are applied by scholars. What is also clear is that interactive governance theory, which is viewed as an authoritative new approach, has not yet been applied to Eco-DRR situations – as it was conspicuously absent in the literature search. There were also few case studies on Eco-DRR in the regions I am particularly interested in – namely India and Indonesia – and especially at the local level.

I have chosen to use interactive governance theory (see Chapter 3) because it enables a thorough understanding of the relations between the social and natural systems especially at local level and takes a much more bottom-up approach than other approaches.

1.3 Research objective and research question

In line with the purpose of this research (see 1.1), the overarching question of this research is:

"What factors contribute to the success of coastal, mangrove ecosystem-based disaster risk reduction strategies?"

Sub-questions include: (1) What are the characteristics of coastal disasters, and what is the specific utility of ecosystem-based protection approaches (Eco-DRR)? And (2) What lessons can be learnt for governing effective coastal ecosystem-based disaster risk reduction in the short-term and long-term?

I mainly make use of the literature on interactive governance and governability assessment in this research (see Chapters 3 and 4). However, my study also reviews the scholarly literatures of governance of ecosystem-based disaster risk reduction (see Chapter 2). Based on the overarching research question, I define the following chapter related sub-questions (see Table 1.1).

Table 1.1 List of sub-questions and location of their discussion

Number	Questions	Chapter
1.	What is the definition of ecosystem-based disaster risk reduction, the state of the art of its governance approach and what are the strengths and gaps of these concepts?	Theory chapter (See Chapter 2).
2.	What is the definition of interactive governance and governability and what are the strengths and gaps of these concepts?	Theory chapter (see Chapter 3).
3.	How is the operationalization of interactive governance for governability assessment in this research?	Methodology chapter (see Chapter 4).
4.	What are the physical and social characteristics which contribute to coastal risk in Indonesia and India?	Case studies (see Chapter 5 and 7).
5.	How is governance taking place to support the Eco-DRR approach in Indonesia and India and what are the crucial factors for successful implementation of Eco-DRR in Indonesia?	Case studies (see Chapter 6 and 8).
6.	How does the governability of Eco-DRR in India and Indonesia compare?	Case studies (see Chapter 7 and 9).
7.	What lessons can be learned for governing coastal ecosystem-based disaster risk reduction approaches?	Comparison and conclusion (see Chapter 9 and 10).

Source: Author

1.4 Focus and limit

This research focuses on the governance aspects of coastal disaster risk reduction and the governance systems operating to implement ecosystem-based disaster risk reduction (Eco-DRR) in low-lying coastal areas. Eco-DRR has been implemented to promote the sustainability of coastal protection measures, using *mangrove* ecosystem services as natural barriers to coastal threats (i.e., storms, erosion, flooding, etc.) and also to protect economic capital including the livelihoods of the people living in the area. The research aims to assess the governability of coastal risk according to various *spatial* and *temporal* scales.

The *spatial* scale of this research is the sub-regional or local. It finds focus in the case study of three villages each in Demak District (i.e. Sriwulan, Bedono, and Timbulsloko village) in Indonesia and Parangipettai Block (i.e. MGR Nagar, Vadakku Pichavaram, and TS Pettai Village) in India; these local settings are, however, linked with the global/tropical and national levels.

The *temporal* scope of the research are they years 2014 to 2017, which coincides with the period of field research. However, I also look back to trace the history of coastal flooding, its impacts and governance responses. Then, the thesis, while focusing on governance opportunities for the short term, also considers the long-term perspective, making use of IPCC climate change impact scenarios and other projection data.

The research is targeted at local people as individuals and households; local community groups; government institutions (national, provincial, district, sub-district, village, and hamlets), non-governmental organizations (NGOs), and research institutions. However, this research does not include any discussion of the national and local budgets for coastal protection, or economic instruments such as subsidies and payments for ecosystem services.

1.5 Ecosystem-based disaster risk reduction (Eco-DRR)

1.5.1 Definition of Eco-DRR and EbA

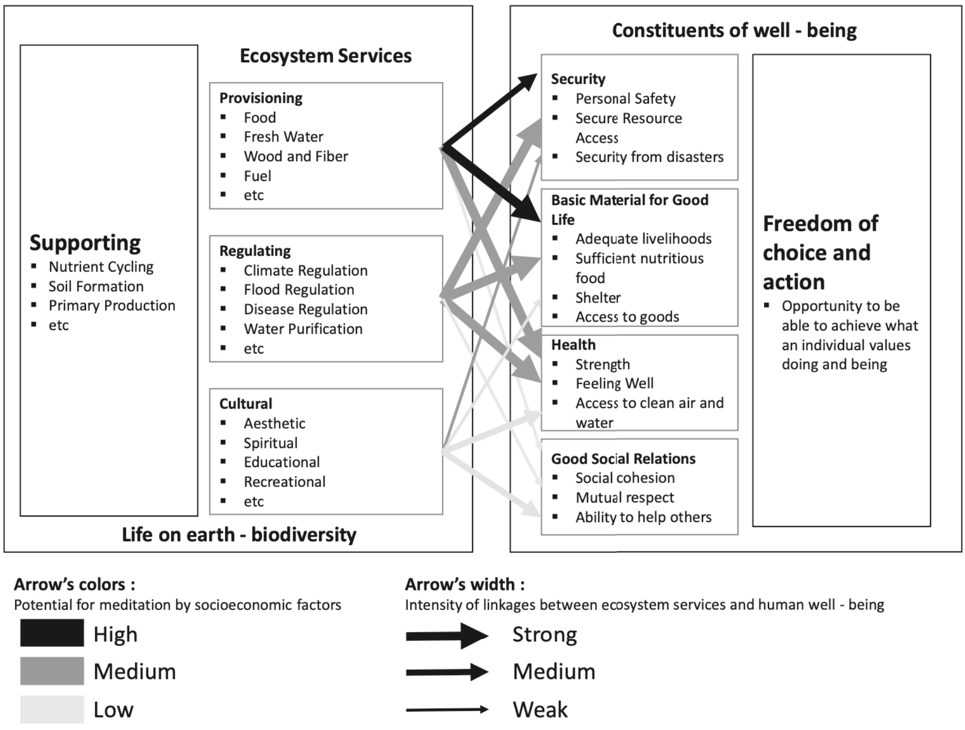
The concepts of ecosystem-based disaster risk reduction (Eco-DRR) and ecosystem-based adaptation (EbA) were introduced as an extension of the sustainable use of resources and presented as win-win solutions (Renaud et al., 2013). For the purpose of this thesis, ***Eco-DRR*** is defined as: "The sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable, and resilience development" (Estrella and Saalismaa, 2012: 30). ***EbA*** is defined as ''The use of biodiversity and ecosystem services as part of an overall adaptation strategy'' (CBD, 2009: 41).

From the definitions provided above on Eco-DRR and EbA, it is clear that Eco-DRR focuses on disaster risk and resilience, which may or may not be linked with climate change impact. EbA focuses on the use of ecosystem services for overall adaptation, including climate change adaptation. It is argued that Eco-DRR is a component of EbA when purposively used for reducing disaster risk at a specific time and in specific locations. However, for discussing long-term climate change impact, EbA is the proper terminology (see also Estrella and Saalisma, 2013: 38).

EbA has received increasing attention since its articulation as a policy priority in the Convention on Biological Diversity and the Ramsar Convention (see 1.6.1). The application of ecosystem-based approaches using the concept of ecosystem services to disaster risk reduction and climate change was later introduced and referred to in the Hyogo Framework for Action (UNISDR, 2005), Sendai Framework for Disaster Risk Reduction (UNISDR, 2015) (see 1.6.2), COP21 Paris Agreement (UNFCCC, 2015) (see 1.6.3), and the Sustainable Development Goals (SDGs) (UNGA, 2015) (see 1.6.4).

Figure 1.1 shows the linkages between ecosystem services and human well-being. Ecosystems can thus provide supporting, provisioning, regulating, cultural services to all life on earth including the rich biodiversity (Millenium Ecosystem Assessment, 2005). Using the mangrove ecosystem as an example, research has shown that mangroves could be beneficial for all of the aforementioned services. In terms of supporting services, mangroves provide nutrients and help sedimentation or soil formation in an eroded area. They also provide provisioning services through their ability to provide leaves, fruits, wood, and fibers to produce medicines and other useful products or food. The regulatory services include protection from coastal flooding and erosion (see Renaud et al., 2013; Glavovic et al., 2014; Spalding et al., 2014). In terms of cultural services, mangrove forests provide aesthetic, educational and recreational services. This thesis however, focuses on the regulatory services in reducing coastal disaster risk, with attention to the other services, including supporting, provisioning and cultural services where these are relevant in terms of supporting the lives and livelihoods of local people.

Figure 1.1 Linkages between ecosystem services and human well-being



Source: Millennium Ecosystem Assessment (2005)

In terms of regulating services to reduce coastal disaster risk, research has shown that ecosystem-based strategies can be an alternative to hard engineering options – which can be non-flexible, spatially disruptive, and expensive to build and maintain – particularly for achieving effective and sustainable pathways for disaster risk reduction and climate change adaptation (Renaud et al., 2013).

Developing countries have recently started looking at ecosystems to gain sustainability and coastal protection. The implementation is, however, only at the smaller and local scales. Developed countries, specifically in Europe, undeniably dominate the efforts through larger projects such as living rivers in the UK (Karr and Chu, 2000) or building with nature and room for the river in The Netherlands (Waterman, 2010; Rijke et al., 2012). However, developed countries experience bigger economic losses during disasters, but face relatively low frequencies of disasters compared to developing countries (UNISDR, 2005; CRED and UNISDR, 2016). This highlights the need for extending and mainstreaming Eco-DRR considering the need to prioritize such initiative to reduce disaster risks in developing countries.

1.5.2 Benefits and limitations of Eco-DRR

1.5.2.1 Benefits

Eco-DRR is beneficial because it is economically cost-effective, socially viable and environmentally friendly. This section elaborates on each of these advantages.

Economic aspects

Regarding hazard protection, there is growing evidence that utilizing ecosystems is far more cost-effective than installing hard engineering structures, where such ecosystems are likely to flourish. A study conducted on ecosystem-based coastal defense by reclaiming marshland in the UK found that after 25 years, the effort was economically more beneficial than building dikes (Turner et al., 2007). A similar study conducted in Fiji, using comprehensive cost-benefit analyses shows that the approach of ecosystem-based adaptation towards flooding by planting riparian buffers and afforesting upper catchments are more cost effective than hard infrastructure measures such as river dredging at the downstream level (Daigneault et al., 2016).

Socially friendly

Eco-DRR approaches are promoted as socially friendly and promoting socio-ecological integration and interaction. Such measures are seen as taking social and contextual issues into account and contribute to community livelihoods through the potential of income generation (Sudmeier-Rieux et al., 2006; Gupta and Nair, 2012). Unlike hard engineering structures, where engineers and government authorities are mostly in charge, Eco-DRR approaches

require the involvement of local communities and generate participation towards its implementation and management (Sudmeier-Rieux et al., 2006; Uy and Shaw, 2012).

Long-term environmental sustainability

Regarding its impact on the environment, Eco-DRR potentially brings fewer negative impacts when compared to hard engineering structures. For example, in the southwestern delta of The Netherlands, a conventional dam has brought issues of tidal habitat loss (Temmerman et al., 2013). The conservation of natural systems is now moving toward the utilization of ecosystems in an ecologically friendly manner to protect human civilization from natural hazards. If this is undertaken well, such systems can also be self-sustaining under normal circumstances and require little maintenance. It is also believed to be more sustainable than the conventional hard engineering structure approaches (Daigneault et al., 2016; Renaud et al., 2013: 10).

1.5.2.2 Limitations

Despite all its benefits, Eco-DRR is not a panacea for all problems and also has limitations. The latter are caused by relatively poor scientific understanding of the response of ecosystems towards climate change and future scenarios, the limited extent of protection, weak policy and flawed implementation of the Eco-DRR approach. I discuss each in turn.

The poor state of knowledge

In order to preserve the function of the ecosystem and have an appropriate adaptation strategy, it is important to assess the current state of knowledge especially on the impact of specific ecosystems to threats such as climate change and anthropogenic activities. Since the thesis focuses on the case study of the mangrove ecosystem, this section takes the mangrove ecosystem as an example and discusses the current knowledge on mangrove responses to climate change (see Table 1.2).

Located in the interface between terrestrial and marine landscape, mangroves have been adapting to of sea level changes since the Holocene (see Jennerjahn et al., 2017). There is, however still a gap in knowledge in terms of the efficiency and feasibility of the ecosystem to cope with the speed of the effects of climate change in the future.

Table 1.2 Climate change factors affecting mangroves

Factors	Relevance	Effects on mangrove
Sea-level	Rate of change in elevation of mangrove sediment compared to the rate of sea-level rise.	1.Mangroves generally do not change position when sea level remains stable; 2.Mangroves will gravitate towards the sea and sometimes laterally if sea levels fall; 3.Mangroves will retreat landward as sea levels rise. Mangroves nearest the sea margin dieback due to stress caused by the rising tide while new growth occurs at the landward fringe (Gillman et al., 2008).
High water events and storm	Increased levels and frequency of extreme high-water events may affect the position and health of mangroves.	1.Tree mortality; 2.Stress and sulfide soil toxicity; 3.Altered mangrove sediment elevation through soil erosion, soil deposition, peat collapse, and soil compression.
Precipitation	Links observed between mangrove habitat condition and rainfall trends.	Decreased rainfall and increased evaporation will: 1.Increase salinity; 2.Decrease net primary productivity, growth and seedling survival; 3.Alter competition between mangrove species, decreasing the diversity of mangrove zones or extinction; 4.Causing a notable reduction in mangrove area due to the conversion of upper tidal zones to hypersaline flats.
Temperature	Linked to mangrove health.	1.Changing species composition (extinction); 2.Changing phenological patterns (e.g., timing of flowering and fruiting); 3.Increasing mangrove productivity where temperature does not exceed an upper threshold. 4.Expanding mangrove ranges to higher latitudes where range is limited by temperature, but is not limited by other factors, including a supply of propagules and suitable physiographic conditions.
Atmospheric CO_2 concentration	A direct effect of elevated atmospheric CO_2 levels may be increased productivity of some mangrove species.	Elevated CO_2 conditions may enhance the growth of mangroves when carbon gain is limited by evaporative demand at the leaves but not when it is limited by salinity at the roots.
Ocean circulation patterns	Changes to ocean surface circulation patterns.	Affecting mangrove propagule dispersal and the genetic structure of mangrove populations.
health of functionally linked neighbouring ecosystems	Functional link between mangrove and neighbouring coastal ecosystems (i.e. seagrass beds, coral reefs, and upland habitat).	Degradation of adjacent coastal ecosystems from climate change and other sources of stress may reduce mangrove health.
human responses to climate change	Increase in the construction of seawalls and other coastal erosion control structures adjacent to mangrove landward margins.	Threat to development from rising sea-levels including: increasingly apparent concomitant coastal erosion, eroding mangroves.

Source: Gillman et al., (2008)

Table 1.2 shows that there are several climate change factors impacting the mangrove ecosystem. These include sea level, high water events and storms, changes in precipitation and temperature, the levels of atmospheric CO_2 concentration, ocean circulation patterns, the health of functionally linked neighbouring ecosystems and human responses to climate change. Most research has been done on the topic of the impact of sea-level rise on mangroves. Research conducted by Ellison and Stoddart (1991) shows that mangroves can generally survive when sea levels rises at the rate of 8-10 cm in 100 years, but will undergo stress when the sea level rises at the rate of 9-12 cm in 100 years. A study conducted in Florida however, shows that mangroves have survived 23-27 cm sea-level rise in 100 years (Ellison and Stoddart, 1991). The two studies indicate that current knowledge on mangrove adaptability towards sea-level rise is highly varied, depending on the type of mangrove species, the local context, the physical processes including sedimentation and the the impacts of related anthropological activities (see Alongi, 2008).

In principle, it seems that mangroves are able to cope when the sediment can keep pace with sea-level rise (see Gillman et al., 2008). Alongi (2008) has described two main responses of mangroves under circumstances of sea level rise: grow further (accrete) and move inland or shrink in the region. It mainly accretes when (1) given a steady sea-level and other physical conditions, the mangrove surface grows and enables accumulation of sediment raising the forest floor above the tidal range; (2) With a constant rise in the sea-level, the floor of a maturing forest may continue to grow at a pace similar to sea-level rise; (3) With an irregular rise in sea-level, the forest floor accretes at intervals of time above tidal range (these intervals are when peat accumulates); (4) With a stable sea-level but with episodic subsidence, the forest floor accretes back to tidal range; (5) With a rising sea-level and episodic subsidence, mangrove response is complex, but the pattern is still one of overall accretion. The mangroves move inland or shrink when there is a rise in sea-level but no change in the sedimentary volume.

Furthermore, climate change exacerbates the frequency and intensity of extreme events, including coastal flooding and storms. These extreme events may cause tree mortality, stress, and altered sedimentation level. Decreased precipitation furthermore reduces the productivity of mangroves and also causes a hypersaline condition. Rising temperature and increased CO_2 levels will most likely increase productivity; however, beyond an upper threshold level of CO_2 concentrations this will not be the case. Furthermore, the coastal development and coastal erosion control structure (e.g. sea wall and dike) could negatively impact the ability of mangroves to move inland. There is, however, still a lack of scientific evidence and detailed research on other factors including ocean circulation patterns and the functional link between mangrove and another ecosystems (see Gillman et al., 2008).

The limited extent of protection

Not all types and magnitudes of hazards, exposure, and vulnerability can be addressed by only using ecosystem services. The successful and sustainable implementation of Eco-DRR measures strongly depends on the regional context, such as the geographical conditions or the specificity and co-occurrence of natural hazards (Koch et al., 2009). For example, in the case of a tsunami, there are debates on the context in which mangroves can and cannot protect the area (see Kathiresan and Rajendran in 2005 debated by Kathiresan and Rajendran, 2006; Kerr and Baird., 2006). The extent of mangrove protection depends on many factors, including the magnitude of a tsunami, the location and distance from the epicenter, and features of nearshore bathymetry, which determines wave height at the coast (Kerr and Baird, 2006; Cochard et al., 2008). Most coastal ecosystems do help to mitigate the impact of coastal disasters such as a low to moderate storm, erosion, and flooding, but cannot provide full protection against high-intensity storms and tsunamis (see Table 1.3). In some contexts, in order to be effective and provide immediate protection, a combination of hard and soft structures can help, as ecosystems naturally take time to develop. Recent research provides elaborations on the benefit of a hybrid approach. However, it is important to ensure that the design of the hybrid approach will not reproduce new types or different risk in a different location (see Spalding et al., 2014) (see Table 1.4).

Weak policy and implementation

The World Bank in its technical report “Managing Coasts with Natural Solutions” (World Bank, 2016) mentions the importance of policy implementation in protecting coastal area in the context of using ecosystem services. However, there is often still a lack of capacity of national and sub-national authorities in coastal protection in general and in using Eco-DRR or the EbA concept in particular. One of the apparent causes is the lack of evidence on the benefits of ecosystem services and their role in reducing disaster risk (Estrella and Saalismaa, 2013). Additionally, there is a gap between science and its uses towards evidence-based policy making (Renaud et al., 2013: 9) which have led to unclear and sometimes contradictory scientific prescriptions on the role of ecosystems for DRR (Estrella and Saalisma, 2013). This leads to the absence of decision-making tools to support the implementation of Eco-DRR efforts and to mainstream them into policies.

Table 1.3 Major types of coastal ecosystem and function in reducing coastal disaster risk

Major type of coastal ecosystem	Function in reducing coastal disaster risk
Mangrove and Salt Marshes	R (Risk): H (Hazard); E (Exposure); V (Vulnerability). H: Coastal erosion: sediment retention. E: Reducing the magnitude of the wave/storm surge to hit the settlement and people belongings. V: Enhancing livelihood, reducing the economic and social vulnerability of disaster through its direct and indirect values.
Coral reefs	H: Supporting the function of another coastal ecosystem: mangrove. E: Reducing the magnitude of the wave (smaller impact than mangrove). V: Enhancing livelihood reducing the economic and social vulnerability of disaster through its direct and indirect values.
Sand dune	H: Tackle the issue of seawater intrusion. E: Natural barrier against a big wave-storm surge. V: Naturally supporting Integrated Water Management by securing fresh groundwater to the people.
Seagrass	H: Providing protection against moderate wave. E: Sediment retention against erosion. V: Enhancing livelihood reducing the economic and social vulnerability of disaster through its direct and indirect values.

Source: McLeod and Salm (2006); Alongi (2008); Cochard et al. (2008)

Table 1.4 Various coastal protection measures

Types		The role and context
Hard-Grey	Dikes	Protecting against high waves.
	Floodgate	Protection against hard waves.
	Seawalls	Protection against high waves.
	Breakwater	Accelerate sedimentation and protection against hard waves.
Soft-Green	Room for the river	Encourage flood protection, master landscaping and the improvement of environmental conditions along the rivers.
	Watershed and coastal ecosystems conservation programme (mangroves, salt marshes, coral reef, seagrass, etc.)	Encourage sustainable watershed and coastal management.
Hybrid (Combination of Hard-Grey and Soft-Green)	Permeable dam	Accelerate sedimentation, protecting against low to medium waves supporting certain coastal ecosystem to grow in healthy condition, improve the livelihood of local people.
	Soil and sediment remediation-Sand Engine	Accelerate sedimentation, enlarge space for tourism and recreation, protection against hard waves.

Source: Author

1.6 Global policy context

This section describes the relevancies of Eco-DRR within the setting of current global policies for disaster risk reduction, climate change and sustainable development. The global policies analysed are: (1) The Ramsar Convention on Wetlands (1972) and The Convention of Biological Diversity (CBD, 1992); (2) Sendai Framework for Disaster Risk Reduction (2015-

2030) (UNISDR, 2015); and (3) The Paris Agreement on Climate Change (UNFCCC, 2015) and (4) the Sustainable Development Goals (SDGs) (UNGA, 2015).

1.6.1 Ramsar Convention on Wetlands and the Convention on Biological Diversity (CBD)

The Ramsar Convention on Wetlands is the first treaty aiming at the conservation and sustainable use of wetlands. It was signed in 1971 and worked through three pillars of actions, including: (1) the wise use of wetlands; (2) the identification and designation of a list of wetlands of international importance, included in the so-called Ramsar List; and (3) the need to cooperate internationally on specific issues such as transboundary water resources and wetlands. The recently adopted resolution XII.13 on "wetlands and disaster risk reduction" during the Conference of the Parties in 2015 (Ramsar, 2015), includes specific issues such as the importance of healthy wetlands and sustainable wetlands management to increase resilience to climate change and extreme weather events and the importance of wetlands-based disaster risk reduction effort. Furthermore, it makes reference to ways in which wetlands are discussed in the working groups of SDGs and Sendai Framework and the work of IPCC.

The Convention on Biological Diversity (CBD) can be traced back to the year 1987 when the United Nations Environment Programme (UNEP) decided to establish an expert group on biological diversity. The first session was held in 1988 to prepare a legally binding agreement on biodiversity. An ad-hoc group was created and this led to the establishment of Intergovernmental Negotiation Committee which adopted the Convention on Biological Diversity (CBD, 1992) in 1992[2]. The ecosystem-based approach was adopted as the primary framework under the Convention in its second COP meeting in Jakarta in 1995. During the 12th COP of the CBD in 2007, ecosystem-based solutions for both climate change adaptation and disaster risk reduction were strongly endorsed (CBD, 2014).

1.6.2 Sendai Framework for Disaster Risk Reduction (SFDRR)

The SFDRR was adopted as a non-legally-binding outcome of the Third World Conference on Disaster Risk Reduction held in Sendai, Japan in 2015 to replace the Hyogo Framework for Action (HFA), which was adopted in 2005, and the earlier Yokohama Strategy and Plan of Action for a Safer World established in 1994 (IDNDR, 2014). As part of the global effort to

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[2] A framework convention is a legally-binding international treaty that establishes a set of general guidelines and principles for the international governance of a particular issue.

achieve the Agenda 2030 for Sustainable Development, SFDRR set specific voluntary targets, considering the issue of climate change and the use of innovative technologies (e.g. on early warning system, and risk prediction as part of understanding disaster risk effort) (UNISDR, 2015).

The SFDRR has four priorities for action, including: (1) Understanding disaster risk; (2) Strengthening disaster risk governance to manage disaster risk; (3) Investing in disaster risk reduction for resilience; and (4) Enhancing disaster preparedness for effective response, and ‘‘Build Back Better’’ in recovery, rehabilitation, and reconstruction.

Good governance as a key aspect in disaster risk reduction was clearly acknowledged in the Yokohama Strategy and Plan of Action for Safer World (1994). The Hyogo Framework for Action (HFA), adopted in 2005, began to address issues of governance deficits, aiming to “ensure disaster risk reduction as a national and local priority with a strong institutional basis of implementation” (UNISDR, 2005). Furthermore, in the newly adopted Sendai Framework for Disaster Risk Reduction (SFDRR), the importance of governance is mentioned under the priority for action 2: Strengthening disaster risk governance to manage disaster risk (UNISDR, 2015) (see also Section 1.6).

The component of ecosystem has been included as an element to be protected from natural and human-caused hazards (UNISDR, 2015; para 5) as well as an element to use for reducing components of risk. SFDRR mostly highlights the need for ecosystem preservation to help reducing disaster risk (UNISDR, 2015; para 30 (g)). In terms of governance, the Sendai Framework calls for the nation-state to enable, guide and coordinate the effort to reduce disaster risk (UNISDR, 2015: para 19 (b)).

1.6.3 Paris Agreement (PA)

In 2015, the Paris Agreement (PA 2015) was adopted as a follow-up Protocol to the United Nations Framework Convention on Climate Change (UNFCCC, 1992) adopted in 1992. While the Framework Convention set up a series of obligations on states to address climate change, the Paris Agreement has adopted the long-term goal of reducing temperature rise to well below 2°C in relation to pre-industrial levels. This means that greenhouse gas emissions need to reduced to net zero emission between 2050 and 2100 and that countries ned to adapt to the adverse impacts of climate change including the increasing frequency and intensity of disasters (see UNFCCC, 2015). The Agrement included ecosystems as a way to manage risks in the context of DRR and pointed to the central role of nations/state in ensuring such adaptation.

1.6.4 Sustainable development goals (SDGs)

In 2015, the United Nations General Assembly adopted the Sustainable Development Goals (SDGs) which includes 17 interdependent goals focusing on social, economic, and environmental issues. The SDGs constitute a non-legally-binding UN-led process, involving 193 member states as well as civil society.

The EbA is addressed by SDGs through various underlying perspectives and diverse goals and targets. Some of the main goals and targets explicitly mentioning ecosystem related issues are:

(1) Goal 6.6 "to protect and restore water-related ecosystems";

(2) Goal 14.2, "to sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts and strengthening resilience";

(3) Goal 15.1 "to ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements";

(4) Goal 15.9 "to integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies".

Meanwhile, with regard to SDG 11 on sustainable cities and communities and SDG 13 on climate actions, ecosystems as elements at risk as well as a means to help mitigate climate change impact are implicit and not mentioned explicitly. Similar to SFDRR and the Paris Agreement, the SDGs mention that the national government should take the responsibility in terms of enactment of legislation, adoption of budgets, ensuring effective implementation as well as follow up and review of the SDGs progress (see UNGA, 2015).

1.7 Structure of this thesis

This chapter has introduced the problem statement on how interactive governance and governability could be employed as an integrated assessment framework to inform policy for improving the ecosystem-based disaster risk reduction effort. **Chapter 2** presents the literature review, focusing on the governance approach to Eco-DRR. **Chapter 3** elaborates the framework of interactive governance and governability assessment. **Chapter 4** describes the methodology used in this research. **Chapter 5** elaborates the nature of the problem and system-to-be-governed in Demak District, Indonesia. **Chapter 6** then analyses the governing system and governing interactions in Demak District, Indonesia. **Chapter 7** presents the nature of the problem and the system-to-be-governed in Parangipettai Block, India. **Chapter 8** continues to discuss the governing system and governing interactions in Parangipettai Block, India. **Chapter 9** compares the case studies of Demak District, Indonesia, and Parangipettai Block, India. **Chapter 10** finally provides a general conclusion and discussion.

CHAPTER 2

A survey of governance approaches to ecosystem-based disaster risk reduction: current gaps and future directions

Chapter 2 : A survey of governance approaches to ecosystem-based disaster risk reduction: Current gaps and future directions[3]

2.1 Introduction

Chapter 1 has introduced the purpose, problem statement, gap in knowledge, and question for this thesis. This chapter now reviews the literature on the governance approach applied in the Eco-DRR field. Most of the chapter has been reproduced from Triyanti and Chu (2018).

The Millennium Ecosystem Assessment (Millenium Ecosystem Assessment, 2005), the first critical global assessment on ecosystem-based approaches, highlighted the emerging role of ecosystem-based approaches to tackling global environmental change. Recent research has shown that ecosystem-based strategies can either be an alternative to hard engineering structures – which can be non-flexible, spatially disruptive, and expensive – or be combined with hard engineering options to achieve effective disaster risk reduction and climate change adaptation (Renaud et al., 2013). The Convention of Biological Diversity (see Chapter 1) defines ecosystem-based approaches as:

> 'The integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. The application of the ecosystem approach will help to reach a balance of the three objectives, including conservation, sustainable use, and the fair and equitable sharing of the benefits arising out of the utilization of resources' (Secretariat CBD, 2004).

The concepts of ecosystem-based climate change adaptation (EbA) and ecosystem-based disaster risk reduction (Eco-DRR) were later introduced as an extension to the sustainable use of resources, and were presented as 'win-win' solutions (Renaud et al., 2013).

Despite these global developments, Huq et al. (2015) show that mainstreaming ecosystem-based strategies into actual policies, strategies, and interventions is in fact a governance challenge. Van den Hoek et al. (2012), similarly argued for the need to address social

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[3] This chapter has been mostly extracted from: Triyanti, A., & Chu, E. (2018). A survey of governance approaches to ecosystem-based disaster risk reduction: Current gaps and future directions. *International Journal of Disaster Risk Reduction*, Volume 32, December 2018, Pages 11-21

uncertainties through unpacking the governance implications of emerging Eco-DRR and ecological engineering efforts. Others have further noted that such challenges are magnified when dealing with complex and uncertain governance arenas associated with multi-scalar environmental risks (Renaud et al, 2013; Grantham et al., 2011; Whelchel et al., 2016; Kloos and Renaud, 2016). However, beyond the recognition that the governance of ecosystem-based approaches remains challenging, there has so far been no comprehensive analysis into which aspects of governance – i.e., whether the decision-making processes, resource networks, institutional arrangements, political powers and authority, or other determinants – shape the opportunities for and constraints to action in the context of Eco-DRR.

In response, this chapter presents a comprehensive synthesis of the current literature to highlight the status of governance studies in the context of ecosystem-based disaster risk reduction (Eco-DRR). Research on ecosystem-based approaches is constantly evolving – with many evaluating it from global to local scales as well as from state-centric to decentralized and devolved actors and process – although there is an overwhelming focus on diagnosing governance constraints (i.e., in terms of finance, political jurisdiction, bureaucratic capacity, etc.) and not on governance opportunities. As a result, in addition to reviewing the literature, this paper explores the various governance opportunities that could enable future research and practice.

This chapter is divided into seven sections. Section 2.2 elaborates on the methods used in the literature survey. Section 2.3 reviews the theories of Eco-DRR and Section 2.4 discusses the main methods of Eco-DRR. Section 2.5 explores a number of emblematic examples, illustrates how Eco-DRR is applied in disaster risk reduction and climate change adaptation, as well as charts emerging trends such as ecological engineering. Section 2.6 elaborates on the gaps in the study of governing Eco-DRR. Finally, Section 2.7 highlights the opportunities for future research and Section 2.8 concludes.

2.2 Survey methodology

For the literature survey, we selected databases from Scopus and Science Direct since both provide advanced research query tools that help to focus and narrow down results based on searchable keywords. We employed a semi-structured method, which allowed us to add several prominent key literatures in addition to filtered literatures from structured queries extracted from the scientific databases. The keywords used in the search were ‘Ecosystem PRE/0 based AND disaster AND risk AND governance’ for both databases. This search method resulted in

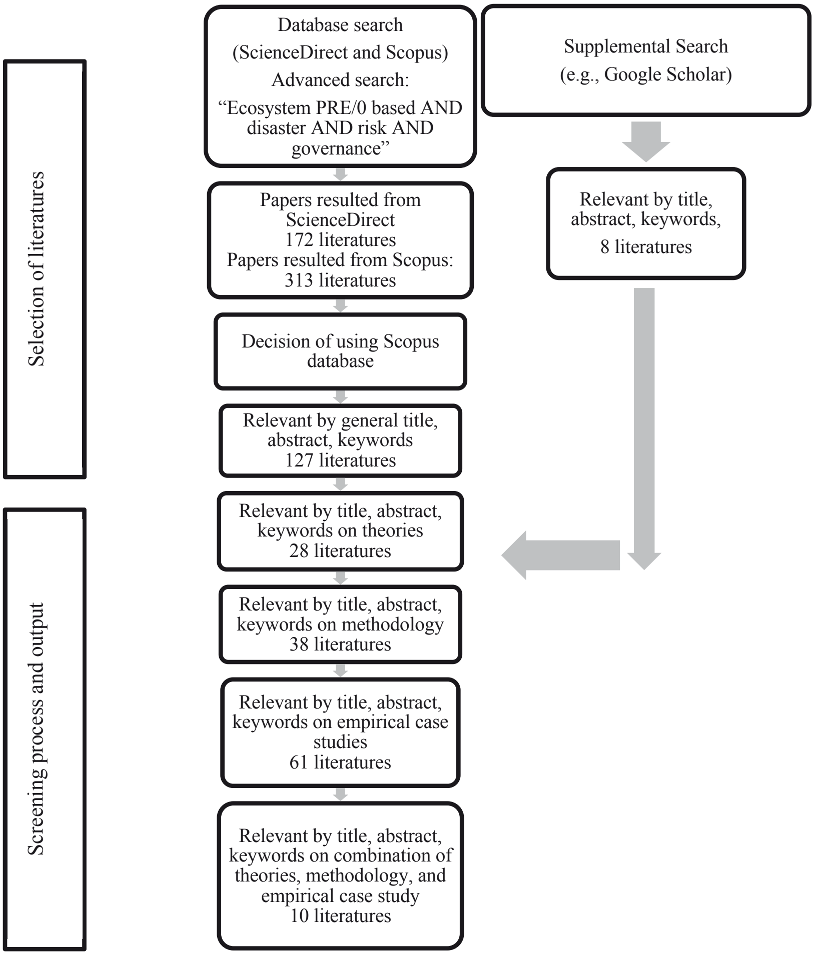
172 entries from Science Direct and 313 entries from Scopus. For the purposes of achieving a wider scope, we selected Scopus as our main source to conduct the review. From it, 313 entries were screened and filtered into 149 articles that were most relevant to the topic of Eco-DRR and governance. Our criteria for relevancy were based on: (1) the inclusion of ecosystem-based approached to DRR and climate change and (2) the inclusion of discussions on management, governance, and politics.

After the application of these three criteria, we were left with 127 entries for in-depth analysis. Of these 127 entries, 20% (28 entries) were theoretical in nature; 28% (38 entries) were discussions of assessment methodologies; 45% (61 entries) were illustrations of particular case studies or examples; and finally, 7% (10 entries) were a combination of theory, methodology, and illustration. For the purposes of this review, we only selected the theory, methodology, and case study-based entries. Also, we added eleven key publications that were not listed in our initial search results. Online public academic search engines such as Google Scholar were utilized for this purpose. In total, we surveyed 138 entries. Figure 2.1 provides a schematic of our methodological approach.

2.3 Governance theories and Eco-DRR

As noted earlier, we identified a total of 28 entries that interrogate theories of governing Eco-DRR. By far the most common umbrella theory used is socio-ecological systems (SES), which takes into account coupled social and environmental challenges in an interconnected world (Folke et al., 2011). SES is often applied to resilience to emphasize the complexity of socio-ecological dynamics. It highlights the ability of systems to absorb disturbances while maintaining their structures and functions (Walker et al., 2004). The argument is that resilience thinking embraces the interaction between ecosystems and human well-being. Furthermore, it sets the goal of preparing the system to tolerate – or bounce back from – current and future environmental changes exacerbated by climate change. In Table 2.1, we list the prominent concepts and theories used as a basis for governing SES.

Figure 2.1 Document sources, screening, and output of the review process



Source: Author

Table 2.1 Theoretical literatures

Theory	Sources
Governance of socio-ecological systems and resilience	(Folke et al., 2011; Adger et al., 2005; Lebel, 2012; Rockström et al., 2014; Woolley, 2014; Kotschy et al., 2015; Perkins et al. 2015; Guerry et al., 2015; Bennett et al., 2016; Bruckmeier, 2016; Davidson et al., 2016).
Adaptive governance	(Folke et al., 2011; Folke et al., 2005; Biermann et al., 2010; Lavell et al., 2012; Chong, 2014; Wise et al., 2014).
Climate change and risk governance	(Renn, 2012; Rosa et al., 2013; Chanza and De Wit, 2016; Kabisch et al., 2016).
Transformative governance	(Glavovic, 2013; Chaffin et al., 2016; Chung Tiam Fook, 2017).
Ecological economics	(Guerry et al., 2015; Lawn, 2016).

Building on theories of SES and resilience, the concept of adaptive governance focuses on learning and knowledge co-production within governance systems and in their interventions to adapt to external shocks (Biermann et al., 2010; Huitema et al., 2016; Zedler, 2017). However, significant challenges for adaptive governance have been identified, including the presence of institutional and legal barriers to ecosystem-based adaptation (Chong, 2014). Examples of such constraints range from the lack of institutions supporting ecosystem-based approaches, poor law enforcement, corruption, and the lack of political will (Chong, 2014).

Some theories apply adaptive governance to climate change and risk (Renn, 2012). Both approaches build upon previous work on SES and argues that in order to govern climate change and to cope with emerging risks, policy-makers must embrace the notion of participation among stakeholders (Folke et al., 2005). Necessary elements for effective participatory governance include decentralization, accountability, responsiveness, participation, and inclusiveness (Renn, 2012). Scholars of climate risks further propose that governance should denote both the institutional structures and the policy processes that guide collective actions to regulate, reduce, or control environmental problems (Renn, 2012).

Emerging theories on transformative governance further pinpoint the importance of change, innovation, and technology in governing complex systems (Renn, 2012). Transformative governance is rooted in ecological theory, and highlights new capacities such as increased risk tolerance, significant systemic investment, and restructured economies (Chaffin et al., 2016). Transformative governance often explores new ecosystem-based innovations for addressing both disaster risks and climate change. Chaffin et al. (2016) provide an example of transformative efforts associated with building green infrastructures in Cleveland, United

States, which enhanced resilience by transforming vacant lots, land, and industrial sites into habitat for biodiversity, urban agriculture, and green infrastructure. In another example, Ziervogel et al. (Ziervogel et al., 2016) describe the FLOW (Fostering Local Wellbeing) program in Bergrivier Municipality, South Africa, which embraced the concept of ‘transformative capacity’. By involving youth in civil society, business, and government agencies, the program boosted innovation to tackle climate change, resource depletion, and inequality (Ziervogel et al., 2016). Key activities were asset mapping, including mapping the municipal water and sewage systems to promote bioswales and recycling programs, as well as building capacity of civil society through movie-making and storytelling.

Finally, some theories pursue an ecological economics perspective, which argues that in order to cope with risks and extreme changes, sustainable development should be the priority rather than capital-led economic growth (Lawn, 2016). This notion is clearly articulated through efforts to balance ecological sustainability with economic co-benefits to achieve sustainable livelihoods (Guerry et al., 2015). However, in order to convince policymakers to make investments in ecosystem-based approaches, evidence creation tools such as valuation of ecosystem services are believed to be the most appropriate (Guerry et al., 2015). As a policy justification, it provides tangible and evidence-based data on the benefits of preserving ecosystems for the providers, suppliers, and beneficiaries of ecosystem services.

2.4 Methods for governing Eco-DRR

Our review shows that there are different methodologies associated with documented Eco-DRR interventions, with a variety of governance assumption embedded within each. In this section, we elaborate on the six broad methodologies for governing Eco-DRR, which include decision-support tools, integrated management and network analyses, economic assessments, spatial knowledge generation tools, mainstreaming approaches, and transdisciplinary approaches. Table 2.2 summarizes these results.

Table 2.2 Methodological literatures

Methods	Examples	Sources
Decision support tools	DPSIR (Drivers-Pressure-State(change)-Impact-Response); Transformative Adaptation Research Alliance (TARA) approaches; Fit for Purpose Governance; Balanced Scorecard (BSC); Source-Pathway-Receptor-Consequence model; Multiple actor analysis; Bayesian Belief Network (BBN).	(Whelchel and Beck, 2016; Rijke et al., 2012; Maccarrone et al., 2014; Metcalf et al., 2014; Nicholls et al., 2015; Bryson et al., 2015; May, 2015; Lewison et al., 2016; Maskrey et al., 2016; Smith et al., 2016; Colloff et al., 2017).
Integrated management and network analysis	Marine Integrated Decision Analysis System (MIDAS); Integrated Flood Management; Integrated island management (IIM); Collaborative disaster management; Bayesian networks.	(Ferrol-Schulte et al., 2013; Holdschlag and Ratter, 2013; Liquete et al., 2013; Jupiter et al., 2014; Gopal et al., 2015; Juarez Lucas and Kibler, 2016; Bodin and Nohrstedt, 2016).
Economic assessment	Payment for Ecosystem Services (PES) and ecological economics approach.	(Kroeger and Casey, 2007; Wertz-Kanounnikoff et al., 2011; Holland et al., 2012; Cartwright et al., 2013; van Putten et al., 2013).
Spatial tools and Knowledge generation tools	GIS, spatial planning; PRISMA for Information need in coastal ecosystem-based adaptation.	(Rist and Moen, 2013; Li et al., 2014; Sitas et al., 2014; Sierra-Correa and Cantera Kintz, 2015; Hernandez-Montilla et al., 2016; Meerow and Newell, 2017).
Mainstreaming approach	Spatial ecosystem-based adaptation priorities at the sub-national level and local planning.	(Bourne et al., 2016; Wamsler, 2016).
Transdisciplinary approach	Participatory approach to understanding change in coastal social-ecological systems; Ecology approach to science–policy integration in adaptive management of social-ecological systems; Private mainstreaming.	(Bennett et al., 2016; Maskrey et al., 2016; Eddy et al., 2014; Spires et al., 2014; Sarzynski, 2015; Benham and Daniell, 2016; Keenan, 2015).

2.4.1 Decision-support tools

As a type of decision support tool, the Driver-Pressure-State (change)-Impact-Response (DPSIR)[2] method can help identify the current conditions of a particular socio-ecological system. This method uses a semi-quantitative method to structure complex environmental problem and bridges the gaps between science, policy, and management (Metcalf et al., 2014; Lewison et al., 2016; Maskrey et al., 2016; Smith et al., 2016). This method was initially implemented in the form of Pressures-States-Response (PSR) by the Organisation for Economic and Cooperation Development (OECD), and is now commonly used across coastal areas to help stakeholders formulate coastal management practices. The European

Environment Agency (EEA) has since added two components – namely "Driving Forces" and "Impact" – to identify and assess progress toward sustainable development (Lewison et al., 2016). Furthermore, this method is often also combined with other assessments such as Bayesian Belief Networks, which help stakeholders understand the cumulative impacts of different policy decisions and interventions (Metcalf et al., 2014; Maskrey et al., 2016; Smith et al., 2016). Despite its comprehensiveness, some have critiqued DPSIR for being a simplistic approach that fails to account for the complexity of multi-scalar and systemic environmental risks (Lewison et al., 2016).

Another decision-support method that is relevant to Eco-DRR is the Transformative Adaptation Research Alliance (TARA) approach, which employs an ecosystem perspective to climate change adaptation (Colloff et al., 2017). Rooted in theories of transformative governance (Chaffin et al., 2016), TARA presents three types of transformations, namely transformation of ecosystems, transformation of decision context, and transformation as developing the capacity for adaptive governance. The first – transformation of the ecosystem – is defined by a permanent shift to an alternative stable state, as in resilience thinking (Colloff et al., 2017). It considers the changes in how the ecosystem is perceived, especially how one ecosystem relates to others; the use of ecosystem services for societal benefit; and the options to manage the ecosystem in an appropriate manner. Second, the transformation of decision context involves recognizing the need to evolve governance arrangements due to dynamic and changing ecosystems (Jupiter et al., 2014). The third type is governance change to support transformation in the context of adaptation, which refers to developing adaptive and transformative governance capacities to accommodate uncertainties and changes in the system.

To operationalize the three types of transformations mentioned above, the TARA approach incorporates three conceptual elements that help stakeholders in decision-making and formulating transformative ecosystem-based adaptation actions. These include, first, the 'values- rules-knowledge' perspective for identifying decision-making contexts that enable or constrain adaptation (Chaffin et al., 2016). The second is 'adaptation pathways', which evaluates implementation through ecosystem services assessments and the values-rules-knowledge perspective in order to explore possible actions based on available options and alternatives in an uncertain environment to avoid maladaptation (Colloff et al., 2017). The third is 'adaptation services', which is a subset of ecosystem services that provides benefits for people to adapt. The identification of these three elements reflects the need to understand changes in adaptation services provided by ecosystems, incorporate values-rules-knowledge on how to use adaptation services, as well as understand the changing aspects of decision-making to guide adaptation pathways. In general, the TARA approach emphasizes the critical elements of governance – i.e., the explicit process of transforming decision contexts and societal values as part of implementation – compared to EbA and Eco-DRR (Colloff et al., 2017). It also suggests the need for implementing adaptation through redistributing power and agency for social change (Colloff et al., 2017). This can be achieved through a more bottom-up approach, such as by involving stakeholders in the co-learning, co-development, and co-construction of future scenarios.

2.4.2 Integrated management

Several tools for operationalizing integrated management are listed in Table 2.2. These tools have generally been used in the context of flooding and sea level rise (Juarez Lucas and Kibler, 2016), water resources management (Meerow and Newell, 2017), as well as coastal zone management (Maccarrone et al., 2014). However, for the purposes of this survey, we looked specifically into Integrated Island Management (IIM) and Marine Integrated Decision Analysis System (MIDAS) as examples (see Table 2.2). Both cases reflect the principles of integrated coastal zone management, which deals with coastal systems as a whole, spanning across boundaries and involving different actors, resources, and sectors to achieve certain goals (Fabbri, 1998). In the case of IIM, integrated management is defined as:

"Sustainable and adaptive management of natural resources through coordinated networks of institutions and communities that bridge habitats and stakeholders at the scale of socio-ecological processes... with the common goals of maintaining ecosystem services and securing human health and well-being" (Jupiter et al., 2014: 26).

IIM is currently applied through a coordinated network across the Pacific Ocean (Jupiter et al., 2014), where it is promoting ecosystem-based efforts to simultaneously address climate change, disaster risk reduction, and ecosystem conservation (Jupiter et al., 2014). The MIDAS approach, on the other hand, offers an interface to model potential scenarios in dealing with certain threats, such as the analysis of oil spills on coastlines and the spatial risks caused by mangrove degradation in Belize's Marine Management Area (MMA) (Gopal et al., 2015). These scenarios are designed based on an interactive platform that simulates problems perceived by the users and managers of the Belize's MMA, including fishers, tourism operators, state environmental agencies, and the general public (Gopal et al., 2015).

2.4.3 Economic assessment

Economic assessments are important tools for understanding the economic value of ecological buffers, food/genetic resources, and recreational opportunities (Kroeger and Casey, 2007). Previous studies have shown that economic assessments are not explicitly referred to in many ecosystem management policies (Sitas et al., 2014) and have not been well documented in current research (Wertz-Kanounnikoff et al., 2011). For Eco-DRR, economic valuation of ecosystems provides insights into the co-benefits of ecosystems besides their regulating functions to reduce disaster risks and climate change impacts (Wertz-Kanounnikoff et al, 2011; Cartwright et al., 2013). It also offers useful economic perspectives on the scope within which adaptation can be a co-benefit (Wertz-Kanounnikoff et al., 2011). However, one limitation of economic assessments is the need to incorporate human behavior and uncertainty into their calculation (Holland et al., 2012). An example of the successful application of economic assessments was found in Durban, South Africa, where ecosystem-based measures had a moderate benefit-cost ratio whereas infrastructure-based measures had a lower benefit-cost ratio (Cartwright et al., 2013). Economic assessments are particularly useful for informing processes of designing market-based approaches – such as through certain incentives – for ecosystem conservation (Kroeger and Casey, 2007).

2.4.4 Knowledge generation and spatial tools

The literature on ecosystem management focuses mainly on the planning and implementation of strategic processes and goals such as conservation or disaster management. In the context of Eco-DRR, however, the study of ecosystem services and its co-benefits have been a major focus for reducing socio-economic vulnerability to disaster impacts. Sierra-Correa and Cantera Kintz (2015), for example, evaluated the method of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). This method generates a systematic review based on clearly defined questions, which helps to narrow down the specific combination of knowledge for analysis. Other important tools such as GIS can help analyse the spatial distribution of potential ecosystem services, and therefore is often used as a basis for planning and management. In the context of Eco-DRR, multi-criteria analyses such as ecological resilience modelling against sea level rise (Hernandez-Montilla et al., 2016) and green infrastructure spatial modelling – which integrates stormwater management, social vulnerability, green space, air quality, urban heat island, and landscape connectivity (Meerow and Newell, 2017) – have helped support decision- making and management by providing guidelines for future green infrastructure.

2.4.5 Mainstreaming approach

A recent study by Wamsler et al. reviewed how EbA can be coherently implemented in local planning in Sweden (Wamsler et al., 2016). The study revealed that although EbA has been integrated into national strategic adaptation planning, at the district and local municipality levels, ecosystem-based measures are limited and continue to focus on biodiversity conservation rather than on reducing climate and disaster risk or providing developmental co-benefits. Wamsler et al. subsequently identify the benefits of ecological structures and why they are needed for increasing the capacity of local authorities to reduce climate risks. For example, through using spatial tools, an inter-scale governance analysis can be conducted to identify the opportunities for adopting ecological engineering structures to improve stormwater management (Wamsler et al., 2016). Another example can be seen in South Africa, where officials from Namakwa District Municipality and Alfred Nzo District Municipality, in partnership with the private sector, used biome maps to define primary areas for EbA (Bourne et al., 2016).

2.4.6 Transdisciplinary approach

A transdisciplinary approach allows for the bridging between scientists, policymakers, practitioners, and stakeholders across different sectors and institutions. However, there are often barriers and gaps among these actors, including poor coordination and a lack of integrated knowledge (Maskrey et al., 2016; Eddy et al., 2014; Spires et al., 2014; Benham and Daniell, 2016). Several approaches attempt to close these gaps, for example by including the private sector and businesses in adaptation strategies (Sarzynski, 2015) or through 'private mainstreaming' approaches (Keenan, 2016). This latter approach introduces wider inter-organizational capacity, which builds linkages among heterogeneous institutions and agencies in climate adaptation (Keenan, 2016) For example, a recent study of the Great Barrier Reef in Australia showed that participatory techniques can be incorporated to develop transdisciplinary projects among scientists and to promote the results for better policy-making (Benham and Daniell, 2016). However, as the authors continue, to influence policy, the research should be appropriately supported by effective communication and science-policy integration. In light of this, the concept of information ecology is proposed as an effective approach for integrating science and policy cultures (Eddy et al., 2014). This approach helps to combine information technology with the ecological contexts in which it is embedded.

2.5 Case studies of governing Eco-DRR

Our results show that mitigating the risks of coastal disasters such as tsunami, flood, storm surge, and coastal inundation are the primary functions of Eco-DRR (Glaser et al., 2015; Huq and Stubbings, 2015; Seijger et al., 2015). In terms of the regional distribution, nine emblematic case studies are found in Asia, whereas case studies in Africa and Small Islands Developing States (SIDS) are most limited, with three case studies for each region. Furthermore, seven case studies in the Americas and six case studies from Europe are identified. In this section, we describe these examples based on different governance strategies for implementing Eco-DRR, which are further summarized in Table 2.3.

Table 2.3 Case studies and empirical literatures

Case study	Country/Region	Source
Ecosystem-based hazard mitigation and general livelihood improvements	UK; Iceland; USA; Indonesia; Germany.	(Keenan, 2016; Glaser et al., 2015; Huq et al., 2015; Sejiger et al., 2015; Arnold, 2012; Kolahi et al., 2012; Ahmed et al., 2013; Ágústsdóttir, 2015).
Values and payments for ecosystem services	Caribbean Region; Tropical Pacific, Southern Oceans, and UK coastal seas; Philippines; Indonesia; Gulf of Mexico.	(Beichler, 2015; Clifton, 2013; Ruckelshaus et al., 2013; Rao et al., 2015; Cavanagh et al., 2016).
Knowledge co-production	South Africa; Caribbean; Southeast Asia; SIDS.	(Thompson et al., 2017; Mercer et al., 2014; Hiwasaki et al., 2015; Reyers et al., 2015).
Community-based, inclusive, and participatory approaches	Thailand; Ethiopia; South Africa; Trinidad and Tobago; Pacific; Bangladesh; Ecuador; India; South Africa; Colombia; Belize; USA; Fiji; Brazil.	(Jupiter et al., 2014; Sitas et al., 2016; Brody, 2012; McClanahan and Cinner, 2012; Roberts et al., 2012; Ahammad et al., 2013; Karlsson and Hovelsrud, 2015; Prado et al., 2015; Reid and Faulkner, 2015; Lin, 2015; Chandra and Gaganis, 2016; Ofoegbu et al., 2016; Reid, 2016; Chu et al., 2017).
Politics discourse	Nicaragua; Mali.	(Ellison et al., 2017; Djoudi et al., 2013).
Science-policy interface	Germany; Gulf of Mexico	(Guerry et al., 2015; Roberts et al., 2012; Benessaiah and Sengupta, 2014)
Policy and governance design	Austria; Gulf of Mexico; Myanmar; India.	(Von Storch et al., 2015; Galvani, 2013; Jordan and Benson, 2013; Govindarajulu, 2014; Webb et al., 2014).

Table 2.3 *(continued)*

Mainstreaming EbA into the multi-level governance for CCA and DRR	South Africa; Germany; Sweden; Australia; India; Seychelles; UK; Samoa, Cambodia; Pacific Islands; Antarctica.	(Grantham et al., 2011; Wamsler, 2015; Chong, 2014; Hernández-González et al., 2016; Lal et al., 2012; Lopoukhine et al., 2012; Mori et al., 2013; Pasquini et al., 2013; Burch et al., 2014; Miller, 2014; Wamsler et al., 2014; Khan and Amelie, 2015; Pasquini et al., 2015; Beery et al., 2016; Sheaves et al., 2016; Vivekanandan et al., 2016).
Innovative green infrastructure for ecosystem-based DRR and CCA	The Netherlands; Australia.	(van den Hoek et al., 2012; Perkins et al., 2015; McClanahan and Cinner, 2012; Wamsler and Pauleit, 2016).

2.5.1 Valuation of ecosystem services

A recent study shows that the number of EbA actions are limited compared to the potential of existing ecosystem resources (Huq and Stubbings, 2015). In 2006, for example, the valuation of the UK's marine biodiversity supported the development of marine legislation and led to the National Ecosystem Assessment, which subsequently also provided input to the UK's Post-2010 Biodiversity Framework. However, the challenge lies in the lack of EbA in formal regulation, which could have negative impacts on ensuring the collection of new data – especially the non-use values of multiple ecosystem services that are currently deficient – to further support EbA policy-making in the UK (Cavanagh et al., 2016). In the Caribbean, recent research highlighted a gap in understanding factors that could potentially determine the value of ecosystem services for protecting shorelines from coastal storms. To address this problem, Rao et al. (2015) identified size, level of development, GDP, type of ecosystem, wind speed, storm frequency, and EbA implementation model as baseline variables for calculating the value of ecosystem services.

Better valuation of ecosystem services can support market-based incentives to promote biodiversity conservation, such as through Payments for Ecosystem Services (PES) (Farley and Costanza, 2010). PES is defined as ‘a voluntary, conditional agreement between at least one 'seller' and one 'buyer' over a well-defined environmental service – or a land use presumed to produce that service’ (Wunder, 2007: 48). It tackles the trade-offs between land owner's interest and external actors, particularly in terms of promoting biodiversity conservation (Wunder, 2007). However, the complexity of valuation methods often constrains PES uptake. Ruckelshaus et al. (2013) noticed that other external barriers such as property rights, governance (e.g., local to international jurisdiction), and the alignment of providers and beneficiaries can also impact the effective use of PES.

2.5.2 Knowledge co-production approaches

For EbA and Eco-DRR, knowledge co-production is valuable because it identifies the current status of knowledge and provides directions for future research and decision-making (Reyers et al., 2015). For example, a recent review of food security in small island developing states (SIDS) analysed the use of local knowledge within the context of community-based disaster risk reduction (Mercer et al., 2014). The study shows that gaps include the lack of coherence in approaching food security in line with the ecosystem-food- climate nexus; the lack of a regional framework despite similarities among SIDS; and the lack of knowledge integration (Mercer et al., 2014). The study proposes deepening the relationship between ecosystems, food security, and climate change through empowering local knowledge of EbA and Eco-DRR. In addition, it proposes the need to ensure that information developed and shared at regional and national levels is made understandable for local needs.

Another study conducted in Indonesia and the Philippines on coastal disaster risk reduction also mentioned the need for utilizing local knowledge for research and policy-making (Hiwasaki et al., 2015). The study concluded that in order to facilitate better adaptation measures, the identification of local knowledge based on different types and uses – such as folklore, rituals, ceremony, and customary law – are needed. However, a recent study of disaster management in South Africa by Sitas et al. (2016) illustrated that some of the active barriers undermining the objective of knowledge co-production can include preconceived assumptions, entrenched disciplinary thinking, and confusing terminology. To tackle these problems, all knowledge stakeholders should be involved in ecosystem-based management, and in the case where it cannot be afforded, the use of knowledge brokers can help (Sitas et al., 2016).

2.5.3 Community-based and participatory approaches

In the United States, ecosystem-based planning is being adopted by different state governments. For example, in the case of the Everglades in Florida, participatory ecosystem-based approaches have been taken into account by Florida's Department of Environmental Protection to facilitate local spatial planning and law enforcement (Brody, 2012). In this case, the local community is consulted during the preparation of a comprehensive plan, which is legally binding and should be consistent with existing state laws on ecosystem management.

Research has also shown that sustainable EbA can simultaneously increase community resilience (Jupiter et al., 2014; Roberts et al., 2012). In the case of Durban, South Africa, biodiversity has been framed as a bio-infrastructure that increases the supply of ecosystem services and provides multiple long-term benefits for local communities, particularly through accessing natural resources and livelihood opportunities (Roberts et al., 2012). However, challenges to this approach lie in the capacity of local actors, which is also a problem noted by a recent case study of community-based EbA in coastal Bangladesh (Ahammad et al., 2013). This study illustrated the challenges faced by a community-based coastal afforestation project, where low capacity of the local government hampered its implementation. Conversely, a study of local action in Monkey River Village, Belize, showed that by affiliating with bridging institutions – such as journalists, researchers, and local NGOs – communities can mobilise and facilitate policy change (Karlsson and Hovelsrud, 2015). Such forms of activism are successfully supporting local claims to political legitimacy, while also helping to raise the community's awareness of increased soil erosion rates.

2.5.4 Political discourse

Several case studies highlight the role of power relations in discursively framing ecosystem-based approaches. In northern Mali, for example, a political campaign to return Lake Faguibine to a Prosopis forest ecosystem has triggered conflict among local groups (Djoudi et al., 2013). In the long term, the Prosopis forest will reduce the community's vulnerability to drought since it is an excellent source of fodder during drought periods. However, local communities tend to only look at the short-term implications of the loss of agricultural land in place of maintaining the Prosopis forest. During the course of the conflict, issues of power and marginalization are clearly shown between regional politicians and local communities, as well as between men and women in extending their voices and interests (Djoudi et al., 2013). Different political interests became a significant barrier to achieving sustainable use of ecosystem services. The study recommended the need for multilevel, participatory, integrative, and gender-sensitive approaches to managing conflicts in newly decentralized political arenas that are pursuing ecosystem-based adaptation (Djoudi et al., 2013).

Another study by Benessaiah and Sengupta in Estero Real, Nicaragua, elaborates on the significance of power relations in influencing governance outcomes of EbA. In this case, shrimp aquaculture was introduced as a new concept for privatizing coastal ecosystem resources, which made small-scale shrimp farmers lose their ponds (Benessaiah and Sengupta, 2014). However, the existence of strong social ties among small-scale fish farmers helped mitigate the negative impacts of privatization. They negotiated their position to communally manage the lagoons with additional consideration for reducing the impacts of environmental degradation (Benessaiah and Sengupta, 2014). The study promotes a co-management approach with clear guidelines for addressing power relations between a resource-dependent people and industries and government.

2.5.5 Science-policy interface

The collection of data on ecosystem valuation and socio-ecological conditions requires effective collaboration between politicians, communities, private actors, and researchers (Ahammad et al., 2013; Von Storch et al., 2015). The involvement of researchers is important for monitoring, assessing, and forecasting scenarios (Von Storch et al., 2015). One example is the coastal afforestation project in Bangladesh's National Adaptation Programme of Action. A study by Ahammad et al. showed how the Ministry of Environment and Forest in Bangladesh managed to facilitate science-policy integration through knowledge co-production (Ahammad et al., 2013). Scientific assessments were conducted to explore the sensitivity of coastal ecosystems, which in turn affected local vulnerability. The evaluation of ecosystem benefits attributed to mangroves has been formulated into a policy to reduce land degradation in the coastal areas of Bangladesh. In this case, the main success factors mentioned are strong institutional leadership from government authorities and the collaborative approach to ecosystem management (Ahammad et al., 2013).

2.5.6 Policy and governance design

A study by Jordan and Benson of the Gulf Coast of the United States shows that decision-making among stakeholders have the potential for being complementary, conflicting, or overlapping in nature (Jordan and Benson, 2013). Jordan and Benson conclude that certain modes of governance can produce different levels of effectiveness in the sustainability of a certain coastal ecosystem. In their study of three sites along the Gulf of Mexico, a networked, participatory, and consensus-based regime showed to be effective in facilitating a more sustainable coastal system, especially at the local level. For example, in Tampa Bay, Florida, the objective was to preserve the existing mangrove functions and water quality, which was supported by a strong regional platform, namely the Tampa Bay Regional Planning Council (Jordan and Benson, 2013). On the Louisiana coast, where disaster and climate change impacts are the main problems, the authors found that reactive policies and hierarchical governance hinder efforts toward finding a sustainable solution (Jordan and Benson, 2013). Beyond the Gulf of Mexico, research by Hernández-González et al. on Austria's flood risk management plans (FRMPs) showed that in order to prevent conflict, improved coordination among different regions through a comprehensive land-use planning approach is necessary (Hernández-González et al., 2016). In this vein, the authors suggest including the planning and development of green infrastructure as an arena for consensus-based decision-making.

2.5.7 Mainstreaming EbA and the multi-level governance of CCA and DRR

Although EbA is beginning to receive global policy attention (Lopoukhine et al., 2012; Mori et al., 2013), efforts to mainstream EbA and Eco-DRR approaches from national to local levels have not been critically evaluated. This is a challenge particularly for island nations in the Pacific Ocean that are experiencing severe climate change impacts and disaster risks. For many of them, there is yet to be integrated climate adaptation and disaster risk reduction policies within sectoral plans (Grantham et al., 2011).

Factors that could potentially improve the effectiveness of main- streaming EbA can been found in the Seychelles. These include leadership, institutional mechanisms, science–policy nexus, decision- making structures, stakeholder involvement, and technological innovation (Wamsler et al., 2014; Khan and Amelie, 2015). In the case of EbA implementation in the UK, a study by Burch et al. evaluated different barriers to mainstreaming approaches, which include ‘uncertainty of funding and climate change as a policy priority; organizational silos leading to insufficient communication; and a legacy of policies that deliver sub-optimal outcomes in the event of a changing climate’ (Burch et al., 2014: 79). Furthermore, in Samoa and Cambodia, the barriers to mainstreaming EbA primarily lie in the institutional and legal constraints at the national level (Chong, 2014). For example, in Samoa, the lack of institutional capacity, resources, and adequate laws made the management of natural resources fully dependent on customary law. In Cambodia, the lack of agency amongst resource-dependent communities is exacerbating poverty, illegal resource extraction, poor law enforcement, and corruption (Chong, 2014).

Finally, although adaptation measures are often implemented locally, local governance can be constrained due to limited capacity (Chong, 2014; Pasquini et al., 2013). Pasquini et al. (2013) conducted a study on the barriers to mainstreaming climate adaptation around the world, which concluded that party politics at the local level reduces the effective performance and operation of local governments. In addition, there is a danger of public officials abusing their power for political gain instead of for the public good. To tackle this problem, the authors suggest that national governments provide stricter controls in appointing senior municipal officials (Pasquini et al., 2013).

2.5.8 Innovation in Green Infrastructure for Ecosystem-Based Approaches to DRR and CCA

Since 2012, the literature has shown that ecological engineering – also referred to as bio-infrastructure, soft engineering, or green infrastructure – can be an innovative solution to current contradictions between unsustainable infrastructural development and ecological preservation (van den Hoek et al., 2012; Perkins et al., 2015; Meerow and Newell, 2017; Roberts et al., 2012; van Slobbe et al., 2013). Unlike traditional engineering approaches, which focus on solving problems with technological designs (Odum and Odum, 2003), ecological engineering provides protection against disaster and climate change impacts by combining infrastructural approaches with ecosystem services, which further promotes sustainable, adaptable, multifunctional, and economically feasible strategies. The so-called ‘soft’ engineering approach can also minimize the impacts of large-scale engineering projects that tend to neglect biodiversity and prohibit communities to gain access or benefit from livelihood improvements (Perkins et al., 2015).

Ecological engineering was first piloted in The Netherlands, particularly in the context of coastal protection against land subsidence, sea- level rise, storm surges, and flooding through the Building with Nature Project (BwN) (van Slobbe et al., 2013). However, a study on the application of the Sand Engine technology implemented in the Netherlands by van den Hoek et al. (2012) showed that the social implications of the project were more consequential than the natural system itself. Environmental uncertainties of the project – including climate impacts, water quantity and quality, and technological innovation pathways – were proven to not be a problem. On the contrary, social uncertainty – in the form of economic, cultural, legal, political, administrative, and organizational challenges – are far more constraining. One example mentioned by van Slobbe et al. (2013) is the existence of the Anti-Sand Engine Action

Committee, who argued that recreational safety and drinking water quality can be affected by the Sand Engine project. The movement was successful in negatively influencing the public's perception. Furthermore, to be able to manage social uncertainties, the research pinpointed the need to cope with diverse knowledge frames and interests through participation, cooperation, and dialogue among stakeholders.

Another challenge of ecological engineering is the lack of empirical baseline data to initiate the combined approach. Perkins et al. (2015) shows that current data on biodiversity and existing ecosystem services is lacking, which prohibits the evaluation of ecological impacts in the case of coastal structure and its effectiveness. Given these recent lessons, emerging theories and strategies of ecological engineering require further institutional support. This support must facilitate participation, dialogue, and the co-production of knowledge, especially for uncovering the social impacts of either existing 'hard' engineering or pipeline ecological engineering structures.

2.6 Governance opportunities and challenges

From our literature survey, we find several governance opportunities and challenges that are reflected in the theories, methods, and case studies of governing EbA and Eco-DRR. In general, existing governance theories – including socio-ecological systems and resilience, adaptive governance, climate risk governance, transformative governance, and ecological economics – have provided strong foundations upon which to further assess emerging EbA and Eco-DRR interventions. In terms of existing methods and case studies, we noted several important dimensions, which include economics, institutions, and spatial planning and implementation at the national, sub-national, and local levels. Furthermore, emerging innovation and technology – such as ecological engineering – serve as opportunities for the future implementation of EbA and Eco-DRR.

Theories of ecological governance and ecological economics are clearly reflected through diverse methodologies and case studies. The economic aspects of ecosystem services – including ecosystem valuation – are increasingly used to better inform decision-making and to support market-based mechanisms such as payments for ecosystem services. A challenge is the lack of data on the non-use values of ecosystems (i.e., recreational satisfaction or indirect use of ecosystem in the food chain) as well as multi-related ecosystems economic valuation (i.e., multiple ecosystem services among different land uses) (Bennett et al., 2009).

Institutional aspects are addressed mainly through the identification of actors and stakeholders; their capacity and interaction among different actors; ways to develop resources and capacities; and the assessment of compatible governance modes for implementing EbA and Eco-DRR. This has been specifically targeted in decision support tools such as in the example of TARA and different integrated management, mainstreaming, and transdisciplinary approaches. It has also been reflected in the case studies, especially in the context of science-policy interface and the processes for mainstreaming EbA into climate adaptation and disaster risk reduction across different governance scales.

The opportunities presented by spatial planning and implementation for mainstreaming EbA and Eco-DRR across national, sub-national, and local levels are also strongly reflected in our review. In terms of methodologies, many authors have suggested using collaboration platforms that facilitate discussion and consensus among policy-makers, government authorities, NGOs, local communities, private sectors, and researchers (e.g. as highlighted in the TARA approach, integrated management, and different transdisciplinary arrangements). Different community-based, knowledge co-production, and networked approaches, as well as integrated spatial management and science-policy interfaces have come through very strongly. Although fewer in number, the cases of emerging innovation and technology of combined ecological and 'hard' engineering have been groundbreaking. The hybrid approach – also known as ecological engineering – has the potential to mitigate the ecological impacts from traditional engineering approaches.

Besides the opportunities mentioned above, we noticed several challenges in terms of socio-political dynamics. Very few assessment methods and case studies critically evaluated the politics of EbA and Eco-DRR in the form of different power relations, negotiated spaces, equity and justice, and the role of community mobilisations. Instead, many of the cases focused on idealized elaborations of accountability, legitimacy, and adaptability (Renn, 2012)

For example, there have been no discussions of how governance actors are interacting with each other or how political behaviors, authorities, and powers can influence the governance outcomes of EbA and Eco-DRR. Other prominent issues such as equity, inclusiveness, and justice are still largely absent, as are nuanced analyses of the diversity, complexity, and competing socio-political scales. A structured methodology for diagnosing the opportunities and constraints of socio-political dynamics across different contexts is therefore required.

2.7 Synthesis: towards a critical governance approach to Eco-DRR and ecological engineering

Although the literature on the governance processes, interactions, and outcomes of EbA, Eco-DRR, and ecological engineering is only recently emerging, many authors highlight how governance is increasingly the main challenge facing disaster risk reduction and climate change adaptation. Future research should therefore consider the existing literature and enrichment of case studies with clear operationalization steps to catalyze policy changes. Our inventory of the different principles of governance – as well as how it is applied in different contexts – can be useful for adaptive learning. In particular, our review highlighted several notable gaps.

First is the lack of diverse disciplinary representation. Although there is a growing number of social and political scientists involved in EbA and Eco- DRR research, there is need for more critical, reflective evaluations of governance. Although most authors either explicitly or implicitly refer to theories of socio-ecological systems and resilience, the topic of Eco-DRR is still very much dominated by the natural sciences, ecologists and economists. Our survey uncovered many methodological and empirical examples that use ecological and economic assessments (such as ecosystem valuation and cost-benefit analyses); however, there have been no corresponding methodologies for assessing the political, social, and institutional dimensions of Eco-DRR or ecological engineering. Furthermore, there are only two case studies on political discourses in the context of EbA and Eco-DRR.

Second, there are no methodologies that promote integrated assessments to analyse the diverse and complex socio-political dynamics associated with implementing EbA and Eco-DRR. This may be addressed by first developing a database of regional and local case studies, with the objective of assessing lessons, developing evaluative criteria, unpacking the politics behind different projects, and highlighting potential implementation approaches across different contexts. This is particularly needed in the context of governing new innovations such as ecological engineering. Furthermore, we find inconsistencies in terminology across the board, where similar projects can be referred to as ecosystem-based adaptation or ecosystem-based disaster risk reduction. Developing robust assessment criteria will help with reducing this confusion.

However, the gaps mentioned above can also be seen as potential opportunities. There are rich theoretical traditions that help to frame the current ecosystem-based practices. These can be further complemented by the study of the institutional and political dimensions of governance, with particular focus on the ‘lived experiences’ of local politicians, implementation agents, and community beneficiaries. Similarly, with the methodology, there are opportunities for expanding into different regional contexts. Future research must interrogate the implications for ‘alternative’ governance models – i.e., ones that are not state-centric – such as self-governance, polycentric governance, and other more inclusive or participatory approaches. The theory of transformative governance and the TARA approach, for example, could be opportunities to provide guidelines for incorporating the institutional and political dimensions of governance. Finally, recent studies also shed light on the need to analyse resource/capacity inputs, institutional processes, and governance outcomes in the case of emerging ecological engineering and green infrastructure approaches (van den Hoek et al., 2012; Perkins et al., 2015; van Slobbe et al., 2013).

In sum, future studies must focus on building comprehensive operationalization strategies based on existing governance theories and methodologies, while also lending additional focus on appropriate integrated assessments that evaluate important socio-political, institutional, and power dynamics found across different spaces, scales, communities, and political arenas. The criteria for integrated assessments should be sourced from the ground up, but should also be available for translation across different contexts. This would ensure robust science-based – but also contextually appropriate – policy outcomes that are consistent with future EbA and Eco-DRR aspirations. These results will be important for further interrogating issues of governing emerging trends and innovations in EbA and Eco-DRR, including in the case of ecological engineering or green infrastructure.

2.8 Inferences

This chapter has highlighted the gaps in knowledge explored further in 1.2. It shows that the combination of social and physical systems have scarcely been covered with respect to Eco-DRR and hence the following chapter explains the interactive governance approach as a way to address the research question. The following lessons from the above literature that will be applied in this thesis include questions regarding the role of science in policy, knowledge co-production, and mainstreaming disaster risk reduction in policies.

CHAPTER 3

Interactive governance and governability

Chapter 3 : INTERACTIVE GOVERNANCE AND GOVERNABILITY

3.1 INTRODUCTION

This chapter explores the concepts of interactive governance and governability and provides the theoretical framework for this research. It explains why interactive governance is suitable for the task at hand, particularly for analyzing the challenges of reducing coastal risk with an Eco-DRR approach (see 2.4). The chapter examines: the perspective (see 3.2) and the features of interactive governance (see 3.2.1); the concept of governability (see 3.3), which drives the assessment framework; opportunities for improving governability (see 3.4); and the gaps that exist in the literature of interactive governance for its application to the field of disaster risk reduction studies (see 3.5). The focus lies on a set of four pathways that are suggested to be crucial to the governability of mangrove-based, coastal disaster risk reduction efforts. The argument is that these governing pathways tend to undermine risk reduction efforts if they are insufficiently available and contribute in a major way to risk reduction if they are present. Subsequent chapters will explore the reality of this proposition in the context of two case study sites.

3.2 THE INTERACTIVE GOVERNANCE PERSPECTIVE

The term governance derives from the Latin word "Gubernare'', which means to direct, rule, and guide (Torfing, 2012). During the 1970s, governments were faced with problems around the state-society relationships, including overload and ungovernability (see Peters and Pierre, 2016:10). Overload implies a response of failed states to meet the expectations of those whom they govern (see also Kooiman et al., 2008: 2, Peters and Pierre, 2016: 10). Meanwhile, ungovernability is defined as the "inability of government to steer the society" (see Peters and Pierre, 2016: 10). To respond to these two problems, in the late 1980s, the terminology of "good governance" was introduced by the World Bank (World Bank, 1989), setting the benchmark of how good governance should be qualified. Since then, the narratives of governance, which are rooted in the discipline of public administration, have greatly evolved and diversified (Bevir, 2011; Levi-Faur, 2012), departing from the normative understanding as proposed by the World Bank (1989) to include a realistic understanding of how governance takes place in practice. Common to all conceptions is that governance reaches beyond government to include other governing actors (Rhodes, 1996).

Interactive governance authors can be categorized as to their instrumental, cultural or democratic perspective (see Edelenbos and van Meerkerk, 2016: 6-7). Kooiman has been one of the prominent exponents in the instrumental perspective, which originated in the public administration field (Torfing, 2012; Edelenbos and van Meerkerk, 2016), aiming to increase the effectiveness of governance in solving a specific problem.

He argued that "governance can be seen as the pattern or structure that emerges in the socio-political system as 'common' result or outcome of the interacting intervention efforts of all involved actors and this pattern cannot be reduced to one actor or group of actors in particular" (Kooiman, 1993: 258). From this perspective, the interactions occurring between actors in a given societal system are crucial to the performance of governing, which is how the approach acquired its name.

Based on Kooiman, **Interactive governance** is defined as:

> "The whole of interactions taken to solve societal problems and to create societal opportunities; including the formulation and application of principles guiding those interactions and care for institutions that enable and control them." (Kooiman and Bavinck, 2005: 17)

Important in this definition is that governance is viewed as contributing not only to the resolution of public, or societal, problems, but to the anticipation of opportunities. In this thesis, I make use of the Kooiman perspective, as it enables me to understand how the social actors interact in protecting themselves against disasters.

3.2.1 History of the Kooiman interactive governance perspective since the 1990s

The interactive governance framework found its origins in Kooiman's (1993) work on public administration. The work of Kooiman et al. in on *Creative governance: opportunities for fisheries in Europe* (1999) then took him into the fisheries field (Kooiman, 1993). The interactive governance approach was adopted by scholars in the Fisheries Governance Network, who then started applying it to fisheries and coastal governance issues (Chuenpagdee and Jentoft, 2009: 110-111).

A series of publications in the MARE Publication Series (published by Springer) - including *Fish for Life- Interactive Governance for Fisheries* Book (Kooiman et al., 2005), *Governability of Fisheries and Aquaculture- Theory and Applications*, (Bavinck et al., 2013) and *Interactive Governance for Small-Scale Fisheries-Global Reflections* (Jentoft and Chuenpagdee, 2015) - explored and presented further development of thoughts and refinement of the governability and the governability assessment framework, mainly on the fisheries and aquaculture topic. This has been done through different methodologies and case studies.

The *Fish for Life- Interactive Governance for Fisheries* book (Kooiman et al., 2005) elaborates the theory of interactive governance, making use of a value chain approach. This book concludes with a first reflection on the notion of governability. The *Governability of Fisheries and Aquaculture-Theory and Applications* Book (Bavinck et al., 2013) further advanced the discussion by focusing on the societal concerns (i.e. ecosystem health, social justice, livelihood, and food security) that were already presented in the previous *Fish for Life* Book (Kooiman et al., 2005). The governability case studies are presented through different case studies including the trawl fisheries in India (Bavinck and Kooiman, 2013; Scholtens and Bavinck, 2013), marine protected areas in Spain (De la Cruz Modino and Pascual-Fernandez, 2013), salmon farming in Canada and Norway (Liu et al., 2013), gender relations in Galician shellfish gathering (Frangoudes et al., 2013), and poverty in small-scale fisheries in India (Onyango and Jentoft, 2013).

Methodological approaches to assess governability are further explored in this book, including the use of network analysis tools for assessing governing interactions (Mahon and McConney, 2013), the damage schedule approach that investigates values, principles, and images (Song and Chuenpagdee, 2013), and the facilitation of group processes for visioning (see Almerigi et al., 2013). While network analyses depend on the use of network web structure software such as UCINET and ECOPATH (Mahon and McConney, 2013), the last two approaches make use of stakeholder judgements for the prioritization process, in order to understand shared values, images, principles (see Song and Chuenpagdee, 2013 and Almerigi et al., 2013). Significantly, this publication also attempts to formulate a framework for the assessment of governability (Chuenpagdee and Jentoft 2013). This framework will be discussed more extensively in Chapter 4.

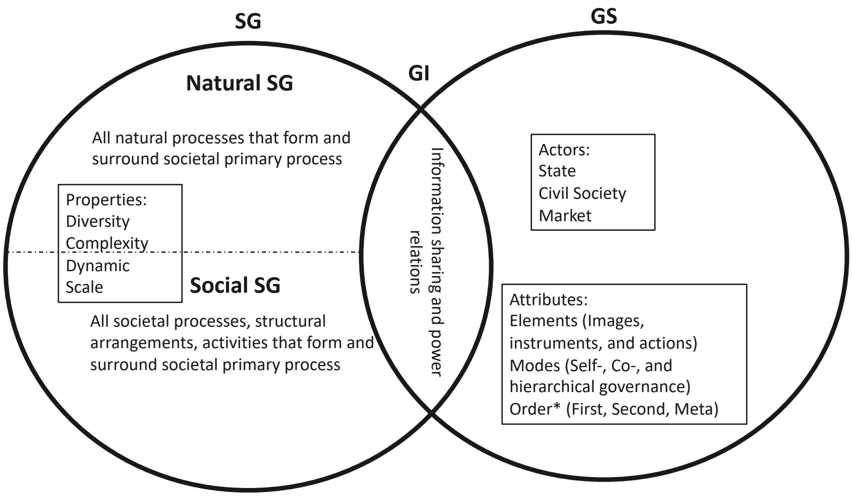
The *Interactive Governance for Small-Scale Fisheries-Global Reflections* book (Jentoft and Chuenpagdee, 2015) provides a broad set of case studies on small-scale fishing around the globe using the lens of interactive governance and governability. Focusing on the relation of governing system orders and modes (terms which are explained more fully in Section 3.2.2 below), this publication concludes that in order to improve governability, the meta order principles should be reflected in second-order governance. Having sketched the genesis of the interactive governance approach, I now turn to its characteristics.

3.2.2 Characteristics of the interactive governance approach

The interactive approach, as developed by Kooiman (2003), commences with the notion of a 'societal system'. A system is defined as "The whole of inter-relations among a given number of entities belonging to the natural and social worlds" (Kooiman and Bavinck 2013: 13). The contours of such systems are not fixed but depend on the nature of the research enquiry. In all cases, such systems should be viewed as part of larger spatial and temporal wholes.

According to the interactive governance approach, all societal systems can be analysed as consisting of three sub-systems: a system-to-be-governed (SG), a governing system (GS), and a set of governing interactions (GI). The governing interactions occur within and between the sub-systems and their quality is influenced by so-called properties of SG and so-called attributes of the GS (see Figure 3.1). This section further explains the definition of each sub-system, its properties, and attributes.

Figure 3.1 The interactive governance model of a societal system



Source: Adapted from Kooiman, (2008); Chuenpagdee and Jentoft (2013)

3.2.2.1 System-to-be-governed, governing system, and governing interactions

The three sub-systems are understood as follows. *System-to-be-governed (SG)* is defined as "all processes including societal and natural, and structural arrangements, activities that form and surround the societal primary process" (Kooiman and Bavinck, 2013: 15). The societal systems in which interactive governance scholarship shows interest generally revolve around 'primary processes', understood as "those activities that meet basic human needs" (ibid.). Many such primary processes – such as fisheries, but also coastal disaster reduction – have a natural and a social component. Their study, therefore, involves consideration of natural conditions and processes, as well as societal actors and structures.

Governing system (GS) is "the total set of mechanisms and processes that are available for guidance, control and steerage of the system-to-be-governed in question" (Chuenpagdee et al., 2013: 16). GS includes actors, entities, and parties which have varying potentials available for the governance roles and task regarding the SG. Governing actors can belong to the domains of state, market and civil society (Kooiman et al., 2008: 2).

Governing interaction (GI) appears in two levels, which are within the actor level (intentional) as well as the structural level, or contextually situated within circumstances such as institutions, general social constructs, patterns of communication, material and technological possibilities and societal power distributions (Kooiman, 2003: 13-15).

3.2.2.2 Properties

The interactions taking place among actors within SG, GS and GI are affected by at least four properties: diversity, complexity, dynamics and scale (DCDS) (Kooiman and Bavinck, 2005: 13-14)[4]. *Diversity* means the quality of various actors, resources and their potential within the social and natural system-to-be-governed. *Complexity* is defined as the examined interdependencies of the structures in the system. *Dynamics* means the potential for change in the system resulting from the changes in its subsystem condition and settings. *Scale* is the pre-determined dimensions of space and time, and also refers to the embedding of localized systems in higher scales. This thesis pays special attention to the properties of diversity and dynamics, for reasons that are explained in Chapter 4.

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[4] In specific case studies in fisheries and coastal governance, other properties are also included, such as vulnerability, capital, and resilience (Kooiman, 2008).

3.2.2.3 Attributes

Kooiman (2003) has divided the attributes of societal systems into orders, elements, and modes.

Orders here means the order of governance which is suitably applied to the governing system. It consists of first, second, and meta order governance. *First order governance* takes place in the interaction between people and responsible institutions on a day-to-day basis. The process includes the identification of problems and the characteristics of the problem in order to solve the problem efficiently and effectively. *Second order governance* tackles the institutional arrangements beyond the first order governance task. It regulates arrangements, rules, rights, and laws in an institutionalized manner. Furthermore, *meta-, or third order governance* take roles in the core principles and norms behind the first and second order of governance. Meta-governance can be seen through different normative lenses, (Kooiman, 1999; 2008; Chuenpagdee et al., 2013) including rationality, responsiveness, and performance. Meta-governance is the core and includes the nurturing principles taken by governing actors considering the properties of the whole governance system. It feeds and binds, and evaluates the first and second order of governance (Kooiman, 2008).

Kooiman (2003) defines **elements** of governance as an intentional activity. There are three elements: images, instruments, and actions. *Image* is defined as a perceived opinion of problems and solutions. The understanding of image is important to determine how actors perceive problems and their underlying direct and indirect causes, and hence how such problems should be addressed in order to achieve effective and efficient governance. *Instrument* constitutes a linkage between the image to action by a certain arrangement of the wide array of instruments or toolboxes in order to govern the system-to-be-governed (Kooiman and Bavinck, 2013: 18) whereas *action* is the final activities to put instruments into implementation. Only when the three of elements fit, corresponds and complement to each other, goodness of fit can be achieved and can help to improve governability (see also 3.4.2).

Modes of governance can be distinguished as three, including hierarchical, self-, and co-governance (Kooiman, 2008). In real life, there are often more mixed patterns of governance modes (Kooiman, 2003: 90). *Hierarchical governance* takes place through 'interventions', or authoritative intrusions from above (Bavinck and Kooiman, 2013: 146). This mode of governance is usually dominated by a command, control and steering process (see Kooiman, 2003) and will only work when there is a strong compliance-pull. Meanwhile, s*elf-governance* applies to the condition that actors take care and govern themselves. Most of the time, this concept has been translated into societal capability to solve the lack of government capacity to tackle specific problems (Kooiman and Chuenpagdee, 2005: 334). And *co-governance* is joint actions with common goals and is referred to as co-management or collaborative governance (Ansell and Gash, 2008). Co-governance mode, with wider distribution of power to diverse societal actors, could hypothetically motivate social mobilisation and societal changes (see also 3.4.3).

3.3 Governability

After discussing the interactive governance perspective, this section focuses on the concept of governability. Governability, which has come to occupy a foremost place in the interactive governance approach (Bavinck et al. 2013; Kooiman and Chuenpagdee, 2005: 342-344), is utilized to assess the performance of Eco-DRR strategies in this dissertation.

Governability is defined as "The overall capacity for governance of any societal entity or system as a whole" (Kooiman et al., 2008: 3). Within the interactive governance approach, it is assumed that governability is influenced by the characteristics of each of the sub-systems (see Jentoft, 2007; Kooiman and Bavinck, 2013: 12), and is, therefore, the result of a combination of influences. This is an important observation: it means that for understanding the condition of governance of any societal system, one considers not only the functioning of the GS but also of the other sub-systems.

Kooiman and Bavinck (2013: 12) discuss governance *capacity* as depending on the *quality* of the object (system-to-be-governed), subject (governing system) and the relationships between the two systems (interaction). Furthermore, the characteristics of each system will influence and produce a certain level of governability as the outcome. The governability concept can thus be viewed as an attempt at systematic thinking to answer the question of "what constitutes effective governance in the first place" (Chuenpagdee and Jentoft, 2009: 112-113).

In line with the above, interactive governance scholars have actually also defined governability not only as the *capacity* but also the overall *quality* of governance (Kooiman and Bavinck, 2013; Chuenpagdee and Jentoft, 2013). This highlights the more nuanced assessment of limits and opportunities of the governance system, including the potential malfunction and complex relationships among different systems (i.e. natural and social system-to-be-governed, governing system, and their interactions) and their features (diversity, complexity, dynamics, and scale) (see Chuenpagdee and Jentoft, 2013: 42-43).

Interactive governance scholars also developed an assessment framework, which could be applied to fisheries, aquaculture, and other contexts. Such a framework would allow for the comparative evaluation of the capacity/quality of governance of societal systems (Chuenpagdee and Jentoft, 2013). Chuenpagdee and Jentoft (2013) were the first to propose a framework for governability assessment which integrates the assessment of the three sub-systems into a whole. This framework (see Chapter 4) is applied in this thesis.

3.4 Opportunities and way forward: returning to the role of governing pathways to improve governability

Kooiman (2003: 62-63) suggests that the governability approach assists in identifying possibilities for improving the capacity to govern (governability) at the actor but also at the structural level. However, questions remain on the conditions that deserve attention. In this research, the focus lies on studying four governing pathways to improve governability. The four pathways were identified from interactive governance theory, in conjunction with the literature on adaptive management (Gupta et al., 2010; Hurlbert and Gupta, 2016) and Eco-DRR. The first pathway focuses on the GS and the presumed existence of multiple governing actors – it looks into the issue of coordination. The second pathway examines the 'goodness of fit' between the GS and the SG, in other words, between governance solutions and the nature of the problems at hand. The third pathway considers the realm of governing interactions and in particular the need in Eco-DRR for hands-on, community involvement – it therefore takes the angle of social mobilisation. Finally, the fourth pathway departs from the dynamics of natural and social sub-systems and the uncertainties surrounding climate change and its impacts – it investigates the role of learning and adaptiveness in responding to changes in the SG.

The choice of these four pathways find justification in the scholarship on interactive governance. Kooiman (2003) thus points out that "co-ordination is a major governing mechanism […] in handling complex societal issues" (2003:75), and notes that "factors complicating co-ordination are easy to find" (ibid.:73). Mahon (2008) and Chuenpagdee (2008) were the first to make use of the term 'goodness of fit' to describe the match that must exist between a GS and a SG for governability to increase within the context of interactive governance – but the problems of fit, interplay and scale were already being discussed in the Institutional Dimensions of Global Environmental Change literature (IDGEC, 1999). The term then found its way into Chuenpagdee and Jentoft's (2013) assessment framework, as a 'feature to look for' under Step 3. Social mobilization is closely related to the second of three ways forward, as described by Mahon et al. (2005). This pathway follows from "the need to be inclusive and to share in the responsibility of governance" (2005: 363 ff), a dictum that is replicated in Chapter 4 of Bavinck et al.'s (2005) guide for better fisheries governance practice. According to Mahon et al. (2005) and Bavinck et al. (2005), the final direction for improving governability is by enhancing learning and adaptiveness.

The following section considers each of the pathways in turn, also including insights from broader literature.

Table 3.1 Relationship between theories/concepts with responding pathways for successful Eco-DRR

Concept origins	Relation with the concept origins	Responding pathways
Interactive governance	Responding to the condition of multiple governing actors (see 3.2.2.2).	Coordination (see 3.4.1).
Interactive governance	Responding to matching orders and elements (see 3.4.2).	Goodness of fit (see 3.4.2).
Interactive governance and Eco-DRR	The prerequisite of successful Eco-DRR (see 2.3.1); co-modes of governance (see 3.2.2.3).	Social mobilization (see.3.4.3).
Interactive governance, DRR, climate change adaptation	Interaction between natural and social system-to-be-governed (see 3.2.2) Dynamics of SGs (see 3.2.2.2), Uncertainty and global environmental changes (see 1.1).	Learning and adaptiveness (see 3.4.4).

Source: Author

3.4.1 Coordination

Coordination includes social activities (Lin, 2002) and social interactions (Becker, 1974: 1087). The explanation of coordination in the literature often links coordination to activities in relation to building a network (Lin, 1999; Goyal and Vega-Redondo, 2005) and forming successful social institutions (see Calvert, 1995). Governance itself is often mentioned as the 'institutionalized form' of social coordination as a way to solve common problem (Lee, 2003; Bevir, 2008).

Coordination used in this research is linked to current interactive governance discourse (see Table 3.1). It takes place at the macro level (Kooiman, 2003: 72) or beyond the individual and focuses on relations across different entities. It is the guided collective action of efforts among groups of individuals to achieve a common goal when individual self-interest would be inadequate to achieve the desired outcome (Ostrom 1990). It is necessary when there are diverse, socially complex issues that need to be dealt with (see 3.2.1.2). Coordination requires an actor that brings different actors together, resolves their differences, allocates the the division of labour, functional differentiation and specialisation of the different actors and networks involved and monitors the effectiveness of the process. Coordination enables the institutionalization of ideas and practices in formal institutions (Kooiman, 2003: 72). However, it is only successful when the coordinator has a clear mandate and resources, when agencies are mutually interdependent and when the coordinator is able to ensure consensus on the image of the problem (and its underlying drivers), and the instruments, and actions that should be taken to solve the problem. Finally, within the discussion of interactive governance Kooiman (2003: 75) stated that "whatever its shortcomings, bureaucracy serve as a relatively controllable hierarchical structure for those coordinating interactions". This implies that in governing the government is still a very important and legitimate actor to ensure effective coordination.

3.4.2 Goodness of fit

The terminology of 'goodness of fit' has been intensively used within the interactive governance scholars (see Chuenpagdee and Jentoft, 2013; Mahon, 2008; Mahon et al., 2008). The goodness of fit refers to the degree to which the governing system matches the traits of the system that it aims to govern (see Jentoft and Chuenpagdee, 2013). Variables of the goodness of fit of elements entails the evaluation of the fit of actions taken, to the problems and their images (Jentoft and Chuenpagdee, 2009; Chuenpagdee and Jentoft, 2013: 342) (see also Section 3.2.2.3 on attributes-elements; Chapter 4 for operationalization). The goodness of fit of elements define the appropriateness of the governing system. It looks at the relationship that occurs between images of problems, goals, instruments, and actions as the governing elements (see Kooiman et al., 2005). The higher the fit between the elements, the higher the degree of governability.

3.4.3 Social mobilisation

The general definition of social mobilisation is the process by which individuals or sections of society mobilise in order to effect social change (Oxford Living Dictionary, 2017). The manifestation of the changes is varied, such as "changes of residence, occupation, social setting, face-to-face associations, institutions, roles, and ways of acting, experiences and expectations, and finally personal memories, habits and needs, as well as the need for new patterns of group affiliation and new images of personal identity" (Deutsch, 1961: 493). The concept of social mobilisation is often being discussed in the context of a spontaneous form of citizen engagement (see Leach and Scoones, 2007: 7). Scholars distinguish the concept of social mobilisation around the so-called 'old' and 'new' social movement discourse. The first one refers to the context of material resources and political power struggle (e.g. Oberschall, 1973; Tilly, 1978), whereas the latter is focusing on emerging issue and identity struggles (e.g. Habermas, 1996; Eyerman and Jamison, 1991; Touraine, 1985; Melluci, 1996; Offe, 1985; Scott, 1990). Example of the 'old' social movement discourse is reflected within the discussion of resource mobilisation theory and collective action (see Ostrom, 2014). Resource mobilisation theory put forward the idea that in order to harness its full potentials, proper use of resources and incentives for realizing actions are crucial (see McCarthy and Zald, 1977). Furthermore, the new insight on the role of civil society, for instance, cover the issues such as ethnicity, gender, and sexuality (Klandermans, 1991).

Within the interactive governance concept, social mobilisation is briefly introduced by Kooiman (2003). He focuses on mobilisation for governance purposes, which could be a manifestation of social-political activism and the use of social capital (Kooiman, 2003: 69). Actors may agree to be mobilized for different reasons (Kooiman, 2003: 69). It also relates to the modes of governance which reflect the way governance is operated, how decision-making power is distributed and by whom (see section 3.2.2.3 on attributes-modes). The co-modes of governance, which facilitate more interaction and a balanced role of diverse actors to co-govern (state and non-state) will generally open more opportunity for meaningful social mobilisation. Furthermore, the social mobilisation concept fits with the contemporary discussion on Eco-DRR, where the public involvement, resource mobilisation and the support of the local community is a major requirement for successful Eco-DRR efforts until the ecosystem becomes self-sustaining (see also 2.3.2 and Table 3.2).

3.4.4 Learning and adaptiveness

Folke et al. (2005) identify two factors which can increase resilience. This includes the capacity for the system to self-govern and the capacity to learn and adapt. Learning can be defined as "a collaborative or mutual development and sharing of knowledge by multiple stakeholders (both people and organizations) through a learning-by-doing" (Armitage et al., 2009: 96). The source of knowledge in learning from technical expertise and local knowledge is crucial, although it can be limited, especially in changing and complex environments (Armitage et al., 2008). Effective learning would be embraced by "group decision making that accommodates diverse views, shared learning, and the social sources of adaptability, renewal, and transformation" (Armitage et al., 2009: 96). In the context of environmental change and abrupt shocks, the adaptive capacity of resource governance regimes as multi-level learning processes (see Pahl-Wostl, 2009). This condition would apply in the context of disaster and climate change adaptation (see Table 3.2).

The condition which would facilitate learning includes the flexibility of institutions which could encourage the process of reflection (see Lee 1999; Cook et al., 2004). The existence of informal networks that bridge various actors including government agencies, private sectors, research institutions and civil societies could facilitate effective learning (See Mahon, 2008; Pahl-Wostl, 2009) Several challenges affecting learning include power asymmetries among different actors, conflicts, ambiguity of information and lack of monitoring of learning outcomes (see Armitage et al., 2008).

Within the realm of interactive governance, learning and adaptiveness are important as it is also a form of governing interactions within and between the (natural and social) system-to-be-governed and governing system (see 3.2.2.1). Mahon et al. (2008; 2013) and Bavinck et al (2005: 59) show in fisheries research that learning can happen through experimental (learning by doing) approaches within the interface of the human-in-nature system. Furthermore, balanced images on the problem, goals, instruments and actions (goodness of fit) (See 3.4.2.2) would likely bring more responsiveness of the system and thus increasing adaptive capacity (see Mahon et al., 2013). Strong learning is important in interactive governance concept, which requires frequent feedback, flexibility to adapt to best available information, to profit from the experience of a different context, to obtain institutional memory to learn from others and increase the efficiency of process and quality. To manage the uncertainty, developing a learning organization which embraces lifelong learning and is crucial (see Bavinck et al., 2005: 49; Mahon et al., 2005). According to adaptive management scholars, more complex and diverse governance regimes proved to produce higher adaptive capacity (See Pahl-Wostl, 2009). However, the governability of such process remains questionable. Although the literature discusses single loop, double loop and triple loop learning, I focus here on learning in general.

3.5 Inferences

Based on the review of the overall concept of interactive governance and governability, the major knowledge gap addressed by this thesis is the relative lack of empirical and methodological applications of governability assessments (see Kooiman et al., 2008; see 1.2.2). As mentioned above, the interactive governance and governability approaches have been applied most intensively to the domains of fisheries and aquaculture, although some other societal systems have also received attention (see Derkyi, 2012) An expansion to other fields, such as coastal risk reduction, adds to the literature and provides opportunities for comparison and cross-sectoral learning. Based on the case studies mentioned above, the range of comparison and analyses between scientific studies found in the sub-discipline of interactive governance and governability has resulted into some common concerns among the researchers related to the theoretical realm as well as the application of this concept in real life. Second, the interactive governance scholarship has generated an assessment framework to provide guidance in measuring governability, but this requires further elaboration (Chuenpagdee and Jentoft, 2013: 348; see Kooiman, 2013: 353). Finally, there are still limited references to the pathways that can be followed in improving governability on the basis of its assessment (Song et al., 2018). This thesis aimed to contribute to explore the role of governing actions as an agent for governability improvement, focusing on the pathways of coordination, goodness of fit, social mobilization and learning and adaptiveness.

Hence, the framework of interactive governance has been selected in this research. The concept helps to unfold governance systems and interaction among sub-systems for a better understanding of problems, involved actors, as well as the socio-ecological-political dimension of such systems. This thesis seeks to contribute to the development of methodology and empirical research in assessing the governability of ecosystem-based disaster risk reduction (See Chapter 4).

CHAPTER 4

Research methodology

Chapter 4 : Research Methodology

4.1 Introduction

This chapter sets out the methodology used for the case study analysis. It operationalizes the theoretical framework of interactive governance and governability in order to answer the research questions (see 1.3). This chapter answers the following questions: What are the methods used in this research and how does this research deal with ethical dilemmas? (see 4.2); How is the framework constituted and what are the steps and measures needed to operationalize it? (see 4.3); and; and finally, what are the limits of the methodology that is employed? (see 4.4). By doing so, it provides the contours of the analysis of empirical cases in Chapters 5 to 8, and subsequently for their comparison in Chapter 9.

4.2 Methods

This research makes use of a mix of qualitative and quantitative research methods. The decision to employ a mixed method approach is based on the idea that all methods, either quantitative or qualitative, had their own biases and weaknesses. The mixed form of methods is expected to neutralize those biases (Creswell, 2013: 15). The qualitative part of the research has been done through review of policy and other secondary sources and interviews with key respondents. The latter played a role in all steps of governability assessments, but significantly in *step 1-identifying the nature of the problem and step-2 examining system properties* (see 4.3) whereas quantitative research has been done through a survey with the combination of a Likert-based questionnaire and semi-structured questions, specifically in *step 3- evaluating the governing system and step-4 governing interaction analysis.* In order to increase the flexibility and accuracy of findings, especially on researching the complex issues (see Bryman, 2008: 472) triangulation has been undertaken during the course of data collections for seeking convergence between qualitative and quantitative data (Jick, 1979 in Creswell, 2013: 15). Furthermore, the convergent parallel design is executed during the integrated analysis of *step 3, 4, and 5* in the governability assessment (see 4.3), where I collected the data roughly at the same time and integrated them to arrive at a conclusion. Furthermore, the convergent parallel design is characterized by equal weight given to the quantitative and qualitative data by conducting comparison and relation (see Creswell, 2013: 15), which is done in this research.

The research took place in four overlapping phases, including (1) Literature review and policy documents; (2) Fieldwork (i.e. survey, interview and focus group discussion) and (3) data analysis. The research timeline and location can be seen under the Table 4.1.

Table 4.1 Research timeline

Activities	Timeline	Location
Literature review	2014-2016.	The Netherlands.
Orientation visit	October 2014.	India.
	October 2014.	Indonesia.
Fieldwork period 1	April-June 2015.	Indonesia.
	February-April 2015.	India.
Data analysis	2015- 2016.	The Netherlands.
Fieldwork period 2	October 2016.	Indonesia.
	February 2017.	India.
Data Analysis	2017-2018.	The Netherlands.

Source: Author

4.2.1 Literature review

A literature review was conducted prior to the fieldwork (see Table 4.1) through keywords-based search (Levy and Ellis, 2006) on literatures existing from 2004 to 2016. Chapter 2 reviews the literatures based on keywords disaster risk reduction' and 'ecosystem-based disaster risk reduction' and 'governance' and 'ecosystem-based adaptation' as the relevant core concepts (see also 2.2). Furthermore, Chapter 3 reviews the literature on interactive governance and governability assessment. For the case studies, I also reviewed all relevant papers.

To enhance the reliability of the reviewing process of literature, backward and forward referencing methods were also (Webster and Watson, 2002; Levy and Ellis, 2006). The literature review was divided into three types of elements to be reviewed, which include: (1) referencing; (2) authors and (3) keywords. Backward literature review (cf. Levy and Ellis 2006) consists of reviewing the references of the articles yielded from the keyword search noted above, whereas forward literature review refers to reviewing additional articles that have cited the articles in question. The databases used were EBSCO Host, Science Direct, and SciVerse Scopus.

4.2.2 Review of secondary sources

Subsequently, the laws, policy, and regulations were collected and analysed. The content analysis included attention for international global frameworks (see 1.5), national, and sub-national level. At the national and sub-national level, I analysed 13 policy documents for Indonesia and 9 for India related to coastal management, biodiversity conservation, forest management, and disaster management. This analysis was quite limited to understanding only what was directly relevant for the case studies.

4.2.3 Case studies

This thesis compares two case studies. I chose the case study method for this research because it enables understanding of an empirical contemporary phenonmenon and addresses the why and how questions, and may enable the testing of pathways for theory construction (cf. Easton, 2010; cf. Gerring, 2007).

I chose to analyse coastal disaster risk governance in Indonesia and India since, first, they have both suffered recently from coastal disasters including the Indian Ocean Tsunami in 2004 and coastal erosion induced flooding (Murty et al., 2007; Karan and Subbiah, 2010); and second, they have both using mangrove ecosystems as protection against ongoing coastal disaster (Kathiresan and Rajendran, 2005).

Within these two large Asian countries, I selected the mangrove area of Sayung sub-district in the district of Demak Northern Java Coastal Area, Indonesia and Pichavaram Mangrove in Parangipettai Block, Tamil Nadu, India because of: (a) contextual similarities (both are low-lying coastal areas, experience monsoons and therefore vulnerable to coastal disaster (Marfai, 2011; Khan, 2012; Selvam et al., 2003; 2004; Triyanti, 2013;); (b) the implementation of coastal ecosystem-based disaster risk reduction strategies (DasGupta and Shaw, 2014). However, there are also differences between the two case studies, both in their physical and human geography (see Chapter 5 and 7). In hindsight, the choice of these two case studies may have influenced the nature of my outcomes.

4.2.3.1 Fieldwork

Interviews

A series of in-depth interviews – 20 in Indonesia and 37 in India – were conducted with key respondents. I used the snowball method for identifying interviewees. Appendix II contains an anonymized list of the interviewees from government departments, NGOs, communities, researchers, and the private sector. Appendix C contains the guiding list of questions.

Survey

I conducted 200 questionnaires in Demak, Indonesia, and 200 in Parangipettai Block, India. These questionnaires made use of structured and semi-structured Likert-based questions to assess perceptions and opinions (see Appendix C1 and C2 for the questionnaires). The purposive sampling is used to select the research units in both case studies and quota sampling is used to define the number of samples. The selection of 200 households was done through accidental sampling or based on the availability of the household (see Bryman, 2008) with no specification of gender and age. In doing this I was supported by students from the Faculty of Geography, Universitas Gadjah Mada, Yogyakarta, Indonesia. No translator was needed in Indonesia as the author is fluent in Bahasa Indonesia and Javanese Language. In Parangipettai Block, India, I was supported by student assistants and guided by professors from the Institute of Ocean Management (IOM), Anna University, Chennai and Annamalai University, Chidambaram. The translation of the results of the 200 surveys from the Tamil Language to English has been done by the students and lecturers from Madras University, Chennai, India.

Focus group discussion

Two focus group discussions were conducted, one each in Indonesia and India. The participants were selected from different actors including the head of local? government agencies, head of village and hamlets, and mangrove groups in different hamlets. All participants were of the male gender. This is due to the lack of representation of women and power imbalance when doing focus group discussion. Therefore, to gather information from female respondents, in-depth interviews were conducted.

4.2.4 Data Analysis

Quantitative data has been analysed through the help of SPSS statistics software. The results were triangulated with inputs of qualitative data.

4.2.5 Mapping

Mapping of the two coastal regions was done to help the candidate to understand certain geomorphological condition, dynamics (i.e. shoreline changes, geomorphological landscape) and spatial patterns of land-use (i.e. mangrove forest and settlements) and how this affects the risk of disaster and the effectiveness of the mangrove-based approach. Maps in this thesis make use of the free source satellite images including Google earth images which are hosted by Landsat images from 1972 onwards and were also sourced from the Indonesian and Indian topographic maps for various years. The delineation of objects (lines and polygons) and spatial analysis has been done with the help of ArcGIS 10.4.1 as well as Google earth application using cartographic principles which are based on the convergence of evidence in a deductive process (see Crampton, 2011).

4.2.6 Ethics

Ethics approval was obtained prior to research from the Amsterdam Institute for Social Science Research (AISSR) University of Amsterdam Research Ethics Board (see Appendix D3). The ethics statement dealt with the collection of the data during the interview, survey and FGD process, research consent and permission, as well as the management of the research data.

4.2.6.1 Consent, permission and privacy

Research consent was collected verbally and informally for both case studies before the interview was conducted. I obtained the letter of permission to conduct research in Demak, from the Indonesian government (see Appendix D1). The Institute of Ocean Management (IOM), Anna University, formally hosted the research in Tamil Nadu, India (see Appendix D2). The anonymity of respondents was respected through the aggregating of research findings. Where interviewees are quoted, their identity is protected through the use of a pseudonym. Furthermore, no recording was made, and individual responses cannot be traced back to participant identities.

4.2.6.2 Data transparency

The raw data collected is stored in personal notes of the author and questionnaire sheets. The digital version of this data is stored securely in the author's personal database, which is password protected. Access to this data is provided only upon request (and through the intercession of the promoter).

4.3 Conceptual framework and operationalization

4.3.1 Overview and conceptual model

Chapter 3 noted that the scholarship in interactive governance has recently applied itself to the development of a framework for the comparative assessment of governability (see Section 3.3). This thesis makes use of the governability assessment framework by Chuenpagdee and Jentoft (2013), which consists of 5 steps. Each step contains a description of targets, features, and measures (see Table 4.1 and Appendix A1, A2 and A3). Table 4.2 provides an overview of the framework as drawn up by Chuenpagdee and Jentoft (2013), and adjusted for the purpose of this study. There are several modifications made, including: (1) the problem contextualization. This study focuses on Eco-DRR governance instead of fisheries governance; (2) the notion of establishing the degree of the 'wickedness' of the problems at hand, which features in Chuenpagdee and Jentoft's Step 1, is replaced by the reference to the 'nature' of the problems at hand. This modification has been made as it is more useful to understand the nuanced nature or origin of the problem and how it linked to current natural and societal systems and governability rather than determine the ‘level of wickedness’ per se.

Table 4.2 Governability assessment steps

Assessment step	**Targets (Where to look)**	**Features (What to look for)**	**Measures (What to look at)**
Step 1 Identifying the nature of the problem	Coastal disaster risk	**Nature of the problem.**	Images of the problem. The embeddedness of the problem (i.e. the direct and indirect causes of the problem). Social impact of the problem
Step 2 Examining system properties	Natural system-to-be governed	**Prevalence of system properties** (i.e. diversity, dynamics, and scale).	Components for diversity Relationships for interactions for dynamics, boundaries for scales.
	Social system-to-be governed	**Prevalence of system properties** (i.e. diversity, dynamics, and scale).	Components for diversity interactions for dynamics, boundaries for scales.
Step 3 Evaluating the governing system	Governing system	**Goodness of fit of elements** (i.e. images, instruments, and actions).	Behaviour, decision mental models, institutional arrangements, implementation.
		Responsiveness of modes (i.e. self-, co-, and hierarchical).	Awareness, learning, sensitivity, conflicts.
		Performance of orders (i.e. first, second, and meta).	Consistency, effectiveness, transparency, justice.
Step 4 Governing interactions analysis	Governing interactions	**Presence and quality of interactions.**	Information sharing, co-learning, adaptiveness.
		Enabling and restrictive role of power relations.	Inclusiveness, representativeness, participation.

Source: Adapted from Chuenpagdee and Jentoft (2013)

4.3.1.1 Step 1-Identifying the nature of the problem

The operationalization of this thesis started with the identification of the nature of the problem. While Chuenpagdee and Jentoft (2013) focus on the identification of the problem, I choose to broaden the scope of the investigation to the nature of the problem, irrespective of its wickedness. (see Table 4.1). Based on Chuenpagdee and Jentoft (2013), several indicators - or what to look at in terms of the nature of the problem include: Stakeholders’ images of the problem, the embedded nature of the problem (i.e. direct and indirect causes), and the impact of the problem. However, in this thesis, three indicators are selected to help to set the scene and illustrate the current condition in the two case studies. It includes the (1) identification of the problem; (2) embedded nature of the problem and (3) impact of specific coastal risk to the community.

In coastal disaster risk reduction and ecosystem-based protection using mangrove resources, there are complex interlinkages and interplays between the natural and social variables as the direct and indirect cause of the problem. For instance, it is unclear to what extent natural and or human pressure contributes to the higher degree of coastal risk (e.g. flooding, storm, erosion). It is therefore difficult to find a single solution. The governability assessment framework which is presented in this chapter offers the tool to analyse the nature of the problem in order to assess the full picture of governability.

1) Identification of the problem

Here, the assessment involves the identification of the problem based on the author's observation from literature and on fieldwork results. It assesses the consensus or overlap between the stakeholders in determining the problem (asking into the perspectives of government authorities, NGOs, and members of civil society).

(2) The embedded nature of the problem

The assessment also considers the bigger problems that might be situated behind the problems that are evident in the local setting. This thesis thus enquires into the problems surrounding the issue of ecosystem-based protection to coastal disaster and in particular looks at the direct and indirect causes of the problem.

(3) The impact of the problem

Lastly, the assessment involves an analysis of the impact of problems on local society, asking into direct and indirect effects. While some impacts are immediately evident, others are expected or emerge only in the course of time.

4.3.1.2 Step 2- Examining system properties

Section 3.2.2 described the manner in which interactive governance scholars study societal systems, distinguishing SG, GS, and GI. According to interactive governance theory, attention is then given to the four properties: (1) Diversity; (2) Complexity; (3) Dynamics; and (4) Scale (DCDS). To do so comprehensively is a labour-intensive, if not a herculean task (see Song et al., 2018). In this context, choices have to be made in order to ensure a focus and clear research instruments. Each DCDS property has different characteristics: the components for diversity; relationships for complexity; interactions for dynamics and boundaries for scale. This research, however, simplifies the analysis, by focusing on the properties of diversity and dynamics, with some attention going to scale. These properties are obviously relevant to the topic at hand, in which change and uncertainty are important factors, and coastlines – made up of diverse natural and human elements - probably require other solutions. The definitions used in this study are: *(1) Diversity relates to resource units and relevant stakeholders, includes heterogeneity and the quantity of systems in different spatial scales;* and (2) *Dynamics relates to the changes in the contemporary process and in different temporal scales.* Furthermore, *scales* is addressed in this research through the temporal scale (i.e. included in dynamics) and the governance scale (i.e. perspective on national, regional and local level governance). In this step, a qualitative approach, making use of guiding questions, is used in order to operationalize the assessment framework in the field. The natural SG assessment is based on the analysis of variables of geomorphology, oceanography, climate, soil, and biodiversity. These natural SG variables are selected as they affect the degree and speed of coastal disaster, as well as the capability of mangrove ecosystem to provide regulating services (Marfai, 2012; Subardjo, 2004) (see 1.5). Meanwhile, the social SG variables are: demography and settlement distribution, occupational transition, and migration. These social SG variables have been selected as they are perceived to strongly affect the exposure, vulnerability and coping capacity of inhabitants in facing coastal disasters (see Joseph et al., 2013). The guiding questions for step 2 are modified and contextualized from Chuenpagdee and Jentoft (2009: 114) (see Appendix A1).

4.3.1.3 Step 3-Evaluating the governing system

This step concentrates on aspects of the governing system. The features assessed include the goodness of fit of elements, the responsiveness of modes, and the performance of orders. To collect and analyse the data, a mixed of quantitative and qualitative approach, using guiding questions and Likert scale analysis is used (see 4.4 for detail explanation on methods).

In brief, the variables of 'goodness of fit' entails the evaluation of the fit of instruments, actions taken, to the problems and their images (see Chuenpagdee and Jentoft, 2013: 342). The goodness of fit of elements defines the appropriateness of the governing system. The better fit between the elements, the higher the degree of governability.

The evaluation of the governing system also involves the assessment of governing modes, which reflect the institutional linkages between governance entities (Chuenpagdee and Jentoft, 2013: 343) and the way in which people from the SG are incorporated as co-governors and therefore included in governing systems (see also 3.4.2.3). The typology includes three modes: hierarchical, co-governance, and self-governance modes. The more top-down, command and steering type of governance is the hierarchical mode whereas co-governance modes entail cooperation among all stakeholders without significant domination. And self-governance is where all stakeholders play an autonomous role in governing problems. These three governance types are ideal typical discriptions that are difficult to differentiate in real life, most often being a hybrid form of governance (see Kooiman, 2003: 90, Kooiman, 2008; see 3.3.1.3). In the perspective of many interactive governance scholars, the co-governance mode is the ideal one, especially since it will enable positive interactions, such as collective learning (Chuenpagdee and Jentoft, 2013: 344; Bavinck et al. 2005). Responsiveness here can be seen in the way actors respond to the problem. Responsiveness may be caused by limitations in opportunities to participate in the various phases of planning, such as decision-making, implementation, monitoring, and evaluation (see Pelling, 2007). Meanwhile, inclusiveness is assessed through the perception of the local community as to their participation in the coastal protection programme, starting from planning, implementation, monitoring, and evaluation (See Appendix A.2).

4.3.1.4 Step 4-Governing interactions analysis

The GI analysis targets specific variables. This analysis includes attention for ‘presence’ or the existence of certain forms of interactions and ‘quality’ or overall process of interactions which could strengthen the effectiveness of interactions to achieve specific goals. The variables include learning and adaptiveness. In addition, the quality of power relations is assessed through the variable of ‘representativeness’. This section elaborates on the variables and uses the definitions from Kooiman (2003) as a general guide, and definitions from Chuenpagdee and Jentoft (2013) in presenting the operationalization in governability assessment framework. Similar to Step 3 of the governability assessment, Step 4 deploys a mixed quantitative and qualitative approach, using guiding questions and Likert scale analysis (see Appendix A3 for detail explanation on methods).

1) The presence and quality of interactions

The ‘presence’ and ‘quality’ of interactions are assessed through the sub-variables of knowledge generation and sharing. Knowledge generation and sharing are assessed through the degree of access and the quality of information about the ecosystem-based disaster risk reduction projects. The greater access to knowledge generation and sharing, the better governability (Chuenpagdee and Jentoft, 2013: 345). The variable assessed in relation to knowledge generation and sharing include the content of information, the media, and perception of satisfaction from mainly the local community.

Furthermore, learning is rather the form of interaction and process that enable a higher degree of governability. The learning process is not mentioned in detail by Kooiman (2003) or Chuenpagdee and Jentoft (2013). I assess co-learning through the existence and type of learning. The more venues and the higher the degree of the learning process, the higher the governability is expected to be. Lastly, adaptiveness as part of governing interaction is also approached by assessing the outcome of successful adaptation in facing coastal disaster risk, using the mangrove ecosystem-based approach. Adaptiveness is the way the governance system adjusts to changes both in the short-term (coping responses) and long-term with more permanent perturbations (Castrejón and Defeo, 2015).

Similar to the co-learning variable, there has been no reference yet on the translation of adaptiveness within the governability assessment framework.

2) Enabling and restrictive role of power relations

Power relations are rather difficult to assess since they involve complex socio-political relations (Chuenpagdee and Jentoft, 2013) However, inspired by Chuenpagdee and Jentoft (2013: 345), the primary research concern is to evaluate the distribution of power in the societal system; it is assumed that a greater balance in power results in a higher degree of governability. The assessment undertaken here is limited to the variables of representativeness and inclusiveness. Representativeness is a way to reducing costs, improve legitimacy and effectiveness in the inclusion process (Dryzek, 2010). Due to lack of detailed discussion on representativeness within the existing governability assessment framework, I defined my own variable including the mechanism in selecting stakeholders; the perception on fairness of the different stakeholders; and the perception of each stakeholder on its ability to influence the process and outcome of the programme (see Appendix A).

4.3.1.5 Step 5-Governability and influencing factors for leveraging the capacity and quality to govern

The final governability assessment is done by analyzing the aggregate of the problem (Step 1), system-to-be-governed (Step 2), governing systems (Step 3), and analysis of governing interaction (Step 4). The results of the qualitative analysis of step 1 and 2 are merged and presented to support the findings from the assessment of step 3 and step 4.

4.3.1.6 Connections of governability assessment frameworks with the pathways and future scenarios

Based on the literature review and a preliminary evaluation of the research theme, I defined four pathways - coordination, goodness of fit, social mobilisation, learning and adaptiveness (see 3.4 and Appendix A4) – that possibly play a role in improving the existing state of governability, and which will be assessed in the case study settings. In addition to evaluating the contribution of the four pathways to the current condition of coastal risk, I also investigate the extent to which mangrove-based risk reduction strategies will be appropriate under conditions of climate change. For this purpose, the Special Report on Emissions Scenarios (SRES) built by IPCC (2000) is used as a reference point. The SRES provide four storylines of a development with regard to the way world population, economies, and political structure may evolve over the next few decades (see also Adger et al., 2004). The analysis of linkages between the current global and national climate change scenario and this research is undertaken in order to understand the challenges and necessities needed to successfully govern the uncertainties and adapting to the adverse impact of climate change in the future (see Chapter 10).

4.4 Limits

There are four limits of this research:

1. Limits on operationalization of interactive governance concept and governability assessment framework

This research has attempted to use the interactive governance concept and governability assessment. However, mainly due to a lack of data and duration of research on the field, several variables could not be taken into consideration, including the assessment on the performance of **orders** (see section 3.2.2.3). Furthermore, selection on measures (4.1) was also adjusted to the availability of data (see Appendix A). The assessment also does not include an assessment of the costs involved or detailed assessments of the policies, the instruments and the actions. The latter would have been useful as the comparative costs of protection measures play an important role in the policy choices made.

2. Varied context between the two case studies

There are limitations due to the different characteristics of Indonesia and India and the contextual practices of the goals of Eco-DRR in each country. However, to address this issue, the variations in context are discussed in all steps, but specifically in step-1 on the identification of the nature of problems and step-2 on the examination of system properties within the governability assessments (See 5.2.2 and 6.2.2).

3. Positionality as Indonesian and language barrier

As a native Indonesian with knowledge of the language and culture, I experienced an advantage in working in Demak in Indonesia over Tamil Nadu in India. Moreover, I had been involved in research on coastal flooding in Demak during my Master's research. This provided me with a head start compared to my work in India. Furthermore, the language barrier is a challenge when I conducted research in Tamil Nadu, India. However, the use of Tamil to English translators and student assistants has helped the process.

4. Bias in the interpretation of perception among different stakeholders

When analyzing the elements of governability (problems, system-to-be-governed, governing system, and governing interaction), the perceptions of different stakeholders are relied on. The perceptions are possibly biased with the researchers and enumerators working in the field to fit their own ideas and personal values (see Bryman, 2015: 39-40) This led to non-linearity of information. Furthermore, there is no gender differentiation in this research, including in selecting survey samples. This is due to the lack of access to women in both contexts. However, these challenges are addressed by conducting in-depth interviews.

4.5 Inferences

Having explored the interactive governance theory in the previous chapter, this chapter has operationalized the methodology for conducting governance assessments. This requires (a) characterization of the problem (identification of the problem, embeddedness, impacts of the problem); (b) aspects of the system to be governed in terms of the natural (geomorphological, oceanography, climate, and soil) and social (demography, settlement distribution, occupation transition, and migration); (c) aspects of the governing system including governing actors; images of the problem and goals, and the fit of images to instruments and action and responsiveness of modes of governance; (d) aspects of the governing interactions including knowledge generation, sharing and distribution as well as representativeness. It also stated the link with the possible pathways as a hypothesis which could leverage the success level of Eco-DRR. The chapter also presented the research methodologies used, a reflection on ethics, and a number of limitations.

CHAPTER 5

Case study of Demak District, Central Java province, Indonesia

Chapter 5 : Case study of Demak District, Central Java Province, Indonesia

5.1 Introduction

This chapter analyses the characteristics of coastal risk in Demak District, Indonesia with the purpose of identifying its main features and drivers, thereby setting the stage for a review of governance efforts in Chapter 6. It uses the lens of interactive governance theory and governability assessment (see 3.3, 3.4 and 4.3) to answer the question: What are the characteristics of the system to-be-governed in Demak related to coastal flooding issues (see 5.5)? Sub-questions include: (1) What is the nature of coastal problems in Demak, (see 5.2)? (2) How diverse and dynamic is its natural and social SG (see 5.3.1)? And (3) what factors contribute to the success of ecosystem-based disaster risk reduction? This chapter also elaborates the preliminary response of local inhabitants towards erosion and flooding (see 5.4). It focuses on the linkages between the diversity and dynamics quality of the system-to-be governed features and the potential governing actions (see 5.4 and 5.5).

5.2 Identifying the nature of the problem

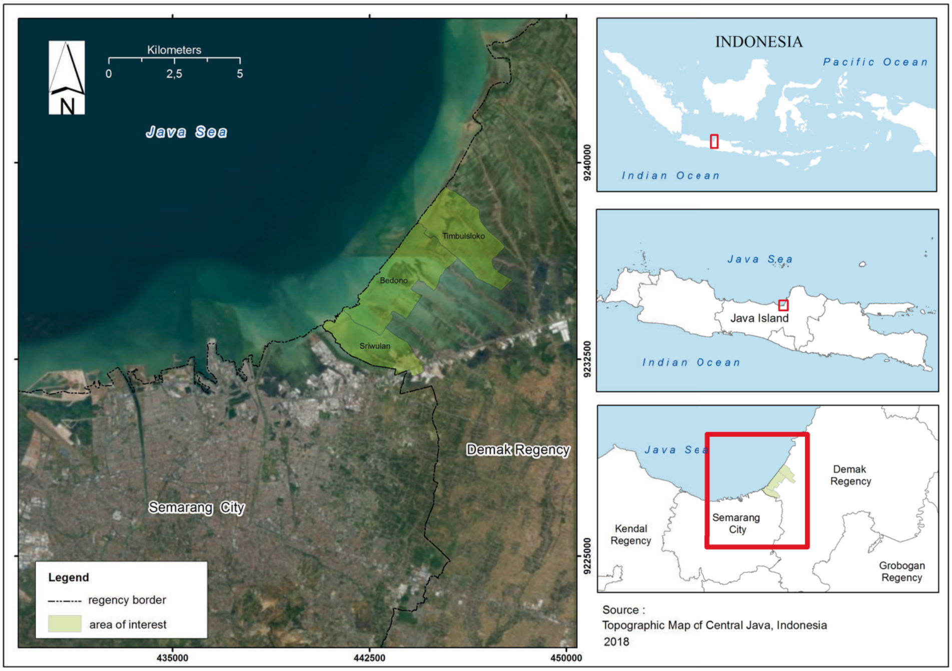
The broader setting. Indonesia has more than 17,000 islands. Its coastline of 81,000 km is 14% of the global coastal length. Three-quarters of its population now live in the coastal area (Wahyudi et al., 2012). Natural and human-induced threats including climate change are known to have exacerbated coastal risks such as erosion and floods (Pachauri et al., 2014: 5-9).

Current government policy in Indonesia focuses on development through available coastal resources (Wahyudi et al., 2012). The Northern Java coastal area, which has a 427 km long shoreline, is a priority area since it has the highest coastal concentration of economic activity (i.e. sand mines, shrimp and milkfish cultivation, port infrastructure, industries, and housing) (Wahyudi et al., 2012). Important coastal cities in Java here include Jakarta, Semarang, and Surabaya. These cities also experience increasing risk due to sea level rise and land subsidence, thereby exposing a growing population to the coastal hazard.

Hard protection measures have been installed in most big cities (Wahyudi et al., 2012). In some areas of the coast, soft and hybrid protection measures are being established as in Demak District.

Demak district. This chapter focuses on Demak district, located in proximity to Semarang – the capital of Central Java. Demak is prone to erosion and flooding due to the changing pattern and intensity of waves, groundwater extraction, sea-level rise, and mangrove cutting (Marfai and King, 2008; Marfai, 2012; Winterwerp et al., 2014). These features are discussed in more depth below (see 5.3.1.1). This chapter is based in particular on studies of three prominent coastal villages in Sayung Sub-District - Sriwulan, Bedono, and Timbulsloko (see Map 5.1).

Map 5.1 Map of Sayung Sub-District, Demak, Central Java, Indonesia



Source: Topographic map of Central Java, Indonesia, 2018

There is substantial evidence that since 1980, mangrove areas have been converted to shrimp ponds (Winterwerp et al., 2014; Ismanto et al., 2017). Since the 1990s coastal flooding has also started to affect Demak (see Joseph et al., 2013; C1-C4). The frequent floods have washed away houses, inundated mangroves, and negatively impacted the lives and livelihoods of local people (Marfai et al., 2012; Winterwerp et al., 2014; Triyanti et al., 2017; Ristianti, 2016; Sugianto et al., 2017). Table 5.1 provides a summary of recorded damages suffered since 1980.

Table 5.1 Recorded damage in Demak District due to erosion and flooding

Damage type	Effect
Inundated area	80 km^2 (Winterwerp et al., 2014).
People affected	70,000 people (Winterwerp et al., 2014).
Damaged mangrove	5,495 ha (Sugianto et al., 2017).

Damage type	Effect
Sinking hamlets	Two hamlets (Triyanti et al., 2013; Winterwerp et al., 2014; Ristianti, 2016).
Reduced income	60-80% for shrimp pond farmer and 25-50% for fishers (Winterwerp et al., 2014).

Table 5.2 presents a summary of the nature of the problem in Demak according to the three variables defined in this thesis (see 4.2.1.1).

Table 5.2 Nature of the problem related to coastal disaster risk in Demak District

Variables	Analysis
1. Identification of problem	There is common agreement by policymakers, scientists, communities and the private sector on the problem of coastal erosion and flooding in Demak District.
2. Embeddedness of the problem	Coastal erosion and flooding is believed to be a symptom of bigger problems occurring in the region due to the short-term (i.e. mangrove cutting) and long-term process.
3. Impact	Although the governing actors aim to produce concrete solutions with past and on-going projects, coastal erosion and flooding are still occurring up to present, inundating houses, reducing livelihood quality and contributing to out-migration.

Source: Author

Point 1 in Table 5.2 suggests that there is a common agreement among the policymakers, scientists, communities, and the private sector on the problem of coastal erosion and flooding. However, governing actors and other stakeholders have different interests and approaches to solving the coastal flooding problem (will be elaborated further in Chapter 6). *Point 2* notes that, despite the initiation of governance approaches to deal with coastal risk in Demak (see Chapter 6), erosion and flooding have only worsened since 1990. Finally, the problem of erosion and flooding in Demak appears to be embedded in much bigger problems along the Northern Java coast. In fact, coastal flooding is also occurring in Semarang, as well as in the neighbouring city of Demak (see Marfai and King, 2008; Marfai, 2012), and in other coastal cities such as Jakarta (Ward et al., 2011; Marfai et al., 2015) and Surabaya (Imaduddina and Subagyo, 2014). *Point 3* is that coastal erosion and flooding in Demak is clearly affecting the local population, inundating houses, reducing livelihood quality and causing migration.

Having briefly described the nature of the problem of coastal flooding in Demak, I now examine the system-to-be-governed in greater detail.

5.3 Features of the Demak system-to-be-governed

In the following analysis of the system-to-be-governed, I focus primarily on issues of diversity, dynamics, and scale (see Chapter 4). These issues make pressing demands on the governing system, with implications for coordination, social mobilisation, learning and adaptation, and inter-scale linkages. I first pay attention to the natural system and then turn to the social system-to-be-governed.

5.3.1 Diversity, dynamics and scale linkages of the natural system-to-be-governed in Demak

The diversity analysis is undertaken by identifying the components of the *natural system-to-be-governed.* The dynamics analysis assesses the interactions which could mobilise society towards positive changes. The analysis focuses on: the physical aspects (i.e. geomorphology, climate, oceanography, and soil) and the biodiversity and ecosystem.

5.3.1.1 Physical characteristics

Geomorphology, climate, oceanography and soil condition

Demak district is a low-lying coastal region, in which the *geomorphology* is formed through fluvial processes and sedimentation from the Juwana and Wulan Rivers and strong tidal activity from the Java Sea in the north. The major landform is mud-flat beaches, estuaries, and mangroves. Demak coast has flat topography with a 0 to 5 meter elevation above sea level (Subardjo, 2004). The *soil* is mainly sandy silt loam with an infiltration speed of 4.268 x 10-5 meter per day (Subardjo, 2004). The soil permeability value is low, exacerbating floods.

Demak has a tropical *climate* with rainy and dry seasons. The highest rainfall in 2004 at Jungsemi station was 2,359 mm in 2013, 1,287 mm in 2014 and 1,976 mm in 2015 with an average number of rainy days of 27 annually (BPS, 2016).

In terms of *oceanography*, the nature of the daily double semi-diurnal tide ranges between 1 and 1.2 meter in the high tide months of June-July. Around September-October, waves are quite low, around 0.6 m (Dinas Kelautan dan Perikanan Kabupaten Demak, 2007). Most coastal erosion occurs during December through February, when the north-west monsoon winds are strong, and waves are high from the north (Winterwerp et al., 2014).

Risks vary along coastal Demak. The combination of physical characteristics of the district coastline and development projects including ports and coastal infrastructure in Northern Java (e.g. Semarang) (see purple polygon in Map 5.2) leads to ocean wave deflection and increasing erosion in Demak especially in the case study villages of Sriwulan, Bedono, and Timbulsloko (Wahyudi et al., 2012; Winterwerp et al., 2014; Ervita and Marfai, 2017) (see red polygon in Figure 5.2). The sub-district to the east of Sayung, named Wedung, is considered to be a transition coast, which could erode in the future (Marfai et al., 2016). In Wulan Delta (see the blue polygon in Map 5.2), the main geomorphological process is sedimentation (Marfai et al., 2016; Ervita and Marfai, 2017). Thus, parts of the coastline of Demak district is suffering from erosion, and in other parts are sedimentation. The main issue to be dealt with in Sayung Sub-District is erosion and flooding.

Map 5.2 Map of the physical condition of Demak and Semarang Coast

Source: Author's analysis based on Google Earth Images, 2017

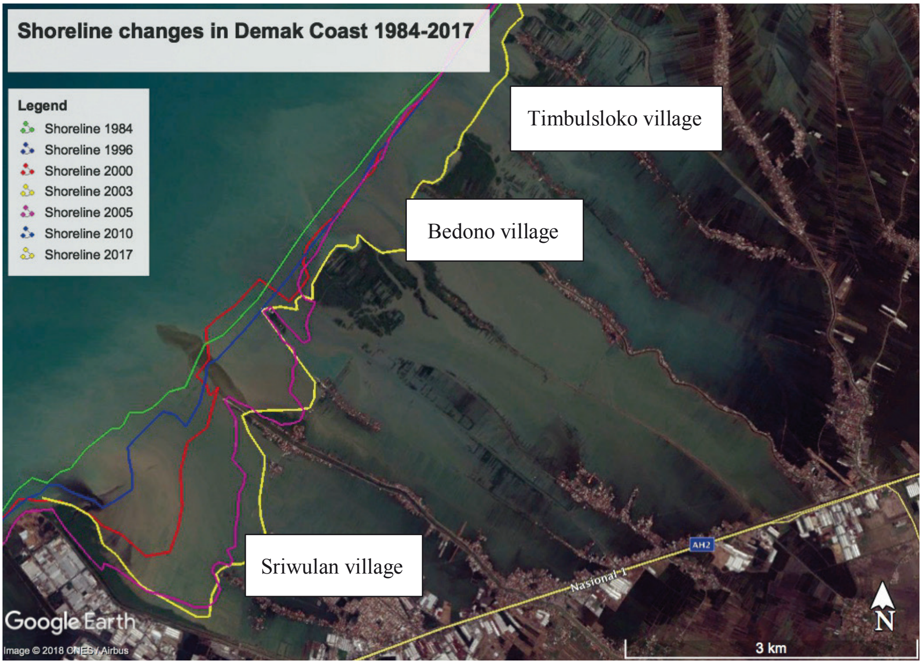
Remote sensing data shows that the erosion rate in Sayung Sub-District has increased from 146 Hectares in 2002 to 750 ha area in 2005 (Pranoto and Atmodjo. 2016). Other research shows that the Demak shoreline has changed by 100 to 1,000 meters measured between 1980 and 2010 (see Winterwerp et al., 2014) or equal to 5 to 50 m per year. The distance of the shoreline to the mainland of the three research villages has retreated as far as 21.53 km in 2003 to 17.27 km in 2009, and 19.69 km in 2013 (very dynamic and go up and down) (Asiyah et al., 2015). This is confirmed by analysis of satellite images (see Map 5.3). Local people agree that coastal flooding commenced in 1988 after the first coastal reclamation projects began in the northern part of Semarang City (Marfai, 2012). Excessive groundwater extraction in Semarang mostly for industrial purposes (Marfai and King, 2008; Chaussard et al., 2013) may have caused land subsidence of 10-17 cm per year in Semarang and seawater intrusion up to now (Abidin et al., (2004) in Kuehn et al., 2010; Marfai and King 2008; Setyowati, 2010). Based on the Japan International Cooperation Agency (JICA) assessment in 2003, extraction of groundwater for annual water supply in Semarang increased from $0.43 \times 10^6 m^3$ in 1990 to $35.64 \times 10^6 m^3$ in 1998 (Marfai and King, 2008).

Figures on sea-level rise and land subsidence are relatively scarce and not in agreement. Based on satellite observations, sea-level rise along the coastline of Demak is currently estimated between 4.0 and 4.3 cm per year (Winterwerp et al., 2014). In Sriwulan, Bedono and Timbulsloko Village, the land subsidence rate is 2.77 - 3.05 cm per year (Yuwono et al., 2018). The data on the annual sea-level rise in Demak varies from 5 mm (Marfai, 2014: 112) to 8.294 cm (Utami et al., 2017: 285). Taking the worst-case scenario, with both sea-level rise and land subsidence occurring at a relatively fast rate, the question as to the most appropriate form of coastal defence is being raised (see Alongi 2008). Experts do not agree on whether mangrove plantations are the most suitable approach under these conditions. Land subsidence and sea level rise in Demak raise questions regarding the suitability of mangroves in tackling erosion and flooding. Healthy mangroves can keep the pace with the sea-level rise as long as the rate of change in elevation of the mangrove sediment surface is not exceeded by the rate of change in relative sea-level (Gilman et al., 2008). They will either form sedimentation and expanding seaward or landward (Alongi, 2008; Gilman et al., 2008). Some argue that a combination of soft and hard infrastructure is needed in order to secure the Demak coast from erosion and flooding (Winterwerp, 2014; A3, A4, A5).

Furthermore, research conducted by Suroso and Firman (2018) considering the components of hazard including mean sea-level monthly variance, highest high-water level tides, sea level rise, storm surge, and river flood, predict that in 2030, over 55,220 ha of land in the northern part of Java coastal area will be inundated. In Central Java Province, Demak District will experience the largest inundation (1,949 ha). Map 5.3 demonstrates the extent of shoreline loss in Sayung Sub-District from 1983-2017.

Map 5.3 demonstrates that shoreline loss is taking place more extensively in the western than in the eastern part of the sub-district and that it is a progressive phenomenon with strong drivers. This map shows that some human habitations and livelihood spaces are being threatened more than others.

Map 5.3 Map of shoreline changes in Sayung Sub-District from 1984-2017



Source: Author's analysis on the basis of Google Earth Images year 1984, 1996, 2000, 2003, 2005, 2010 and 2017[5]

Biodiversity

Northern Java coastal area hosts different coastal ecosystems, including sand dunes, mud-flat beaches, mangroves, and estuaries (see Wahyudi et al., 2012). Mangroves are found on the coasts of Semarang, Demak, and Wedung. In Demak the mangrove ecosystem dominates with Avicenia (*Avicenia marina* and *Avicenia lanata)* and Rhizopora (*Rhizophora mucronata* and *Rhizophora stylosa) (*Magdalena et al., 2015*)*. These two types of mangroves provide nourishment and protection for fish species, prawns, crustaceans, and molluscs (Nagelkerken et al., 2008) and are argued to be the *soft* protection against coastal flooding and inundation (Nagelkerken et al., 2008, Alongi, 2008).

Dutch maps from the 1740s show that Northern Java coastal area was then fully covered by mangroves (Winterwerp, 2014). Mangrove coverage has since decreased due to natural causes (see 5.3.1.1) and human activities, including: (1) land reclamation for coastal infrastructure, (i.e. Tanjung Mas Port in 1987), real estate housing in Semarang (i.e. along Marina beach), and

[5] See also similar mapping exercise by Winterwerp et al., 2014.

5

jetties in Semarang coast which reduce sediment transport to Demak coastal area, and (2) land-use change, especially from mangrove to shrimp ponds (Marfai 2012; Winterwerp et al., 2014; Hiwasaki et al., 2015). In Demak, the mangrove area, starting in 1980, was degraded by cutting and land conversion from wetlands into shrimp ponds (Dinas Kelautan dan Perikanan Kabupaten Demak, 2007; Setyowati, 2010; Wahyudi, 2012; Marfai, 2012; Triyanti, 2013; Apri et al., 2014; Winterwerp et al., 2014; Tonneijck, 2016). The percentage of unhealthy mangroves in Demak was around 13.8% in 2012 (see Faturrohmah and Marjuki, 2017).

Although a reduction in mangrove coverage is part of a longer historical trend spread over the entire coast of northern Java, it continues into the present, also in Sayung Sub-District. Scientists thus argue that total mangrove coverage in Sayung Sub-District has decreased from 2089.45 ha in 2010 to 2021.28 ha in 2015 (-68.17 ha or 3.2%) (Fathurrohmah and Marjuki 2017). In some areas, however, such as Bedono and Timbulsloko villages, mangrove coverage has doubled from 113.95 ha in 2010 to 254.38 ha in 2015 (see Table 5.3) through intensive mangrove rehabilitation and planting. The mangrove coverage in Sriwulan village is decreasing due to the submergence area, and there are no significant projects related to mangrove rehabilitation there.

Table 5.3 Distribution and total mangrove coverage in Demak District (2010-2015)

Villages	2010 (ha)	2015 (ha)
Bedono	76.53	154.46
Sriwulan	4.82	0.51
Timbulsloko	32.60	99.42
Total	113.95	254.38
Total in Sayung sub-District	2089.45	2021.28

Source: Faturrohmah and Marjuki, 2017

I have argued thus far that green coastal infrastructure of Sayung Sub-District has gradually decreased over time. Chapter 6 shows that because of mangrove rehabilitation projects, the deterioration process may have slightly been reversed. Map 5.4 points out that available mangrove plantations are presently concentrated in particular locations along the coast, with other locations being sparsely covered. This can indicate that in several other areas, mangroves cannot be grown due to physical limitations. Mangrove coverage is thus uneven, with possible consequences also for coastal protection policy. Table 5.4 provides a summary of the physical/natural system-to-be-governed in Demak. It shows that although physically mangroves can grow in Demak, there are doubts about whether mangrove Eco-DRR is suitable in 2030 due to the extreme level of erosion and climate change impact, higher waves and impact from infrastructural development. However, there is clearly an urgent need for more reliable data in terms of sea-level rise and other physical factors which could threaten mangroves in the future. This data would be useful for the decision-making process.

Table 5.4 Summary of risks raised by the physical/natural system-to-be-governed in Demak District

Steps	Variables		Properties	Condition	Implication for governance (See also Table 1.2)
2. Assessment of system to be governed	2.a Physical	2.a.a Geomorphological	Diversity	Mud-flat beaches, estuaries and mangroves; 0-5 meter above sea level (Subardjo, 2004).	Mangrove ecosystem-based might not be suitable in the long-term due to the extreme level of erosion and land subsidence.
			Dynamics	Erosion level 5-50 m per year (Winterwerp et al., 2014); Land subsidence 2.77-3.05 cm per year (Yuwono et al., 2018).	
		2.a.b Oceanography	Diversity	Tide is semi-diurnal and varies in amplitude by 60-120 cm in different seasons. (BPS, 2016)	Higher wave exposure to mangroves potentially reduces the ability to survive.
			Dynamics	Climate change impact including sea-level rise and erosion (see geomorphological dynamics).	
		2.a.c Climate	Diversity	1976 mm annual rainfall (BPS, 2016).	Higher precipitation potentially positive to the growth of mangrove in its relation to reducing salinity.
			Dynamics	Sea-level rise: Great variation of data, 0.5 to 8.294 cm per year (Marfai, 2014: 112; Utami et al., 2017: 285); 1949 ha area in Demak will be inundated in 2030 (Suroso and Firman, 2018).	The need for reliable data on sea-level rise for updating policy.
		2.a.d Soil	Diversity	Sandy silt loam (Subardjo, 2004).	Higher risk of coastal flooding.
			Dynamics	Low permeability (Subardjo, 2004).	
		2.a.e Biodiversity	Diversity	3 mangrove species, covering 254.38 ha (Faturrohmah and Marjuki, 2017).	Low number of mangrove species made the area more vulnerable and less stable.
			Dynamics	13.8% degradation due to land use conversion and waves (Faturrohmah and Marjuki, 2017).	
2. Assessment of system to be governed	2.a Physical	2.a.f Infrastructure	Diversity	Occurrence of coastal structure in the neighboring city of Semarang and reclamation area.	The existing structure have diverted the ocean waves, resulting in sediment erosion in Demak and threatening the mangrove ecosystem.
			Dynamics	Changes and dynamics which resulted from the emerging coastal infrastructure projects.	Higher uncertainty, poor and unsustainable coastal management planning will increase the vulnerability and risk of coastal disaster.

Source: Author

5

5.3.2 Diversity, dynamics and scale linkages of the social system-to-be-governed in Demak

5.3.2.1 Social characteristics

A full discussion of the diversity, dynamics and scale linkages of the social system-to-be-governed in Demak would involve many variables. For this reason, I have chosen to concentrate on demography, settlement patterns, and occupation, all of which relate to the life situation of the local population. This population has historically depended on local resources and coastal space and experiences vulnerability with regard to coastal hazards.

Demography and settlement distribution

Demak District covers 897.43 km², consisting of 14 sub-districts and 243 villages and has a coastline of 57.89 km and 1,106,328 people (BPS, 2016). The Regional Office of Marine Affairs and Fisheries of Demak District has categorized sub-districts as coastal areas, including Sayung, Karang Tengah, Bonang, and Wedung. Sayung Sub-District, where the three research villages are located, has the highest population. In 2015, there were 103,902 people living in the area of 78.80 km^2, implying a population density of 1,318 people per km^2 exposed to coastal risks (see Table 5.5).

Table 5.5 Population in coastal sub-districts in Demak District (2015)

Sub-District	Sayung	Karangtengah	Bonang	Wedung	Total
Population	103,902	62,110	100,727	72,864	**339,603**

Source: BPS Kabupaten Demak, 2016

In terms of settlement patterns, local people in the Bedono and Timbulsloko villages currently live beside the channels that lead to the coast. The settlement pattern in Sriwulan Village is mixed, but mainly located along the main road that runs parallel to the coast at a distance of 0-2 km. The remaining settlements which have not been submerged, especially in Sriwulan and Bedono Village depend on the surrounding mangroves that protect houses from flooding and inundation (See Map 5.4).

The population in Sayung Sub-District is increasing. However, compared to national population growth from 2010-2015 data (1.4%), population growth in Sayung Sub-District is lower, possibly induced by out-migration (see also Table 5.8). The population in the three villages decreased especially in 2014 to 2015 and especially in Sriwulan Village caused by submergence from erosion and flooding in Sriwulan Village (F3) and the submergence of two hamlets, namely Tambaksari and Rejosari-Senik in Bedono Village (see Table 5.6). Inhabitants of the latter have been relocated to Purwosari, Sidogemah, and Daleman Village within the Sayung Sub-District (see Damawyanti, 2013).

Table 5.6 Changes of the number of population in the case study villages in Demak District (2012-2015)

Villages	**Number of populations**				**Population increase from 2012-2015**	**Growth Percentage (%)**
	2012	**2013**	**2014**	**2015**		
Bedono	2,948	3,546	3,542	3,536	588	
Sriwulan	11,765	12,607	12,592	12,572	807	
Timbulsloko	3,383	3,479	3,475	3,469	86	
Total in three villages	18,096	19,632	19,609	19,577	1,481	
Total in Sayung Sub-District	100,142	101,425	102,692	103,932	3,790	1.2
Indonesia (2010-2015)						1.4

Source: BPS Kabupaten Demak, 2016

The distribution and total area of settlement has decreased by 9 ha in Sriwulan Village between 2003-2015, and 14.3 Ha in Bedono between 2003-2014 (see Table 5.7).

Table 5.7 Total area of settlement in the case study villages in Demak District (2003-2015)

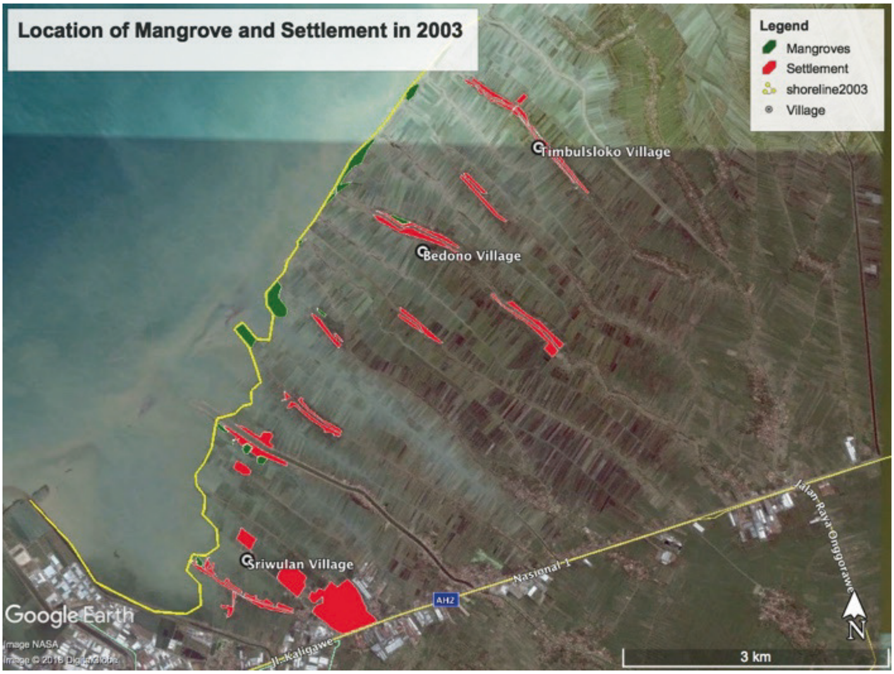
Landuse	**Settlement (ha)**		
	2003	**2014**	**2015**
Sriwulan	86	no data	77
Bedono	50.3	36	no data
Timbulsloko	no data	114	114

Source: Asiyah, 2014 and BPS, 2016

Satellite images from the period 2003-2017 also show the reduction of mangroves and settlement areas in the research area (see Map 5.4).

Map 5.4 points out first of all that inundation of this coastal region has progressed substantially since 2003, also resulting in the displacement of settlements. Residents are elevating their houses as an adaptation strategy (see 5.4). In addition, the mangrove coverage has increased substantially.

Map 5.4 Dynamics of distribution of mangrove and settlement areas in Demak (2003 and 2017)



Source: Author analysis based on Google Earth Image 2003 and 2017

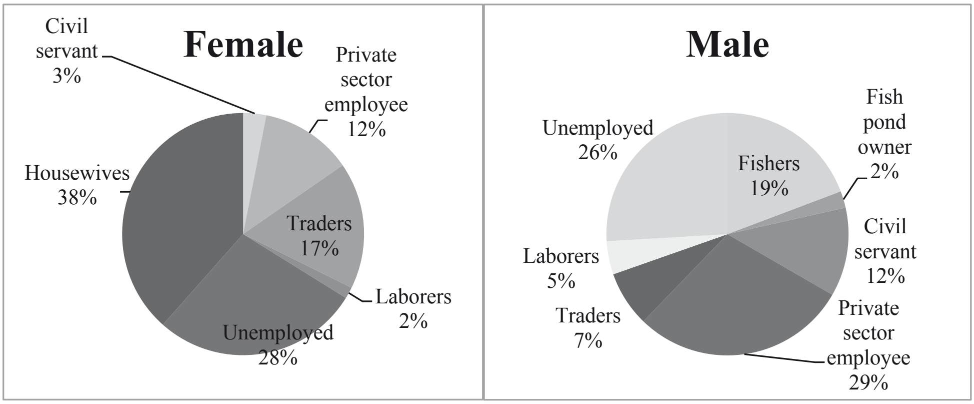
Occupational diversity

In terms of occupation, the people in Sayung Sub-District are not directly dependent on mangroves. Most people in Sayung Sub-District work in agriculture (e.g. rice farming) and as fishers and fish pond owners (Hiwasaki et al., 2015). Some people also work as traders, and labourers in the textile and construction industries located in neighbouring Semarang (Hiwasaki et al., 2015). Some find employment as government officials in the village, sub-district, or district government (Hiwasaki et al., 2015).

I interviewed 200 local respondents in the three villages of which 67% were male and 33% were female (see 4.3.3.2). The surveyed population has diverse occupations, with 34% of the men working as labourers in textile factories and construction industries mainly located in Semarang and Demak and 26% are unemployed. 38% of the women are housewives, and 28% are unemployed[6] (see Figure 5.1). Interviews reveal that coastal erosion and flooding is affecting livelihood choices: submergence of rice fields and ponds has led to unemployment of farmers (see 5.3.3) causing problems which could motivate them to search for common solutions to the flooding and inundation problem.

"I was living here, (in Bedono village) as long as I remember. My father was a farmer, and so was I. But since the year 1985, the farm fields were disappearing, flooded by seawater and I became a fisherman. I also owned a fish pond, it was shrimp booming and have big profit (in the 1990s) and now not so much" (Personal interview, F3, 21 October 2016).

Figure 5.1 Occupational profile of respondents in Demak coastal area



Source: Fieldwork survey, 2016, n= 200

[6] The samples are taken from the labour force age; for elaboration on sampling methods see 4.3.3.2

The analysis reveals a high diversity in the social system-to-be-governed in terms of current occupation. The threat of coastal flooding and impacts on natural assets has resulted in different adaptation strategies including occupational transitions and out-migration.

Occupational dynamics

Most transitions are triggered by the impacts of flooding on fields on productivity; they are not linear and one-way transitions (Joseph et al., 2013). Rice field farmers are becoming fish pond owners (Winterwerp et al., 2014). The agriculture land in Sayung Sub-District has reduced by over 12% from 2,136 ha agricultural land in 2012 to 1,417 ha in 2015 (Jannah et al., 2017).

Meanwhile, fishers or pond owners are becoming labourers because of fish depletion and submerged ponds (Winterwerp et al., 2014; CI-C2). On average, changes in the 1,510 fish ponds in the area apparently lead to an annual per household loss of up to Rp. 8,409,006 (USD 576,38) or Rp.700,750 per month (USD 48), amounting to an average loss of income of 58.5% per month (Desmawan and Sukamdi, 2012). Labourers are also becoming fishers and pond farmers because factories are closing down due to flooding (Joseph et al., 2013).

Among the interviewees, one fishpond owner in Bedono Village stated that before the erosion and inundation in Demak, he was a rice field farmer. After the flooding in the 1990s, his rice field was inundated and he became a fish pond farmer, while once in a while he also goes fishing in the sea (F2).

Murpratiwi (2016) provides evidence from Timbulsloko village in Sayung Sub-District) that there is an increasing number of fishers, traders, and unemployed and a decreasing number of farmers and fish pond farmers (Murpratiwi, 2016) (see Table 5.8).

Table 5.8 Occupational transition after the flooding and inundation of Timbulsloko Village in Demak District

Occupation	**Before flooding and inundation (1980)**	**After flooding and inundation (1990)**	**Before flooding and inundation (1980) (%)**	**After flooding and inundation (1990) (%)**
Fishers	6	14	8.33	19.44
Farmer	9	3	12.5	4,16
Fishpond farmer	27	5	37.5	11.11
Civil Servant	3	3	4.17	4.17
Laborer	15	15	20.83	20.83
Trader	1	8	1.39	11.11
Not working	5	16	6,94	22,22
Others	6	8	8,33	6,94
Total	72	72	100	100

Source: Murpratiwi (2016), n=72

Among all types of occupation, fish pond farmers are apparently the most vulnerable to erosion and flooding in Demak coast as they experience damage of fish ponds (cf. Joseph et al., 2013).

Out-migration. A significant number of local people have moved to other places as an adaptation strategy. Data from the statistical bureau shows that many local people have moved out from Sriwulan Village between 2004-2016 (27.42%) followed by Bedono Village (12.13%) and Timbulsloko Village (6.38%) which together contribute to 45.93% of the total migration in Sayung Sub-District. The biggest migration event occurred in 2010 when 972 people from Bedono, 790 people from Sriwulan, and 473 people from Timbulsloko migrated out from the villages (see Table 5.9).

Table 5.9 Migration in case study villages in Demak District (2004-2016)

Years	Type of migration	Village			Total in Sayung Sub- District
		Bedono	Sriwulan	Timbulsloko	
2004	In	4	6	0	no data
	Out	0	40	0	no data
2006	In	0	9	0	41
	Out	58	160	9	355
2008	In	0	12	2	101
	Out	36	98	14	498
2010	In	4	61	83	6315
	Out	972	790	473	3476
2012	In	21	88	25	979
	Out	16	314	28	975
2014	In	14	102	18	860
	Out	32	208	44	1099
2016	In	27	81	26	808
	Out	26	166	28	793
Total (2004-2016)* with some gap years	In	98	653	203	11572
	%	0.85	5.64	1.75	100
	Out	1403	3170	738	11562
	%	12.13	27.42	6.38	100

Source: BPS, 2009-2017

Irrespective of livelihoods, the research reveals that local people are generally worried about flooding. People have resided in and inherited the land from their ancestors, and most are unwilling to relocate (F1-F3). I conducted an interview from Sriwulan Village with a resident who had his house inundated (see Figure 5.2).

"My house is now flooded, but I am not willing to leave since I have no other place to live. It will hopefully dry by tomorrow, and I can work again as a fisherman" (Personal interview, F3 8 May 2015).

Figure 5.2 Inundated houses in Sriwulan Village

Source: Personal documentation, May 2015

Table 5.10 shows that the characteristics of both natural and social system-to-be-governed in Demak have contributed to the high level of risk. The higher the density of people, the higher the exposure and risk of disaster. Furthermore, high migration flow from Demak to other cities will potentially reduce the effectiveness of social mobilisation for reducing disaster vulnerability from the socio-economic perspective.

Table 5.10 Summary of risks raised by the natural and social system-to-be-governed in Demak District

Steps	Variables		Properties	Condition	Implication for governance
2. Assessment of system to be governed	2.b Social	2.b.a Demography and settlement distribution	Diversity	High population density, settlements are in leapfrog pattern along the river, sheltered by mangrove.	Higher number of people is exposed to erosion and flooding. Settlement pattern is vulnerable to erosion and coastal disaster.
			Dynamics	Population growth with a high rate of migration to the neighboring city.	
		2.b.b Occupation and transition	Diversity	Traders, fishers, laborers, fish pond owners and migrant workers.	Lower direct livelihood dependency of mangrove could potentially reduce the awareness of mangrove conservation.
2. Assessment of system to be governed			Dynamics	Dependency on mangroves for provisioning services in livelihoods; Transition to other occupation due to erosion.	
		2.b.c Migration	Dynamics	Relocation due to inundated houses and voluntary migration to the nearest big city.	Decreasing number of the young adults could reduce the opportunities for social mobilisation for supporting Eco-DRR governance efforts.
	2c. Risk (physical and social SG) see also Table 5.4	Creeping-fast onset	**Hazard**: Erosion and flooding in Demak are categorized as slow-onset in terms of the frequency of events. Although "creeping" in terms of frequency, the rate of erosion (up to 50 m per year) (Winterwerp et al., 2014), land subsidence (2.77-3.05 per year) and sea-level rise (0.5-8.294 cm) (Yuwono et al., 2018) is fast-onset. **Exposure**: Large coastal population and exposed settlements. **Vulnerability**: Migrated population and unstable livelihoods due to erosion and flooding.		The need of: -Evidence-based/science-based approach for informing policy -Coordinated, interdisciplinary, integrated and transboundary management - Adaptation strategies, managing uncertainties (e.g. mitigation, ecosystem conservation) - Effective learning process, addressing uncertainty - Sustainability.

Source: Author's fieldwork (interview and focus group discussion), 2014; 2015; 2016

5.4 LOCAL PEOPLE RESPONSES TO THE ISSUE OF EROSION AND FLOODING

This section touches upon the responses of the local community living in the three case study villages to the circumstances sketched in Sections 5.2 and 5.3. Although in interactive governance theory, community measures are analytically included in the governing system (see Chapter 6), an understanding of the community response will help to gauge the relevance of the external governance efforts.

Clearly, the local people living in Sayung Sub-District are aware of the coastal risks they have been exposed to since the 1980s. They view erosion and flooding as a natural phenomenon exacerbated by human action (F1-F3):

"We believe that the flooding started right after the reclamation and expansion of port in Semarang, so that should be the trigger" (Personal interview, F1, 10 May 2015).

Coping strategies are both individual and collective. Individuals and households have various opportunities to mitigate the consequences of flooding: The most extreme option is to migrate out of the region (see 5.3), others seek livelihoods outside Sayung Sub-District and become less dependent on local space and resources, and still others have either raised or moved their homes so that they are less affected by flooding.

But coping strategies are also collective and shaped by interaction within the community. One clear response is the establishment of community groups, including fishers, youth, and women with various activities, including community work (e.g. repairing roads and help to clean and elevate their neighbour's houses after coastal flooding events), engagement in mangrove groups, or not cutting or converting the mangrove area (see Chapter 6). The establishment of mangrove groups since 2004 through NGO support has helped them to understand the importance of mangroves in protecting their area from flooding as well as to reduce the risk of more severe erosion in the future (C1-C4).

Both soft and hard measures have been undertaken by local people. Soft measures have been implemented through participating voluntarily in mangrove planting activities run by the NGOs (C1, C2, F1, F2) (see 6.2). Hard measures include fixing damaged roads, elevating houses and helping to construct hybrid structures as part of the Building with Nature Project (see 6.2). Some local people, not included in the survey from the two submerging hamlets in Bedono Village (i.e. Tambaksari and Rejosari-Senik), have also migrated to another village as their adaptation strategy. The survey results show that local people favour hard measures such as elevating roads and houses which are conducted mostly through community work (A1-A6, B1-B4, and F1-F3).

Collective action has also induced local groups to report their anxieties to the authorities. This generally follows the regular bureaucratic line, with the heads of hamlets reporting to village officers, and village heads reporting to the sub-district and district government office.

In addition, the local population has engaged in political mobilisation, especially since the flood in December 2017. Banners were then installed on the national Semarang-Demak road by the community in Sayung Sub-District, requesting the president to build a coastal seawall in Demak (see Tribun News, 2017b) as mangroves and hybrid structures may be insufficient to address coastal risks (C1-C2).

5.5 Inferences

My analysis leads to seven conclusions regarding the coastal risk in Sayung Sub-District and the challenges that are being posed to the governing system regarding coastal protection:

First, the problem of coastal defense is aggravated by the combination of land subsidence caused by groundwater extraction, new coastal infrastructure, and heavy construction in the built environment, sea level rise, extreme weather events and the degraded health of the existing mangroves. The scientific evidence for these trends is, however, still incomplete, and the range of drivers is still insufficiently understood. It is clear, however, that sections of the northern Java coastline are badly affected by creeping type of coastal disaster risk, and that Sayung Sub-District is one of the most affected.

Second, the nature of coastal geomorphology implies that some parts of Sayung Sub-District are more affected by land use changes occurring in other regions and by mangrove degradation than others.

Third, the mangrove plantations of Sayung Sub-District, which were previously abundant, have degraded substantially over time, but are recently increasing again due to replanting programmes. The coverage of mangroves is, however, uneven, and many plantations are of recent date, possibly affecting their protective capacity.

Fourth, the flooding of Sayung Sub-District has already reshaped settlement patterns. The dispersion of settlements creates challenges for ecosystem-based disaster risk reduction, possibly in combination with hybrid or hard measures.

Fifth, occupational transitions are affecting the reliance of the local population on the natural environment and leading to out-migration of adults mainly to the nearby city of Semarang. Although there are multiple causes for migration and occupational transition, the flooding of the coastal region is apparently a major factor. These transitions arguably reduce the motivations and abilities of the local population to engage with Eco-DRR.

Sixth, natural and social trends in Sayung Sub-District can only be viewed in the context of the larger region of which it is part. This has important consequences for governance, which therefore cannot be handled on the local level alone.

Finally, research demonstrates that the threat of flooding has triggered collective action of various kinds among the population of Sayung Sub-District which can potentially be supported and strengthened further by external governing actors. The extent to which this is matched and taken up by external governing actors will be discussed further in Chapter 6.

CHAPTER 6

Governance of coastal disaster risk in Demak District, Central Java province, Indonesia

Chapter 6 : Governance of coastal disaster risk in Demak District, Central Java Province, Indonesia

6.1 Introduction

The previous chapter discussed the nature of the problems of coastal disaster risk reduction in Demak, Indonesia, scrutinizing both its natural and social features, and ending with an inquiry of how the local population has responded spontaneously to the problems incurred. This chapter assesses the quality of the governing system and its interactions as it pertains to coastal risk in Demak. Using interactive governance theory (see 3.3, 3.4 and 4.3), I first ask: (1) How does the nature of the governing system and its interactions affect the governability of disaster risk reduction in Demak? Special attention will be paid to topics related to the pathways of (a) coordination, (b) goodness of fit, (c) social mobilisation, and (d) learning and adaptiveness (see Chapter 3). My second question then is: (2) What are the specific issues which enable or constrain such pathways?

The first section (see 6.2) below provides an overview of external governance efforts (excluding community governance efforts – see 5.4) taken to address coastal risk in Demak. Then I turn to the various governance agencies (government and non-government) that play a role in addressing coastal risk (see 6.3), and examine the quality of coordination, goodness of fit of problems and goals (images), instruments and action (see 6.3.2); and responsiveness in its relation to the requirements of inclusiveness and social mobilisation (see 6.3.3). Section 6.4 shifts the focus to governing interactions by examining the presence of quality of interactions and the power relations in particular into issues of information sharing and representativeness which corresponds to learning and adaptiveness.

6.2 A Bird's eye view of governing efforts in Demak

This section discusses the governing actions taken by various governing actors to address the problems of coastal flooding in Demak (see 5.2). Figure 6.1 presents an overview of disaster risk in the three case study villages (Sayung Sub-District) and the responses of various governing actors. The table also includes a column on Semarang City as the problem in Demak is embedded in the context of a larger region, especially in connection to Semarang as the neighbouring coastal city. It is followed by, and to be read together with, Table 6.1 which depicts the area units of the analysis.

Figure 6.1 Transect profile of part of Demak District and Semarang City, Central Java Province

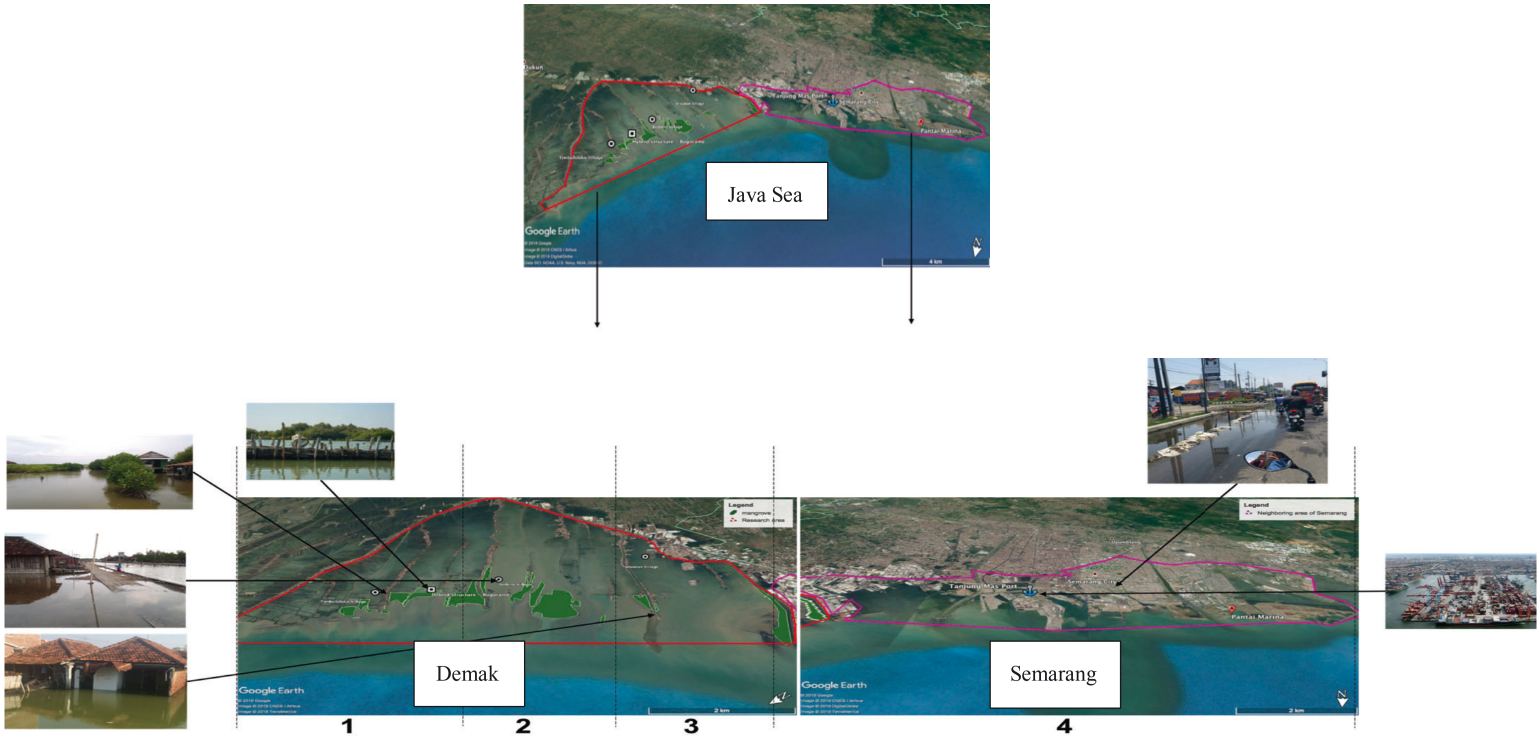


Table 6.1 Chronological account of coastal risk reduction efforts in Sayung Sub-District, Demak District

	1	2	3	4
Transect unit	**Timbulsloko village, Sayung Sub-District, Demak District, Central Java Province**	**Bedono village Sayung Sub-District, Demak District, Central Java Province**	**Sriwulan village Sayung Sub-District, Demak District, Central Java Province**	**Semarang City, Central Java Province**
Specific Problems	Short-term: erosion, coastal flooding, inundated and damaged houses, and fishponds Long-term: land subsidence, excessive groundwater extraction, sea-level rise.			Short-term: coastal flooding, Long-term: land subsidence, excessive groundwater extraction, sea-level rise, reclamation projects and expansion of Tanjung Mas Port changes the oceanography and geomorphology condition of neighbouring coast of Demak District and increase the risk of more severe erosion in the future.
Actions	-Breakwater (1990s-present). -Mangrove planting (1996-present) -Hybrid structure (2013-2020). Coastal field school (2016-). -CRV programme (2013-2015).	-Breakwater (1990s-present). -Mangrove planting (2000-present). -CRV programme (2013-2015).	-Breakwater (1990s-present). -Mangrove planting (2000-present). -CRV programme (2013-2015).	- Polder system in Semarang to prevent flooding. - Regulation of issuance of groundwater permit. - Regulation of issuance of coastal reclamation. - Construction of jetties.
Primary governing actors	-Ecoshape and Wetlands International consortium in partnerships with Ministry of Marine Affairs and Fisheries and Ministry of Public Works and Human Settlement. -Government agencies (Environmental Office, Office of marine affairs and fisheries).	-OISCA. -Government agencies. (Environmental Office, Office of Marine Affairs and Fisheries).	-Government agencies. (Environmental Office, Office of Marine Affairs and Fisheries).	-Government agencies. (Environmental Office of Semarang).

Source: interview and survey, 2014-2016

Problems in Demak, (unit 1-3 in Figure 6.1 and Table 6.1) and Semarang (unit 4 in Figure 6.1 and Table 1) are being addressed by government agencies since 1990. Their policies are focused on hard infrastructure projects such as breakwater, dikes and sea walls, especially to protect big cities such as Semarang (Wahyudi et al., 2012). It was only after 1996 that the government, through the Agricultural Office, initiated the rehabilitation of mangroves along the coast of Demak, and the livelihood improvement programme, such as trainings embedded in the Coastal Resilience Village (CRV) programme in all three villages (unit 1 to 3 in Figure 6.1 and Table 6.1). This programme is carried out by the Environmental Office and the Marine Affairs and Fisheries Office of Central Java Province and Demak District (see Table 6.2).

Figure 6.1 mentions a variety of governing actors, and both Figure 6.1 and Table 6.1 indicate that there has been a sequence of efforts to address the flooding of Demak coastal region (3 villages). Table 6.3 includes information on the three most significant projects (in terms of duration and size) undertaken through collaboration between government agencies and foreign NGOs.

In the first project, OISCA selected Bedono Village (Unit 2 in Figure 6.1 and Table 6.1) in Demak as the location of a mangrove planting and conservation programmes. Beside the soft approach, a hard approach is also taken by renovating schools.

In the second project, implemented in Sriwulan Village (Unit 3) by the Ministry of Marine Affairs and Fisheries and others, actions are limited to the construction of breakwaters and the CRV programme (see Table 6.2). The programme includes training for capacity building (i.e. livelihood training and disaster resilience) and infrastructure development (i.e. road and breakwaters) which has been implemented from 2013 to 2015.

The Building with Nature (BwN) programme, financed by the Dutch Sustainable Water Fund (Wetlands International, 2016) and being implemented by Ecoshape and Wetlands International Consortium in collaboration with government agencies since 2015, focuses on the development and construction of a hybrid structure using mangroves and a permeable dam. It was preceded by an investigation into the status of mangroves and its role for reducing disaster risk (2012-2014). The BwN programme also conducts a *field school* and trains on sustainable aquaculture emphasizing the importance of mangrove ecosystems for protecting the coastlines (B1-B2) (see 5.2.1). Using the notion of *bio-rights*, local people are given financial support for aquaculture on the condition that they have to also conserve mangroves and the hybrid structure used to protect the coast from flooding (Wetlands International, 2016).

The bio-rights programme so far has included 30 individuals in one village (i.e. Timbulsloko) (Murpratiwi, 2016). However, based on the research conducted up to 2016, only Timbulsloko Village (Unit 1) has been involved as the pilot project location.

Table 6.2 Chronological account of coastal risk reduction efforts in Sayung Sub-District, Demak District

Year	Events
1985	-Reclamation project of Tanjung Mas Harbour in Semarang City started. (Marfai, 2012). -Erosion level is slowly increasing in Demak coastal area. (Marfai, 2012). -Land conversion from rice fields and mangrove to fish and shrimp ponds in Demak coastal area. (Chafid et al., 2012; Marfai, 2012; Asiyah, 2015).
1988	-Flooding and inundation started to occur in Sayung Sub-District (F1, F3).
1998	-Initiation of training on mangrove planting by the regional government (A3-A6).
2000	-Mangrove planting project launched in Demak (Triyanti, 2013). -Tidal flooding event, 208 households were evacuated (Marfai, 2012).
2001	-Tidal flooding event inundated 308,65 ha area in Bedono Village. (Asrofi and Hadmoko, 2017).
2004	-NGO from Japan, OISCA, and Ministry of Home Affairs signed Memorandum of Understanding for mangrove rehabilitation and conservation project in Demak. (Wetlands International Indonesia, 2016). -Establishment of mangrove groups at the local community level (C1-C4).
2005	-2 Hamlets (Tambaksari and Rejosari-Senik) submerged and relocated. (Marfai, 2012; Triyanti, 2013; Asiyah et al., 2015). -Inundation has reached more than 5 km inland. (Marfai, 2012).
2007	-Erosion level has reached 1,5 km long and 6 m in depth. (Marfai, 2012). -Construction of breakwater in front of mangrove forest in Bedono Village. (C1-C4).
2012	-Early assessment of mangrove capitals project in Demak District. (B1, B2). -Initiation of hybrid engineering methods in Timbulsloko Village, in collaboration of Ecoshape consortium and Ministry of Marine Affairs and Fisheries (Winterwerp et al., 2014).
2013	-Implementation of Coastal Resilient Village (CRV) Programme conducted by the Ministry of Marine and Fisheries Affairs in Demak. (A2). - The first construction of hybrid engineering structure in Timbulsloko village. (B1, B2).
2015	-Damages of the hybrid structure in Bogorame hamlets are reported by the local community due to high waves. (F3, B4). -Memorandum of Understanding between The Netherlands and Indonesia is signed for the development of Building with Nature Indonesia project for the period 2015-2020. (Indonesia-Investment, 2015).
2016	-Progress result of hybrid engineering structure reported 45 cm sediment had been successfully deposited. (Wetlands International Indonesia, 2016). - The local community reported that coastal flooding and inundation still occurring. (FI-F3). -Coastal field school programme as sub-programme under the Building with Nature Project has started. (B1, B2).
2017	-Coastal flooding has inundated 3,500 houses, and 5 houses are collapsed in Sriwulan village due to the flooding. (Tribun News, 2017a).

In Semarang City (Unit 4), a polder system has been built to prevent flooding. To tackle the issue of excessive groundwater extraction, regulations (Hadi, 2017) requiring industries to apply for a groundwater permit have been introduced. There is also a coastal management policy (see 6.2.2.2) which regulates reclamation activities. For tackling coastal flooding, jetties have been constructed along the northern coast of Semarang by the Ministry of Public Works and Human Settlement (Hadi, 2017).

6

Table 6.3 Overview of three main projects in Demak coastal area

Detail project	**OISCA**	**Coastal Resilience Village Development Project**	**Building with Nature project**
Initiator:	OISCA.	Ministry of Marine Affairs and Fisheries.	Ecoshape and Wetlands International Consortium.
Collaboration with:	Ministry of Home Affairs.	Office of Marine Affairs and Fisheries in Demak, District, Sub-District and village office.	Ministry of Marine Affairs and Fisheries and Ministry of Public Works and Human Settlement.
Type of approach:	Soft and Hard.	Soft and Hard.	Soft and Hybrid.
Period of project:	2004-2019.	2013-2015.	2013-2020.
Location:	Bedono Village.	Sriwulan, Bedono, and Timbulsloko Village.	Timbulsloko Village.
Main Activities/years:	-Planting Mangrove/ 2004-present; -School Renovation/ 2004-2006.	-Establishment of coastal community groups/2013; -Training for capacity development/2013-2015; -Infrastructure development/2013-2015.	-Mangrove Capital Project-Study on mangrove situation in Demak/ 2012-2014; -Construction of permeable dam with hybrid engineering / 2013-present; -Coastal field school / 2016-present.

Source: Author's fieldwork (interview and focus group discussion), 2014; 2015; 2016

Chapter 5 noted that, despite the governance actions taken till now, problems of coastal flooding continue and there is high uncertainty about future risks. I now discuss the quality of governance efforts more precisely, offsetting them against the overall capacities of the governing system and the magnitude of the problems that exist.

6.3 EXAMINING THE GOVERNING ACTORS AND THEIR QUALITIES

6.3.1 GOVERNING ACTORS AND COORDINATION

The governing system (GS) in Demak is diverse in terms of *types* and *levels* of governing actors. Each governing actor has different interests, goals, expectations, and ways to act in terms of the coastal disaster issue. This section discusses the diversity of actors and also the vertical and horizontal relations among them which could either enable or constrain the coordination effort. Vertical interaction means the interaction that takes place between governors at different scale levels. Horizontal interaction refers to the propensity of governing actors of different origin to interact in an organized but equal manner (Kooiman, 2003).

The four *types* of relevant governing actors in Demak District include: (1) Government agencies; (2) local and international NGO's; (3) research and scientific institutions; and (4) local communities. This section explains each separately (see Table 6.4). Each actor is responsible for implementing specific laws and policies with specific goals and instruments (see Table 6.5).

(1) Government agencies

According to Act No. 23/2014 on regional government, the formal governing system in Demak coastal area consists of three levels: National, Provincial and Regional. At the **national level**, there are 3 key ministries or national agencies that are included as official partners in the Building with Nature project. The departments include: (1) The Ministry of Marine Affairs and Fisheries; (2) The Ministry of Public Works and Human Settlement[7] and (3) Indonesian National Board for Disaster Management.

At the **provincial** level, there are four main agencies including: (1) The Office of Marine Affairs and Fisheries in Central Java Province; (2) Environmental Agency in Central Java Province; (3) Regional Development Planning Agency in Central Java Province and Demak District (BAPPEDA); and (4) Regional Board for Disaster Management in Central Java Province (BPBD). Based on the Local Government Law Act Number 23/2014, the four regional institutions are not connected functionally to national level institutions but are accountable to the respective provincial governor. In this thesis, I discuss the role of two of these agencies that have played in a significant role in past and present projects: The Office of Marine Affairs and Fisheries in Central Java Province and the Environmental Agency in Central Java Province.

At the **regional** level, there are six main agencies involved, including: (1) The Office of Marine Affairs and Fisheries in Demak District; (2) Environmental Agency in Demak District; (3) Regional Development Planning Agency in Demak District (BAPPEDA); and (4) Regional Board for Disaster Management in Central Java Province and Demak District (BPBD).; (5) Regional Board for Disaster Management in Demak District (BPBD) and (6) the Sub-District Office. Here again, this thesis focuses on two agencies that have a significant role in the main

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[7] The Strategic Plan 2015-2019 (KEMENPUPR, 2015) of the Ministry of Public Works and Human Settlement clearly states the scope of work and responsibility to: 1) Provide technical supervision to regional government and relevant agencies for construction of coastal protection infrastructure; and 2) Development and improvement of function and condition of facilities and coastal protection infrastructure for 530 km between the year 2015-2019. Meanwhile, the Strategic Plan 2015-2019 (KEMENPUPR, 2015) of the Ministry of Marine Affairs and Fisheries has targeted 3 million mangroves to be planted, 50 km hybrid structure, and 15 km of breakwater in the northern coast of Java.

(past and present) projects: The Office of Marine Affairs and Fisheries in Central Java Province and the Environmental Agency in Demak District. These offices report to the Head of the District of Demak (Bupati).

At the **local** level, I distinguish villages which include hamlets as units. The villages are led by heads of offices at each administrative level. These report back to the Head of the District of Demak (Bupati). The local level also includes formalized fisher and youth associations that are registered as mangrove groups and engage in voluntary, and project-based, risk reduction efforts.

(2) Non-Governmental Organizations and consultancies

The main ecosystem-based projects established in Demak since 2004 are initiated through the collaboration between international partners with international funding and the national government of Indonesia. The government of Indonesia has signed a Memorandum of Understanding with OISCA (i.e. Ministry of Home Affairs) and also Ecoshape and Wetlands International Consortium (i.e. Ministry of Marine Affairs and Fisheries and Ministry of Public Works and Human Settlement) for better cooperation and partnership in rehabilitation of mangroves and revitalization of the coastal area (see 5.4). This includes Japan, with the initiative from OISCA (2004) and the initiative between the government of Indonesia and The Netherlands (2015) on Building with Nature in Demak (B1, B4).

The implementation of these projects involves collaboration at the national (Ministry of Marine Affairs and Fisheries, and Ministry of Public works and Human Settlement), provincial, regional, and local government level (head of village and hamlets) as well as community groups. The arrival of NGOs started in 2004 after the first NGO, which is a collected body of companies from Japan called OISCA (Organization for Industrial, Spiritual, and Cultural Advancement), signed a memorandum of understanding with the Indonesian Ministry of Home Affairs (B1). Since 2012, Wetlands International and Ecoshape, and a consortium including Witteveen&Bos, Deltares, Wageningen University & Research, IHE Delft Institute for Water Education, Von Lieberman, and Blue Forests have been collaborating in the Building with Nature Project in Demak.

Table 6.4 List of relevant governing actors, goals and law and policies in Demak District

Actor	Level	Agencies	Goals	Law and policies
Government agencies	National	Ministry of Marine Affairs and Fisheries (MMAF); Ministry of Public Work and Human Settlement (MPWH); Indonesian National Board for Disaster Management (BNPB).	Revitalization of coastal area and green belts; livelihood improvement through aquaculture.	Coastal Zone and Small Island Regulation (National); Disaster Management Act (National).
	Provincial	Office of Marine Affairs and Fisheries in Central Java Province; Environmental Agency in Central Java Province; Regional Development Planning Agency in Central Java Province (BAPPEDA); Regional Board for Disaster Management in Central Java Province (BPBD).	Revitalization of the coastal area and greenbelts; Conservation of coastal ecosystem; Coastal development; Disaster management (Sudden disaster).	Zonation of Coastal Area and Small Island in Java; Environmental protection and management act (National); Operationalization of Disaster Management Law in Central Java Province.
	Regional (District and Sub District)	Office of Marine Affairs and Fisheries in Demak District; Office of Agriculture and Horticulture of Demak District; Environmental Office in Demak District; Regional Development Planning Agency in Demak District (BAPPEDA); Regional Board for Disaster Management in Demak District (BPBD); Sub-District Office.	Revitalization of the coastal area and greenbelts; Conservation of coastal ecosystem; Coastal development; Disaster management (Sudden disaster).	Strategic Planning Coastal Area in De District; Environmental Protection and Management in Demak; Operationalization of disaster management in Demak District.
	Loc	Village offices.	Coordinating programme in village level.	Village rules/adat.
NGOs/consultancies	Int.	Ecoshape; Wetlands International; Witteveen+Bos; Deltares; Von Lieberman; Blue Forests; OISCA.	Supporting the coastal mangrove ecosystem-based approach for coastal protection.	Project documents.
	Nat.	KESEMAT	Supporting mangrove conservation.	
Research and Academic	Int.	Wageningen University & Research; IHE Delft Institute for Water Education.	Research and data collection.	-
	Nat.	Diponegoro University; Other universities conducting independent research.		-
Local community		Mangrove groups; Fisher groups; Youth groups.	Maintaining mangrove and hybrid structure.	Village rules/adat.

Source: Author's analysis

Table 6.5 Laws, goals and instruments for Eco-DRR in Demak District

Topic	National/ Regional acts	Goals	Instruments
Decentra-lization	Regional government and decentralization (National).	Delegate responsibility to regional level.	Decentralization.
Coastal zone and small islands regulation	Coastal Zone and Small Islands Regulation (National).	Sustainable/ global natural resources management and ecosystem conservation.	Reclamation, protection, and participation.
	Zonation of Coastal Area and Small islands in Java in 2014-2034.	Operationalizes coastal management at the provincial level.	Elaboration of coastal activities and development.
	Strategic Planning of Coastal Area in Demak District.	To develop marine/coastal resources and sustainable use.	Policy plan and coastal disaster plan.
Disaster management	Disaster management (National).	To reduce national disaster risk.	Guidance of disaster policy; Governance structure for disaster management.
	Operationalization of Disaster Management Act in Java (Provincial).	To reduce provincial disaster risk.	Disaster risk management; Governance structure.
	Operationalization of Disaster Management Act in Demak (District level).	To reduce local disaster risk.	Disaster risk management; Governance structure.
Environmental protection and management act	Environmental Protection and Management Act (National).	Healthy environment and economic development aligned with sustainable development principles.	Decentralization, environmental protection, adaptation and the right to a sustainable environment.
	Environmental protection and management act (Provincial).	To reduce disaster risk through environmental protection.	Restricts activities that degrade environmental quality, thus increasing disaster risk.
	Environmental protection and management in Demak District (District level).	To reduce disaster risk through environmental protection.	Ditto in Demak District
Bio-diversity	Biodiversity and Ecosystem Conservation (National).	To conserve biodiversity and ecosystems.	Conservation rules; Use rules.
Mgt of PA	Management of protected areas in Central Java province (Provincial).	To promote integrated, harmonious, aligned, and balanced, protected area management.	Protected and conservation areas, including the mangrove forest areas.
Forest mgt	Forest Management Act (National).	Optimal and sustainable utilization, including mangroves.	Mangrove conservation.

Source: Author’s analysis

In addition to these internationally funded projects, there are also many local NGOs conducting mangrove planting programmes in Demak. One of them is KESEMAT that is mainly focusing on the planting programme in this district (see also Table 6.5).

(3) Local community

In 2004, local people begin to establish formalized community-based organizations in the form of mangrove community groups to participate in the mangrove-planting programme (B1, C1). There are 5 different mangrove groups in Bedono village (Triyanti, 2013) and many more in different villages in Sayung sub-District. Mangrove groups are usually led by a respected and high-profile community leader such as the head of hamlet, or the village secretary. Members include fishers and youth (B1, C1-4).

(4) Research and academic institutions

The research and academic institutions mainly play a role in conducting relevant scientific research (D1). There has been some representation of academic experts in the regional mangrove working group (A3-A6, D1). International NGOs have built relations with research and academic institutions in Indonesia. The Building with Nature Programme conducted by Wetlands International and Ecoshape consortium, for example, has engaged Diponegoro University in Semarang as one of their official partner institutions (B2).

6.3.1.1 Vertical and Horizontal analysis and the issue of coordination

The *vertical* relation that exists within government in Indonesia is set by the process of decentralization and devolution (see Satria and Matsuda, 2004) regulated by the Local Government Law Act Number 23/2014. While coastal issues were previously handled at the district level, the amended Regional Government and Decentralization Law of 2014 located them in the domain of the national and provincial government, whereby the role of the regional government is to ensure implementation in local sites. The power over budgeting and decision making is mainly in the hands of the national and provincial government. An example of the vertical relationship that pertains within government can be seen from the Building with Nature Project, where two nodal ministries (Ministry of Marine affairs and fisheries and Ministry of Public Works and Human Settlement) are heavily involved through political and co-funding support[8]. The provincial, regional, and local government only play the roles of support and implementation.

The relations between governmental agencies are aligned through spatial planning documents/ *Rencana Tata Ruang Wilayah* (RTRW) at the provincial as well as the regional level. The RTRW in Demak District level has served as guidance for each governmental agency for establishing their 5-yearly strategic plan and work plan. Despite the effort to align the work of regional government agencies, there are some inconsistencies reported between the provincial and regional (District) spatial planning document (see Nurlambang, 2012; Sutarto and Javie, 2012; Resosudarmo et al., 2014; Salim, 2015).

Vertical relations in the NGO-scene consists of linkages between local operational units and their mother agencies in the countries of origin. Horizontal relations in the coastal protection and mangrove planting initiatives in Demak coastal area include relations between governmental agencies, NGOs, and community groups at the district level.

The connections between NGOs are generally poor (A6, B1, C2) as each NGO has its own mandate and programme (A3, A4, C3). This leads to competition among different community groups over gaining funding (see Triyanti et al., 2017).

Horizontal relations between government agencies and NGOs often appear to be well-designed in respect of each official partners or network engaged in the specific project. As an example, the BwN programme in the district level is strongly supported by the District Office of Marine Affairs and Fisheries. Consultation and coordination are done through meetings (formal and informal). However, other relevant government offices for ecosystem-based coastal protection such as the environmental office at the District level are not actually consulted.

Although each type and level of governing actor has its own mandate, scope of interest, and network, to effectively govern the problem and upscale the solution for the coastal erosion and flooding, a coordination effort is clearly needed. To do this at the regional level, a formal, multi-stakeholders' platform called the Regional Working Group for Mangrove Management/ *Kelompok Kerja Mangrove Daerah* (KKMD) was established in 2011 by the Office of Marine Affairs and Fisheries in Demak. It also involves other relevant governmental agencies in the coastal protection and mangrove planting programmes (see Box 6.1). However, the working

[8] Ministry of Marine Affairs and Fisheries has allocated Euro 1.87 Billion for the implementation of hybrid technology in northern Java coastal area (see Netherlands Water Partnerships for the Dutch Government, nd: 28-29)

group is still not fully operational. The interactions taking place among governing actors are therefore mainly through informal meetings and discussions (A1-A3, C1-C4). Furthermore, government officers in different agencies communicate mostly through informal meetings with the local people, for instance, while monitoring infrastructure or conservation programme in the villages (A3-A5).

Box 6.1 The setting and task of the Regional Working Group for Mangrove Management/Kelompok Kerja Mangrove Daerah (KKMD) in Demak District

The setting of the working group

The working group is set up under the responsibility of the regional district secretary. Latest degree in 2011 has appointed the Office of Marine Affairs and Fisheries, Agriculture, Forestry section, Environmental office and the Bureau of Planning and Development of Demak District in its memberships. The working group is supposed to involve other non-governmental and civil society organization in its coordination efforts.

The task of the working group

1. Identification and inventory of the coastal/watershed and social condition in Demak District.

2. Identification and inventory of damages and management of coastal/watershed area and also providing data of mangrove development as a basis for the mangrove management plan.

3. Establishment of planning and providing technical guidance to communities to revitalize the coastal area.

4. Establishment of planning and providing assistance, monitoring and evaluation tasks to the government at the district level on the development and conservation of mangrove activity.

5. Facilitate the problem solving and development of potential in the coastal area.

6. Increasing awareness and participation of the local population in management and conservation of mangroves.

7. Facilitate the governance of conservation and management of mangrove.

8. Coordinate the relevant departments to mangrove conservation in Demak District.

Source: Decree of Demak Regent number 660.05/19/2011 on the establishment of the working group and secretariat for management of mangrove ecosystem in Demak district (KKMD)

6.3.2 Governance and the goodness of fit

A diversity of governing actors of different origins results in diverse framings of images, instruments, and actions. ‘Goodness of fit’ refers to the “consistency between images, instruments and actions, and how well they address the problems” (Chuenpagdee and Jentoft, 2013: 343) within single and different agencies – thus, to what extent do images, instruments, and actions of an agency match.

The overview of governing agencies and their images is concretized as goals. I highlight the laws that these agencies implement, ignoring the variety of other instruments.

Following the table, I examine the match, or fit, that exists between the images, instruments and actions of the various agencies, concentrating on the agencies that play the largest role in the governing of coastal risk in Demak.

6.3.2.1 Diversity of images of problem and goals

(1) Matching of problem images

In Demak District, coastal flooding is recognized as an overarching problem that urgently needs to be addressed. The problem includes high waves, erosion, and continuous inundation from tidal flooding (see Chapter 5). The problem is clear and agreed to by all actors. Based on the formal document of the Medium-Term Development Plan 2011-2016 published by Demak Regional government, the main cause of coastal erosion is the geomorphology of the peninsula, as a natural phenomenon (RPJMD Demak, 2011). However, independently, authorities from several government agencies at regional level agree that the cause of erosion in Demak is mainly triggered by unsustainable coastal development in Semarang (A1, A2). Disagreement regarding the cause of the problem is likely aggravated by complex political interests involving different jurisdictions at various levels regarding the current coastal development strategy along the Northern Java coast.

(2) Matching of the goal images

Variation of images on the goals of coastal disaster risk reduction efforts occurs when it comes to the different priorities set by different governing actors. The national government has a strong focus on general and overarching issues, including environmental protection and conservation, coastal management, and disaster management through the revitalization of coastal area in Demak (A1, A2). At the provincial level, strategies are set in more detail and are in line with the provincial development plan, including attention for livelihood and welfare of people, increasing fish productivity, preserving mangroves, and building capacity of provincial and regional staff (A5). At the regional level, governmental actors are focusing on more or less the same strategies, but are more locally targeted in terms of their application (A3-A6). In the case of Demak, slowing down the erosion, protecting local people from flooding, maintaining livelihoods, and ensuring the sustainability of the programme are the main concerns, which are agreed to both by all parties, including local people, NGOs, and government authorities at each level (A1, A3-A6, B1, B3, B4, C1-C4).

The horizontal analysis demonstrates a variety of goals among different NGOs. The Ecoshape and Wetlands International consortium, for example, focus on the implementation of hybrid engineering and livelihood improvement through a coastal field school. OISCA and KESEMAT mainly focus on mangrove planting and its conservation. Furthermore, the research and academic institutions that are sometimes associated with and sometimes independent of the project are all interested in collecting data and understanding the current status of the problem and prediction in the future although with different purposes and approaches. Meanwhile, local people are mainly concerned with the safety and the sustainability of their livelihood. They are involved in the established community groups, including fishers and youth groups, and are focusing on obtaining funding from governmental agencies or NGOs to run their livelihood improvement projects (see Table 6.1).

(3) Views on the matching of images of problem and goals

Turning to the views of the coastal population of Demak on the possible diversity of images, the result of the survey conducted in 2016 demonstrate that more than half of the local people in the three coastal villages agree that everyone involved in the coastal protection programme understood, and had the same opinion about, the problem and goals (see Table 6.5). Furthermore, the goals of protecting their settlement from flooding as well as restore their livelihoods are agreed upon. They also believe that the problems and goals of the coastal protection programme are perfectly matched, as well as the actions that have been taken by different parties. The correct matching of problems, goals, and actions is confirmed by the NGOs and government authorities, mainly at the district level (A3, A4, and B1-B4). However, there is still lack of agreement in terms of the causes of the erosion itself among the governing actors and local community.

Table 6.6 Survey results on the goodness of fit of images with problems

Sub-variables	**Quantitative**	**Qualitative**	
	Local population n=200	NGOs	Government authorities
Understood the problem well and had the same opinion about the problem	Strongly Disagree: 0.4% Disagree: 3% Neutral: 4.7% Agree: 73.6% Strongly Agree: 18.3%	Agree. -Coastal erosion, flooding, reclamation.	Agree. -Coastal erosion and flooding.

***Table 6.6** (continued)*

Understood the goals of coastal protection well and had the same opinion about the goals	Strongly Disagree: 0.9% Disagree: 9.8% Neutral: 5.5% Agree: 73.2% Strongly Agree: 10.6%	Strongly Agree. -Tackling coastal erosion and livelihood improvement.	Strongly Agree. -Tackling coastal erosion and livelihood improvement.
The understanding of stakeholders on problem and goals in coastal protection programme with mangrove planting is matched	Strongly Disagree: 1.3% Disagree: 15.7% Neutral: 5.5% Agree: 69.8% Strongly Agree: 7.7 %	Agree.	Agree.

Source: Fieldwork survey, 2016

6.3.2.2 Diversity of instruments

The main law regulating the management of the coastal area in Indonesia is the Coastal Zone and Small Islands Regulation (Act Number 27/2009). However, the topic of coastal disaster risk reduction cross-cuts many government departments and regulatory frameworks. In this section, I analyse 13 policy documents that are relevant to the governance of coastal disaster and ecosystem-based disaster risk reduction. This list includes formal laws and regulations related to: (1) Regional government and decentralization; (2) Coastal and small island management; (3) Disaster management; (4) Environmental protection; (5) Biodiversity conservation; and (6) Forest management. I define three levels of regulations: including national, provincial, and regional level (See Table 6.4, Table 6.5). I also highlight the informal regulations that play a role at the local level.

Subsequently I discuss available legislation in relation to four key topics: (1) the implementation of disaster management and coastal risk; (2) the ecosystem-based approach, which is relevant to the current ecosystem-based coastal protection effort in Demak; (3) the financing of coastal protection, which is essential for the realization of plans; and (4) the structure of governance. Finally, this section will discuss the perception of governing actors regarding the goodness of fit of instruments among various thematic topics covered in each law.

Law 23/2014 on Regional Government and Decentralization divides thematic tasks between national and regional government (also see 6.3.3.2). Regarding marine and coastal issues, this law regulates the transfer of authority from regional to the provincial government, as it has been viewed as a strategic and transboundary matter. Based on interview with district and local government authorities, the shift of the authority has caused confusion of mandates on task and responsibilities (B2, B3). However, in the long run, the shift might be a good opportunity to ensure that the transboundary coastal issues are addressed in an integrated manner.

Law 27/2009 on Coastal Zone and Small Islands Regulation regulates the general management of the coastal area including reclamation and sustainable use of natural resources and ecosystem conservation in the coastal area. This national law is operationalized by provincial-level law which contextualizes coastal management based on provincial strategies and priorities. At district level, further specifications are made in terms of role and responsibility of governmental agencies.

A separate policy applies to disaster management (Act No. 27/2007). It provides guidelines for terminology related to disaster management. It also sets the governance structures to support disaster management strategy by establishing national, provincial, and regional bureaus for disaster management.

Law 32/2009 on Environmental Protection and Management Act regulates the issue of degradation and pollution in all areas, including coastal areas. This law is also relevant in terms of ensuring economic development to be in line with sustainable development. At the provincial and the district level, the national law is operationalized by regulations which involve restriction of the activities which could degrade environmental quality, thus resulting in higher risk of disaster.

The environmental aspects related to biodiversity and ecosystem are covered in Law 5/1995 on Conservation of Biodiversity and Ecosystem and Law 41/1999 on Forest Management which is crucial to ensure the healthy condition and maximization of ecosystem services. At the provincial level, issues of biodiversity and ecosystem protection are ensured in the form of management of Protected Areas, involving categorization and classification of protected and conservation areas including mangrove forests. Similarly, the Forest Management Law (Act number 41/1999) regulates forest management in general and includes regulations on mangrove conservation (see Table 6.7).

The aforementioned documents are overall coherent and complementary. However, there are some challenges: (1) Who is accountable for slow-onset disasters and environmental degradation? Slow-onset disasters are not explicitly addressed in any of the policy documents. (2) While some policies prioritize livelihood improvement with fishing and aquaculture, others prioritize mangrove conservation and the two could potentially contradict each other. (3) Another challenge is whether impacts on coastal erosion should be included as an element of a standard environmental impact assessment of a coastal development project? (4) Furthermore, although policies are complementary, the question is whether there are enough resources and capacity to execute good ideas and projects that might be a solution to the coastal disaster risk problem in Demak District.

In addition to formal law, Indonesia has a living practice of informal, customary law (Adat), that is also incorporated into the lowest levels of government practice. In the research villages, a body of such rules exists that I refer to as 'village rules' (B1, B3, and C1-C4). These rules regulate the use of mangrove and coastal ecosystems. Some of the rules codified in village regulation include a prohibition to cut mangroves and to hunt birds in the mangrove area. The enforcement is undertaken by village and hamlet leaders (Bedono village office, 2011). In the case of Timbulsloko Village, Wetlands International has assisted village heads and several local people from the community to revise the existing village rules. The revision added the importance of maintaining the hybrid structure and formulation of development priorities in the village, including the need to develop more permeable dams (Apri et al., 2014).

Table 6.7 Legislation related to mangrove ecosystem-based disaster risk reduction in Demak District

Topic	Relevant national and regional acts	Findings
Regional government and decentralization	Regional Government and Decentralization (Act number 23/2014).	(+) Regulate thematic task between national and regional government; (-) Marine and coastal issues authority are currently transferred back from regional to the provincial government, as it has been viewed as a strategic and trans-boundaries issue, causing confusion on mandates and accountability.
Coastal zone and small islands regulation	Coastal Zone and Small Islands Regulation (Act number 27/2009); Zonation of the Coastal Area and Small Islands of Central Java province in 2014-2034; (Central Java Provincial Regulation Number 4/2014); Strategic Planning of Coastal Area in Demak District; (Demak District Regulation number 11/2012).	(+) Refers to integrated coastal zone management; the perspective of bio-eco-region; include economic, social, and ecology of the environment in the coastal area and small island; (-) Only include limited analysis of future threat (only on seismic faults); does not include the elaboration on coordination mechanism.

***Table 6.7** (continued)*

Disaster management	Disaster management (Act number 27/2007); Operationalization of Disaster Management Act in Central Java Province (Central Java Provincial Regulation Number 11/2009); Operationalization of Disaster Management Act in Demak District (Demak District regulation number 9/2016).	(+) Provide a solid foundation of governance structure in all levels related to disaster management, therefore secure national, provincial, and regional budget allocation; (-) No definition for coastal disaster; does not include creeping disaster in the terminology, therefore also in all the management phases; does not include elaboration on coordination or national platform for better implementation.
Environmental protection and management act	Environmental protection and management act (Act Number 32/2009); Environmental Protection and Management Act (Central Java Provincial Regulation Number 5/2007); Environmental Protection and Management in Demak District (Demak District Regulation number 8/2016).	(+) Includes clear reference to climate change and emphasizing sustainable development principles to economic activities; (-) Disaster is seen as environmental impact, which then limits the definition to only natural hazards; In regards to reference to disaster, the provincial regulation left out the definition of disaster risk set already by the national level regulation (lack of alignment).
Conservation of biodiversity and ecosystem	Conservation of Biodiversity and Ecosystem (Act Number 5/1990).	(+) A clear classification of protected areas as a regulatory instrument; (-) Lack of multidimensional aspect, no reference to the linkage between conservation, biodiversity, and shared benefits of genetic resources; no reference to the use of ecosystem services and the linkage of conservation, biodiversity, and efforts to lower disaster risk; ecosystem is seen as the component of disaster risk, but not as part of resources and solution.
Mgmt. of protected areas	Management of Protected Areas in Central Java Province (Central Java Provincial Regulation 22/2003).	(+) Elaborates the importance of mangrove coastal area and also inclusion of tidal area in the definition of disaster-prone areas; (-) No elaboration on the mechanism of funding.
Forest mgmt.	- Forest Management (Act number 41/1999).	(+) Elaborates the importance of mangrove in the coastal area and also the inclusion of the tidal area definition in the definition of disaster-prone areas; (-) No elaboration on the mechanism of funding.

6

The linkage between existing laws and disaster management

The analysis of horizontal relations among the six types of regulations shows several important results. Overall, the laws are coherent and there is a consistent delegation of responsibility among the five sectoral regulations. However, there are inconsistencies of terminology in different regulations (coastal management, disaster management, environmental management, biodiversity law, and forest law) with regard to the *type of disaster*. Coastal disaster is only defined under the Coastal Area and Small Island Management Law (27/2009) and is thus the most relevant Law for mangrove ecosystem-based disaster risk reduction. Disaster management has not been mainstreamed in all of the relevant regulations since there are different perspectives of what constitutes a disaster and different types of disaster that are considered in the regulations; references to disaster management are also often incomplete. For example, in the environmental protection law, the reference to disaster is only in terms of the 'disaster event' phase or when the disaster occurs, rather than the complete cycle of disaster management, including the pre- and post-disaster phase. The inclusion in the Environmental Protection Law (Act number 32/2009) includes the compulsory environmental impact assessment for pre-determined disaster-prone areas based on previous or existing events (poisonous natural gas, primary and secondary impact of volcanic eruptions, tidal flooding, and river flooding). There is, however, no further discussion on forecasting and monitoring methods, which is important to decide whether an area is prone to a specific type of disaster in the future. In addition, there is no specific regulation on coordination mechanism between these law documents (see Table 6.7)

The linkage between existing laws and ecosystem-based approach

In existing regulatory frameworks, ecosystems are formulated as an element at risk, rather than an element contributing to (or mitigating) risk. For example, in the law on Conservation of Biodiversity and Ecosystem (Act Number 5/1990), mangroves is argued to be protected and conserved, but no reference and link to why we need to conserve mangrove and forest specifically is made. The Central Java Coastal Management Law (provincial) provides a converse example, mentioning the reference of "the utilization of both hard and soft (nature-based) infrastructure". This particular point is relevant to the existing initiatives in incorporating a hybrid approach (combination of mangroves and permeable dams) in Demak District to reduce the risk of coastal flooding in the future. Beside the Provincial Law of Central Java coastal management, there are no centralized and high-level policy instruments which integrate the ecosystem conservation with disaster risk reduction (see Table 6.6)

Analysis of financing

In terms of financing, the main source is described as coming from national, provincial, regional government budgets. Some regulations mention voluntary funding from community and NGOs without explicit descriptions (Ferrol-Schulte et al., 2015). An example actually mentioning specific amounts is the Building with Nature Indonesia project, which provides EUR 5 million until 2020 financed from the Dutch Sustainable Water Fund (see Wetlands International, 2016).

Perception of the goodness of fit of instruments

Table 6.8 sums the views on the 'goodness of fit' of legal instruments as they emerged from the field survey. It considers the views of the local population, NGOs, and government.

In terms of the perception of local people, NGOs, and government authorities, the survey and interview results reveal that many local respondents are aware that there is a kind of law or regulation existing (see Table 6.8). However, they have less in-depth knowledge on the content of such national or district level regulations on the guidance to conserve coastal ecosystems, and the specific use of mangroves to protect the area from erosion and flooding. This is specifically reported by NGOs. They also perceived a lack of explicit rules on the issue of ecosystem conservation and its linkage with reduction of coastal disaster risk and that, so far, only the village regulation is implemented well.

Table 6.8 Survey results on the stakeholder perception on the goodness of fit of instruments

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
The rules/regulation existing in the whole system are adequate	Strongly Disagree: 0.4% Disagree: 20.9% Neutral: 35.3% Agree: 36.2% Strongly Agree: 7.2%	Disagree. -National and provincial regulation is not adequate to regulate the need for ecosystem conservation and protection against coastal disaster; -Only village regulation of the ecosystem conservation exists.	Disagree. -The provincial and district government authorities acknowledge inadequate and inconsistent regulation and currently in discussion for revision; -Local government demands clarity on decentralization law.
The existing rules/regulation are implemented well	Strongly Disagree: 1.7% Disagree: 22.1% Neutral: 37.9% Agree: 31.9% Strongly Agree: 6.4%	Disagree. -Only village regulation is implemented well.	Disagree. - Local people are still cutting mangrove.

Source: Fieldwork Survey, 2016

The government authorities, from provincial to district level, agree that there is a need for amendment of the core regulations besides the existing Coastal Zone and Small Islands Regulation (Act number 27/2009), to clearly define coastal disasters and allocate tasks and responsibilities among different governing actors. Some of the NGO staff called for clear terminology on ecosystem conservation in its relation to disaster risk reduction efforts, especially in the coastal area (B1, B4). However, there are bureaucratic and procedural challenges to revising a regulation which are often time consuming and complex (A1, A2, A3, and A5).

6.3.2.3 Summary on 'Goodness of fit' and the issue of coordination

At an organizational level, the goodness of fit of government agencies from national to local level can generally be concluded to be in line. The government at the national level usually deals with more general issues, and has also been involved directly in the implementation of the ecosystem-based project in Northern Java coastal area, including in Demak District (see KKP, 2015 and KPU, 2015). The national government also provides technical assistance and supervision to the provincial and regional government (A1).

The existing law and regulation at the different level are coherent. However, there is a lack of reference to the use of ecosystems as opportunities to reduce coastal disaster risk in a sustainable way and also lack of clear mandates on the task to manage coastal erosion and flooding problem, and how these can be adequately funded. This could affect the effectiveness of programme implementation and the plan to upscale such programmes to the wider regional level. The NGOs, which generally possess a similar image of the problem as the government does, however, has different images on the possible solution. The Wetlands International and Ecoshape consortium introduced the hybrid protection structure, which is believed as the effective solution. Other NGOs including OISCA and local NGOs are mainly focusing on the soft approach by only planting mangrove to protect coastal area from flooding.

Overall, while there is agreement on the problem, there is disagreement on the cause of the problem especially in relation to the coastal development projects in the neighbouring coastal city of Semarang. The latter is a sensitive political issue which requires revisiting the development paradigm and strong transboundary relations, shared images of problem and prioritization of coastal protection. The dissonant images of the cause of the problem have translated into varying instruments. There is no existing law at the national level which integrates, nor adequately supports the disaster management and ecosystem-based management effort to enable the implementation of ecosystem-based adaptation and ecosystem-based disaster risk reduction effort at the lower administration levels. The state continues to prioritize hard structures (Wahyudi et al., 2012) to protect coastal areas. The lack of coordination is the main reason for the dissonance occurring with regard to images, instruments, and therefore, actions.

6.3.3 Governance, responsiveness and the issue of social mobilisation

Interactive governance theory suggests three ideal-typical modes of governance: hierarchical, self- and co-governance (see Chapter 3). All three types exist in Demak (see Table 6.9). The **Hierarchical** mode is reflected in state law which proceeds from the national to the local. **Co-governance** is found in the form of formal and informal cooperation and the involvement of diverse stakeholders in managing the mangrove management programme, for example, through the regional working group on mangrove management. **Self-governance** is reflected in Demak in Community-based action groups protecting coastal areas by using a mangrove ecosystem-based approach that has come about in response to interventions by outside actors.

Table 6.9 Different expressions of governance modes in Demak District

Modes	Forms of Implications
Hierarchical	Establishment of aid and development program arranged mainly by the government in clear hierarchical structures: central-regional-local governmental agencies and bodies.
Co-	Cooperation among different governmental agencies with local groups, NGOs and private parties.
Self-	Self-managed community mangrove groups are in operation.

6.3.3.1 Diversity of modes

Hierarchical

Hierarchical structures play a major role in dealing with societal issues, including coastal disaster. The central government, through several ministries relevant to the coastal disaster risk reduction programme, have the legislative power to regulate the coastal zone and to budget for major programmes, including breakwater construction, mangrove seed distribution and planting programmes and hybrid engineering structure. This dominant role is also reflected in Demak coastal area through the exercise of power for decision making by using the formal instruments such as acts and regulations, and financial resources from national to regional government budget allocated for coastal protection programme.

Co-governance

The co-governance modes in Demak include: (1) the informal cooperation among different governmental agencies with local groups and NGOs; (2) the integrated platform in the form of Regional Working Group for Mangrove Management; and (3) joint projects through public-private partnerships. The first type of cooperation involves different governmental agencies, NGOs, and various community groups, including mangrove groups, fisheries groups, and youth groups (C1-C4). This type of cooperation effort has developed organically, meaning that there is no standard for such cooperation. The second type of cooperation, which is the Regional Working Group for Mangrove Management as a formal collective action among different stakeholders, is not yet fully functioning due to a lack of institutional leadership and capacity from the respective agencies in charge (see Section 6.3.1). Some local people perceived that the government agencies, as the main leader and initiator of these cooperation efforts, are not up to their task of responding to their problems and concerns (F1-F3). The third type is the initiation of projects through public-private partnerships. This emerges in the Building with Nature Indonesia programme which was officially launched in 2015.

Self-governance

Self-governance is reflected in the community-based programme in the form of mangrove groups, the establishment of which was triggered by mutual cooperation and agreement between the Indonesian government and OISCA in 2004. Although started as part of co-governance modes outcome (i.e. partnerships and collaboration initiatives between all governing actors), in their day-to-day operationalization, the local communities are taking roles in decision making and self-governing their areas (i.e. the location to plant mangrove and the volume) (A3, A4, B1, B3). This has ensured the existence and sustainability of the mangrove groups to date. However, the communities are not being adequately represented. This is due to the distribution of project benefits among different villages and hamlets, leading to latent conflicts among different mangrove groups. (A3-A4; C1-C4). Table 6.9 summarized different forms of governance modes in Demak coastal area.

6.3.3.2 Responsiveness of modes, the issue of inclusiveness and social mobilisation

There is a diverse degree of responsiveness of governing actors to issues of coastal risk in Demak. The hierarchical mode, which is mainly represented by the power of government agencies in formulating and implementing policy from national to local level, is responsive in word and deed to the issue of erosion and flooding in Demak. This is reflected through the strategic plan of the two nodal ministries and the adoption of the ecosystem-based approach in the provincial law (see 6.3.2.2). The responsiveness of co-governance modes in Demak coastal area is shown through the collaboration and partnerships of NGOs and community groups (e.g. in the case of OISCA project with community groups in Bedono Village), as well as the public-private partnerships established by the national government and the Wetlands International and Ecoshape consortium. Lastly, the responsiveness of the self-governance mode can be viewed from the way mangrove groups and other community groups are reacting to the problem of coastal flooding. Although their work has been supported by NGOs and government, the segregated actions and competition over funding among different community groups have reduced the responsiveness of such self-governed modes. This leads to the investigation of inclusiveness. In the context of mangrove ecosystem-based coastal protection programmes in Demak, inclusiveness here is viewed in the context of horizontal inclusiveness including the involvement of governmental agencies in the regional level, NGOs, research communities, and local people who are directly and indirectly involved in the mangrove ecosystem-based programme in Demak.

Horizontal inclusiveness

The BwN programme provides an example for discussing inclusiveness in coastal risk reduction projects. As mentioned previously, at the regional level, the Office of Marine Affairs and Fisheries of Demak is taking the role as a nodal agency. However, in the implementation, mangrove conservation issue is also within the scope of work of the Environmental office which has a less significant role (A3). For the involvement of NGOs, the current programme in Demak is clearly focusing on the BwN programme. Although aiming to achieve a regional scale of coastal protection, based on the data and information gathered up to 2016 for this thesis, the other NGOs such as OISCA have not yet been involved (B1). Meanwhile, most local people are only included in the implementation phase of the programme, (i.e. planting mangroves, attending sustainable aquaculture training, or constructing the hybrid structure) and less included in the planning, monitoring, and evaluation process. The NGOs and government argue that it takes more time, cost, and capacity to include local people (B3, B4). Furthermore, they claim that the inclusion efforts to some extent have been reflected through the representation of the community, such as the village leader or mangrove group leader (B1, B3, and B4).

Table 6.10 Survey results on inclusiveness and participation in Demak District

Sub-variables	**Quantitative**	**Qualitative**	
	Local people n=200	NGOs	Government authorities
Were local inhabitants included in the planning process of the coastal protection programme?	Strongly Disagree: 21.3% Disagree: 60.9% Neutral: 0% Agree: 13.2% Strongly Agree: 4.7%	Disagree. - In the preparation and early survey for project planning, local people knowledge to some extent is considered.	Agree. - Village head is included in the planning process; -NGOs are included when the programme planned is relevant to them.
Were local inhabitants included in the implementation process of the coastal protection programme?	Strongly Disagree: 14.5% Disagree: 37.4% Neutral: 0.4% Agree: 39.6% Strongly Agree: 8.1%	Agree. - Local people are involved in mangrove planting and construction of hybrid structures, as well as in its training programme; -Divided perception on the inclusion in the government project outside of their own programme; -The regional working group is yet to start to function.	Agree. - Local people are included in the mangrove planting activity; -For hard infrastructure planning, local people and NGOs are not included.
Were local inhabitants included in the monitoring process of the coastal protection programme?	Strongly Disagree: 27.2% Disagree: 59.6% Neutral: 0.4% Agree: 7.7% Strongly Agree: 5.1%	Agree. - Local people are involved in monitoring by reporting to the field coordinator or village head if there is any damage to the hybrid structure, or if there are any complaints about other programmes.	Agree. - Local people are responsible for reporting the progress of community-based projects.
Were local inhabitants included in the evaluation process of the coastal protection programme?	Strongly Disagree: 28.1% Disagree: 61.3% Neutral: 1.3% Agree: 6.0% Strongly Agree: 3.4%	Agree. - Local people are involved in the evaluation through village heads and mangrove group leaders.	Agree. -Local people are involved in the evaluation through village heads and mangrove groups leaders.

Source: Fieldwork survey, 2016

The survey results show that local people disagree that they are included in the planning process (60.9%), monitoring (59.6%), and evaluation (61.3%) of the projects related to ecosystem-based coastal protection. Meanwhile, the NGOs claim that local people have been included to some extent through the early survey and consultation with the local people before the initiation of the projects (Apri et al., 2014). Through the consultation process, common norms and rules were agreed, mainly in terms of conserving mangroves and maintaining the hybrid structure (see Table 6.10). The government authorities also claimed that local people were included by local authorities including village and hamlet heads, in relation to soft-approaches and not hard approaches such as infrastructure construction.

In Demak, the co-governance modes function as the most effective mode to accommodate coordination, promoting inclusiveness and possibly also promoting social mobilisation among different actors. The effectiveness and sustainability of ecosystem-based disaster risk reduction efforts depend on the mobilisation of coastal inhabitants (see 3.4.2). Mangrove ecosystem-based approaches in Demak requires mobilisation of resources of all actors in planning, implementation (e.g. planting), and monitoring (e.g. conservation of mangroves and maintenance of hybrid structure). Collaboration, partnerships, and shared resources increase the ownership of such a programme. However, to be able to perform effectively, some support from the hierarchical mode is necessary to provide a legitimate and sustainable basis for such cooperation. Table 6.11 provides the assessment of the governing system in Demak.

Table 6.11 Summary of risks posed by the governing system in Demak District

Steps	Variables		Properties	Condition
3. Assessment of governing system	3.a Stakeholder mapping and governance elements	3.a.a Actors	Diversity	Many actors involved;
			Dynamics	Multiple coordination mechanisms assist in organizing collaborations overtime.
		3.a.b Images of problem	Diversity	Problem defined as erosion due to natural phenomenon;
			Dynamics	Root-causes for erosion are not agreed upon (i.e. land subsidence, sea-level rise, anthropogenic causes);
				Contestation between the issue of coastal disaster and coastal development (i.e. impact of port expansion on extended coastal risk).
		3.a.c Law instruments	Diversity	Inconsistency and lack of explicit reference to EbA in the national coastal management zone law;
			Dynamics	Amendments of national law on coastal management issue from centralized to decentralized and then back to centralized at the provincial level.
		3.a.d Actions	Diversity	Segregated and localized actions;
			Dynamics	Lack of discussion on integrated soft and hard infrastructure in the regional context (i.e. Northern Java coast).
3. Assessment of governing system	3.b Responsiveness	3.b.a Modes	Diversity	Hierarchical, self- to co-governance;
			Dynamics	Centralized to decentralized with lack of capacity (human and financial capital) at the local level.

Table 6.11 *(continued)*

3. Assessment of governing system	3.c Risk (coping capacity/governability)	Higher risk and lower governability due to: **1. Coordination** (-) Lack of effective and sustainable of network and coordination mechanism, the absence of legalized statutory body and leadership to coordinate. **2. Goodness of fit** (-) Lack of evidence-base for informing policy, especially to deal with future threats; (-) Contestation on the issue of disaster risk reduction, environmental protection, and coastal management, reflected in multi-level law instruments; (-) Segregated project-based action in mangrove-based ecosystem approach. **3. Social mobilisation** (-) Lower responsiveness of co- and self-governance due to unclear responsibility, lack of capacity, participation, legitimacy, and leadership. **Opportunities:** (+) Existence of community mangrove groups and awareness to conserve mangrove. (+) Current public-private partnerships mechanism could encourage better coordination.

Source: Author's analysis

6.4. GOVERNING INTERACTION, THE ISSUE OF POWER RELATION CORRESPONDS TO THE PROCESS OF LEARNING AND ADAPTIVENESS

Governing interaction analysis focuses on the dynamics of exchange among all the governing actors. The dynamics here means how the forms of interaction change over time to respond to the coastal disaster threats and injection of the ecosystem-based disaster risk reduction efforts (Chuenpagdee and Jentoft, 2009). This analysis includes a discussion on diversity and dynamics of learning and adaptiveness, and power relations including representativeness (see Chapters 3 and 4). This section concludes with the overall status of dynamics occurring within the realm of governing interaction and the roles for scaling up learning and adaptiveness of governing actors.

6.4.1 *Presence and quality of knowledge generation, sharing, and distribution*

In dealing with coastal flooding in Demak, government agencies develop and implement specific strategic planning and work plans. This can lead to lack of flexibility of government agencies to expand the network and to interact with wider stakeholders (A3-A6). Meanwhile, although NGOs have more flexibility in expanding their networks and interacting with diverse actors, they tend to work independently in the implementation of projects (B1, C2). The interaction between different research projects is also limited as they are focused on specific research topics.

The research demonstrates that the continuous and increasing threats from erosion and flooding in Demak have transformed the way governing actors interact among each other over time. The general approach to deal with flooding and inundation has been slightly shifting from hard infrastructure to hybrid and soft infrastructure.

I assess the learning and adaptation process and outcome among actors in Demak through three aspects. *First*, the knowledge generation, sharing, and distribution process including the type of information and perception of local people and governing actors on the effectiveness of such information. *Second,* the perception of local people and governing actors on the existence of a learning process, and *third*, the identification of adaptation strategies conducted by local people as a result of the learning process.

Knowledge generation and sharing is one way of interaction among governing actors. Besides existing local norms, knowledge and values, the quality of information generation, sharing and distribution play an important role in the learning process on how to deal with coastal flooding and inundation problem. As flooding in Demak District occurred continuously, the flow of information is expected to also be continuous and coordinated. In this thesis, the quality of knowledge generation and sharing is assessed through the diversity of types of information shared as well as the effectiveness of media to disseminate particular information. In Demak District, information is commonly shared by government authorities to local people to increase preparedness as part of coastal disaster risk reduction effort. Most of the type of information shared is general information related to flooding and inundation. Furthermore, another dominant type of information being shared to the local community is the planning of infrastructure work conducted by the government (i.e. construction of road and breakwater). The NGOs have information on the construction of hybrid structures and development plans in the villages, such as the construction plans of breakwater and seawallssand information regarding the mangrove planting programme (C1, C2, F1, F2).

Table 6.12 Survey results on knowledge generation and sharing in Demak District

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Has the information generation and sharing content and mechanism been adequate?	Strongly Disagree: 6.4% Disagree: 25.1% Neutral: 13.6% Agree: 50.2% Strongly Agree: 4.7%	Agree. - Information is given to the head of the village to be distributed, and it should be adequate.	Agree. - Information related to the programme will be given during a meeting with village heads; -Lack of scientific information being shared by research and scientific institutions.

Source: Fieldwork survey, 2016

According to the survey results, half the respondents feel that information generation and sharing is adequate, although 31.5% of people disagree with this (see Table 6.12). This shows that there is still a gap in knowledge generation and sharing. Interviews conducted with the government staff at the regional level agencies shows there has been lack of information especially in terms of research relevant to coastal flooding and erosion in Demak (A3, A4, A6). One notable researcher on the topic of erosion and flooding in Demak claimed that the government is unwilling to involve research institutions in the decision-making process (D1). These issues may hamper the efforts to scale up the research outcome for informing policy (D1). It seems that information from government and NGOs is usually shared with the village leaders. Sometimes the information does not percolate down to wider groups of local people in different hamlets (A3, A4, BI, B2, and B4).

The survey and in-depth interviews conducted in 2016 show that 46% of the local people agree that they have experienced learning. This experience is shared by the NGOs and government authorities (see Table 6.13). The local people experienced learning related to the coastal erosion problem, the benefits of mangroves for livelihood and coastal protection and how to plant them, and on the new sustainable knowledge of practicing aquaculture in a mangrove restoration area (B1, C1-C4, F1-F3). The process of learning has not always been successful. NGOs claimed that previously local people had planted mangroves incorrectly (CI-C4) (see also Wetlands International, nd). Mangroves can only grow in their natural habitat and natural successions with appropriate layer of species. Planting mangroves without proper knowledge will reduce the growth and survival rate of the mangrove.

Table 6.13 Survey results on learning in Demak District

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Have people learned something together from the coastal protection programme?	Strongly Disagree: 4.7% Disagree: 24.7% Neutral: 17.0% Agree: 46.0% Strongly Agree: 7.7%	Agree. - We have learned from local knowledge and government authorities on the current status of the problem and actions taken in Demak coastal area.	Agree. - We have learned about the erosion and flooding problem in Demak coastal area from the local people and experts. - We have learned the new concept and technology of coastal protection through the hybrid structure from NGOs.

Source: Fieldwork survey, 2016

The NGOs have learned from the local people about the existing conditions of coastal erosion, flooding and socio-economic. The government authorities have gained new knowledge about the ecosystem-based solution concepts and technology behind the Building with Nature project, through the development of the hybrid engineering structure (A3-A4). The process of learning occurred through several media, such as collective meetings, individual meetings, and conferences (A3-A6).

6.4.1.1 Representativeness

Representation is a way to include and to bridge gaps between civil society and government and is one way to analyse how power shapes policy. In this section, representativeness will be seen through two perspectives. *First,* I consider the representation of civil society institutions in governmental arenas, and *Second,* the manner in which the local population is represented in community institutions.

Representation in Governmental agencies

The representation in governmental agencies is in the existing multi-stakeholder partnerships platforms, such as the regional working group on mangrove management (KKMD). It is claimed that this group has represented all relevant stakeholders, including the governmental agencies at the regional level, and NGOs, research institutions, and community representatives. However, this platform is not very active (A3-A6).

Representation in community institutions

The mechanism of representation in the context of the Eco-DRR programme in Demak is done through informal selection conducted by the local elites, including village and hamlet leaders. The leaders mostly select their close relatives (A3, A4, B1, and C2) and this results in narrow representation of the local population in the programme. Several local people I interviewed during the fieldwork claimed that they are willing to contribute, however, the local politics have constrained them from getting engaged (F1, F2, F3, and B4).

Table 6.14 Survey result on representativeness in Demak District

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Is the representation mechanism for including local people is fair	Strongly Disagree: 4.7% Disagree: 18.7% Neutral: 8.9% Agree: 59.1% Strongly Agree: 8.5%	Agree. - Village meeting is held to collect the interest of local groups -Local politics exist and make it difficult to select fair representation	Neutral. - Willing to ensure more participation from local people, but there is a cost for greater representation of local people involved in the programme, for which budget is not available; -Low capacity of local people and local politics makes it difficult to select representation.
As individuals, people possess adequate power to influence the process and outcome	Strongly Disagree: 2.6% Disagree: 20.4% Neutral: 3.8% Agree: 59.1% Strongly Agree: 14.0%	Agree. - The village meetings initiated by NGOs are open for people who are interested and motivated; -Local politics is hampering the quality of representation.	Agree. - The government agencies, especially at the local level, are very accessible for local people who are interested and motivated; -Local politics is hampering the quality of representation.

Source: Fieldwork survey, 2016

Table 6.14 shows the ability of local inhabitants to influence the governing process. This stands in contrast to the results presented in Table 6.9 on inclusiveness and participation. Whereas in Table 6.10 local people complained about their lack of involvement, in Table 6.14 they appear to agree with the fairness of the governing process. However, in contrast with the result of the survey on inclusiveness assessed under Section 6.3.3.1 (see Table 6.10), although the local people do not feel totally included in all phases of existing programmes, the survey result shows that more than half of the local respondents feel that the existing representation mechanism is already fair (see Table 6.13). This is because they have chosen to not participate actively. They also claimed that if they show willingness, they will have the power to influence the process and outcome of certain projects. This result indicated that the local community does not own the problem, which made them hesitant to get involved actively in the representation mechanism which they consider as political activities (C2, C3, F1, and F3).

However, in-depth interviews reveal that there might still be a problem of unfair representation as decision-making in participation and representation is mostly in the local government's hand (i.e. head of villages and hamlets) (C1, F2).

NGOs claimed that they are aware of the issue of unfair representation and have been trying to tackle it through an open village meeting with a wider scope, including both local people who are members or non-members of the existing mangrove groups (C1-C4) (see also Apri et al., 2014). Based on the result of the meeting, they would then involve people who show motivation and are interested in taking roles in the programme. However, NGOs acknowledge that even in open village meetings, local politics exist and that the people holding power take control of the discussion (A3). This has also been confirmed by the government agencies, especially at the district level (B3, B4) (see Table 6.12).

Table 6.15 shows the summaries of risks in GI in Demak. There is a gap in terms of lack of science- or evidence-based research to understand the future trends of disaster and threats to ecosystems and its possible impact on the local community. Furthermore, there is also a lack of fair representation due to local politics, although in comparison to earlier regimes, inclusiveness and public participation have been slowly increasing. The opportunities in terms of GI is the availability of information that could be further advanced for more effective mitigation in the future.

Table 6.15 Summary of risks posed by governing interactions in Demak District

Steps		Variables	Properties	Condition
4. Assessment of governing interaction	4.a Quality of interactions	4.a.a Knowledge generation and distribution	Diversity	Availability of different knowledge coastal flooding and mitigation to increase the preparedness of the local community.
			Dynamics	Unavailable science-based research on the future trends of disaster and threats to ecosystems and how it impacts the locality of the case study (I.e. subsidence, sea-level rise, future coastal development).
	4.b Enabling power relations	4.b.a Representativeness	Diversity	Dominated by the representation of village elites and mangrove groups. Local politics have hampered fair distribution of information to the wider population.
			Dynamics	Since the reformation era which started in 1998, inclusiveness and public participation in governance system has been increasing.

Table 6.15 *(continued)*

4. Assessment of governing interaction	4c. Risk (Coping capacity/Governability)	Creeping-fast onset	Higher risk and lower governability due to: **1. Learning and adaptiveness** (-) Lack of scientific-based knowledge generation and distribution (i.e. on planting method and species selection) (-) Lack of institutionalized learning platform; (-) Mechanism of representation is still lacking. **Opportunities:** (+) Information-based to mitigate the coastal risk that can be further developed.

Source: Author's analysis

6.5 Inferences

The problem of coastal flooding in Demak commenced in the 1980s and has been addressed by many of the governing actors in varying combinations over time. International NGOs have played an important role. Strategies for achieving sustainable coastal protection have changed over time, occurring within the framework of governmental legislation as well as NGO activity. The totality of governing action has not solved the problem of coastal flooding yet and is unlikely to do because of the challenge of rising sea levels compounded by land submergence. The governing process needs to enhance the continuing adative capacity of loca people. I will return to this in the following chapters. Some obvious problems affecting the governability of coastal risk have, however, also has been tested in the governing system (See Chapter 4), and include:

1. *Coordination.* The governing system in Demak is diverse and fragmented, which disables the governability of the coastal erosion and flooding problem. Different types of governing actors at different levels tend to establish separate programmes to rehabilitate mangroves and revitalizing the coastal area in Demak with insufficient coordination efforts.

2. *Goodness of fit.* The lack of agreement on the root cause of the problem (especially regarding the impact of coastal development in Semarang to flooding in Demak) is a disabling factor for governability, and is partly due to a lack of scientific evidence. The governance instruments related to coastal management that have been applied to Demak District do not complement each other completely, which reduces the goodness of fit with the current action for integrating the Eco-DRR approach to reduce the erosion and flooding problem in Demak. Mainstreaming DRR and Eco-DRR require: (a) consistent, coherent and complementary law instruments which connect the DRR and ecosystem approach to relevant regulations; (b) Centralized

government, which could enhance the effectiveness of coordination; and (c) Adequate financial resources and capacity.

3. *Social mobilisation.* Another disabling factor is that the Eco-DRR projects in Demak have not yet realized broad inclusion and participation of local people in the coastal protection projects; where they are involved, participation mainly occurs at the implementation level. The co-mode of governance (i.e. through existing projects run by NGOs and governments) is still fragmented. However, it shows a potential and opportunity to achieve greater inclusion of relevant stakeholders as well as a better social mobilisation strategy. The current design of BwN programme could be an opportunity to reactivate this group or establish a similar idea of multi-stakeholder engagement. This could accelerate positive interaction including knowledge generation and sharing and learning process.

4. *Learning and adaptiveness.* An enabling factor for governability is the quality of governing interaction, including learning and distribution of information; however, it has been insufficient to increase the adaptive capacities of governing actors in the longer-term. There is a lack of evidence-based knowledge, and an absence of a fair representative platforms to facilitating co-learning, which weakens the adaptiveness of the governing system. The government is also highly dependent on foreign sources of funding in regards to Eco-DRR projects in Demak. This could bring challenges in terms of legitimacy, sovereignty and in achieving sustainability of Eco-DRR efforts in the future. As the regional working group on mangrove management is still inactive, the representation of stakeholders in the DRR process is ad-hoc and uneven. The representation of villagers in community institutions is governed by favoritism, which negatively influences the legitimacy and willingness to engage in mangrove planting efforts.

CHAPTER 7

The characteristics of coastal disaster risk and adaptation in parangipettai block, Tamil Nadu State, India

Chapter 7 : The Characteristics of coastal disaster risk and adaptation in Parangipettai Block, Tamil Nadu State, india

7.1 Introduction

Parallel to Chapter 5, which focused on Demak District, Indonesia, this chapter analyses the characteristics of coastal risk in Parangipettai Block, Tamil Nadu State, India, thereby setting the stage for a review of governance efforts in Chapter 8. It uses the lens of interactive governance theory and governability assessments (see 3.3, 3.4 And 4.3) to answer the question: What are the characteristics of the SG in Parangipettai Block related to coastal risk? Sub-questions include: (1) What is the nature of coastal problems in Parangipettai Block (see 7.2)? (2) How diverse and dynamic is its natural and social SG (see 7.3.1)? And (3) How diverse and dynamic is the social SG (see 7.3.2)? This chapter also elaborates the preliminary response of local inhabitants towards mangrove degradation and tsunami (see 7.4). It then considers the linkages between the diversity and dynamics quality of the system-to-be governed features and the potential governing actions (see 7.4 and 7.5), setting the stage for an investigation of the GS and GI in Chapter 8.

7.2 Identifying the nature of the problem

The broader setting. India's coastline is about 7,517 km long, including a mainland coastline (5,423 km) and the Andaman, Nicobar, and Lakshadweep Islands' coastline (2,094 km) (Kumar et al., 2006). Tamil Nadu's coast is 1,061 km in length, and its coastline is the second longest in India. Of the state's approximately 62 million people, about 29 million live in the thirteen coastal districts. Coastal inhabitants often depend on fishing in marine areas and backwaters, and agriculture (Janakarajan, 2007). The fisherfolk population in Tamil Nadu is 1.05 million of which 0.20 million fishers are actively engaged in fishing, based in 591 marine fishing settlements along the 13 coastal districts (Fisheries Department of Tamil Nadu, nd). Furthermore, 70 percent of the population in Tamil Nadu is engaged in agriculture and allied activities for their livelihood (Agriculture Department of Tamil Nadu, nd).

Tamil Nadu's coast is prone to coastal threats of various kinds. In terms of natural threats, it is susceptible to coastal disasters including tsunamis and cyclones. Furthermore, the human-induced threats include exposure caused by high population density; thus, the population density of the coastal districts of Tamil Nadu is around 528 people per km^2, almost double the state average of 372 people per km^2 (Janakarajan, 2007). In addition to the population density, rapid industrialization of the coastal zone can also be identified as a human-induced threat. It includes a proliferation of chemical, textile, oil refinery, thermal power and fertilizer industries in the coastal region, concentrated in the capital city of Chennai, as well as Cuddalore District, where the Indian case study is located. This has caused challenges and threats to land degradation and marine pollution (Janakarajan, 2007) (which could harm the surrounding coastal ecosystem, including Pichavaram mangrove (Subramanian and Vannucci, 2004) (see Figure 7.2). The degrading coastal ecosystem aggravates the situation and makes the coastal area more vulnerable to the impacts of climate change (Janakarajan, 2007). Authors thus argue that long-term, adaptive strategies are needed for the region rather than engineering solutions (Janakarajan, 2007). Adaptive strategies should comprise efforts to leverage environmental and social resilience against future threats. Ecosystem-based adaptation strategies are one option (Saleem Khan et al., 2014).

The Indian Ocean tsunami in December 2004 affected about one million people living in 376 coastal hamlets, killing an estimated 10,000 people in India. Most of the damage occurred in Cuddalore and Nagapattinam Districts (Janakarajan, 2007). In Cuddalore, 610 persons reportedly died, and 38 persons went missing (Saxena et al., 2013b). There is emerging evidence that the mangrove forest in Cuddalore District reduced the number of deaths and extent of damage (Kathiresan and Rajendran, 2005; Sandilyan and Kathiresan, 2005). The tsunami also caused loss of life and worsened socio-economic conditions of local people in several villages which were not protected by mangroves. Thus, of the ten villages in Parangipettai Block in Cuddalore District between 2 to 50 deaths occurred in the five villages that were not protected by mangroves (Kathiresan and Rajendran, 2004; Ramasubramanian, 2016). Meanwhile, the other five villages, which were sheltered by the mangrove forest, suffered zero loss of human lives (see Table 7.1 and Map 7.1).

Table 7.1 Loss of human lives in the Indian Ocean tsunami affected villages in Parangipettai Block

Affected village	Loss of human lives	Protected villages	Loss of human lives
Muzhukkuthurai	11 (0.2%)	Kalaingar Nagar	0
MGR Thittu	50 (5.8%)	MGR Nagar	0
Chinnavaikal	11 (5.2%)	Killai	0
Pillumedu	12 (10%)	Vadakku Pichavaram	0
Kannagi Nagar	2 (6.6%)	T.S.Pettai	0

Source: Ramasubramanian, 2016

Map 7.1 Villages affected by the Indian Ocean Tsunami in Parangipettai Block

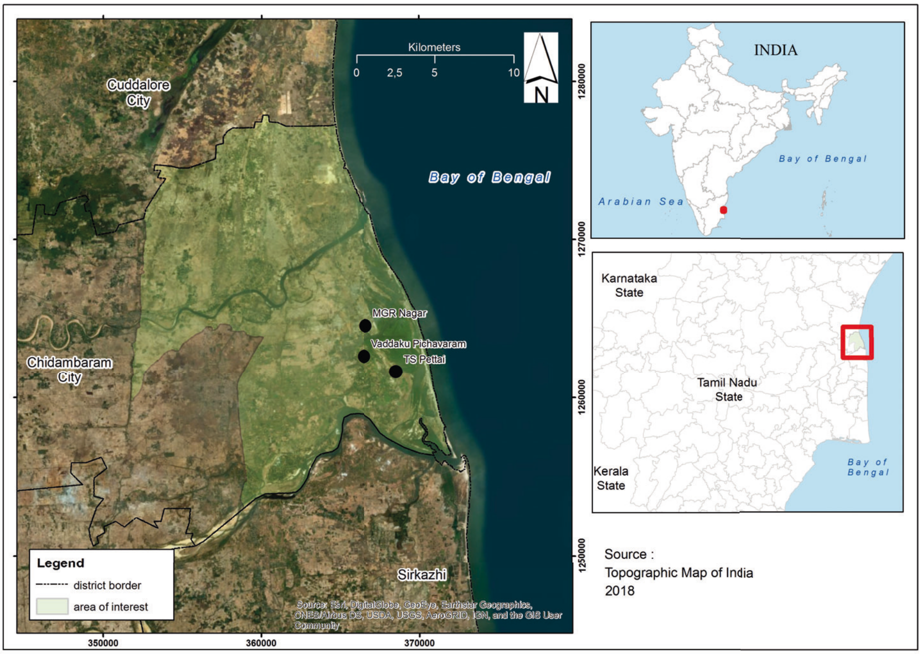
Source: Author's analysis based on Google earth image, 2016

Tamil Nadu's coastal wetlands are rich in hydrological, biological and socio-economic resources. This chapter focuses on one of the two wetland areas - Pichavaram mangrove forest. To ensure the spatial context, the administration boundary of the research includes the whole Parangipettai Block in Tamil Nadu, India. I focused on three hamlets, including MGR Nagar, TS Pettai, and Vadakku Pichavaram as they are covered in the Joint Mangrove Management Programme and have zero loss of human lives during Tsunamis, presumably due to the protection from Mangrove Forests (see Map 7.1).

Parangipettai Block. Pichavaram Mangrove Forest, which is located in Parangipettai Block, is home to many mangrove species (see Map 7.2 and Map 7.3). The expanse of mangrove forest degraded heavily between 1935 and 1970 (Selvam et al., 2004a) This was due to the colonial and post-colonial "coupe-system" of management which required rotational felling of the mangrove every 20 to 25 years to maximize revenue generation. In this time period, 500 ha of mature mangrove forest was clear-felled by government agencies to gain revenue, with the expectation that mangroves would redevelop naturally in the clear-felled areas. The felling and tidal exposure to the mangrove forest has led to the evaporation of soil water. This caused subsidence of sediment in the clear-felled areas and made the topography in the clear-felled trough-shaped. The tidal process left water in the trough-shaped topography and increased the salinity of the soil and groundwater (Gnanapphazam and Selvam, 2011). The resulting hyper-saline conditions have made the natural growth of mangroves impossible (Selvam et al., 2002;

2003a; 2003b; 2004a). In addition to the clear-felling of mangroves, although not identified as a primary cause, cattle grazing has also caused degradation, especially during the monsoon season (Kathiresan, 2008).

Map 7.2 Map of Parangipettai Block, Tamil Nadu, India



Source: Topographic Map of India, 2018

The degradation of Pichavaram mangrove forest, which is the second biggest mangrove area managed by Tamil Nadu State government after Muthupet mangrove forest, has led to livelihood problems for local people. Villagers here are mangrove-dependent communities as their livelihoods depend on the health of mangrove ecosystems for the generation of resources such as fish, prawns, and crabs (Selvam et al., 2003b; 2004a). The declining fish catch in Pichavaram Mangrove Forest is exacerbated by the degrading mangroves as reported by several people residing in the nearby villages of Pichavaram mangrove. Selvam et al., (2003b: 24-25) argues that fishers report that the decline of mangrove forest cover is mainly responsible for a reduced quantity of prawn catch since the local people believe that prawns breed only in decaying mangrove leaves (see 7.3.1.1). My interviews with fishers from MGR Nagar resulted in a similar conclusion, although no quantities of decline were mentioned (I1, I2).

Table 7.2 Summary of the nature of the problem related to coastal disaster risk in Parangipettai Block

Variables	Analysis
1. Identification of problem	There is agreement among policymakers, scientists, communities, and the private sector on the problem of coastal risks.
2. Embeddedness of the problem	The causes of mangrove degradation and the short-term coastal disaster threats and how they can be scientifically and politically tackled. The mangrove degradation problem that occurred previously is believed to have local rather than regional causes. Furthermore, in terms of the risk of coastal disasters (i.e. tsunami and cyclones), it is understood as a result of natural and social factors, which therefore requires an integrated, regional approach to ensure sustainability.
3. Impact	Mangrove degradation has initially impacted the quality of livelihood of local inhabitants; the conservation efforts that took place afterwards, however, resulted in more prosperity (i.e. increasing productivity of fish, prawn, and other ecosystems) as well as reducing the risk and exposure to disasters.

Source: Author

Table 7.2 shows that there is agreement among policymakers, scientists, communities, and the private sector on the problem of coastal risk and its root causes. Thus, one can conclude that governing actors and other stakeholders basically have similar interests in solving the problem regarding mangrove degradation and reducing coastal risk (see Chapter 8 for an elaboration of different governance viewpoints).

Secondly, the mangrove degradation problem in Pichavaram Mangrove Forest, Parangipettai Block is mostly caused by local drivers in the mangrove area (i.e. unscientific management of mangrove and cattle grazing), exacerbated by outside factors, such as tsunamis, climate variability and change. The issue of coastal disaster is a problem embedded in the regional context. Therefore, to ensure effective use of the mangrove ecosystem as a bio-shield to reduce disaster risk, one should take a regional, national and integrated perspective. However, there is still a challenge in terms of forward thinking to govern uncertainties in the future due to climate variability.

Third, mangrove degradation and coastal disaster risk in Parangipettai has clearly been affecting the local population especially reducing their livelihood quality.

Having briefly described the nature of the problem of coastal flooding in Parangipettai Block, I now examine the SG in greater detail.

7.3. Features of the Parangipettai system-to-be-governed

In the following analysis of the SG, as it relates to coastal risk, I focus primarily on issues of diversity, dynamics, and scale (see Chapter 4). These issues make pressing demands on the governing system, raising specific demands for coordination, social mobilisation, learning and adaptation, and inter-scale linkage. I first pay attention to the natural system, subsequently turning to the social SG.

7.3.1 Diversity, dynamics and scale linkages of natural system-to-be-governed in Parangipettai

The diversity analysis is undertaken by identifying the components of the *natural system-to-be-governed.* The analysis focuses on the physical aspect (i.e. geomorphology, climate, oceanography, and soil) and the biodiversity and ecosystem.

7.3.1.1 Physical aspect

Geomorphology, climate, oceanography, and soil condition

Parangipettai Block lies in the very northern part of the Cauvery delta, near the mouth of the river Coleroon in which the *geomorphology* is formed through fluvial processes and sedimentation, and has an approximate coastal length of 21 km. The area is "a vast plain with a gentle slope towards the Bay of Bengal with an elevation of between 0.5-4 meter above sea level" (Selvam et al., 2002: 12). Major landforms include beaches, barrier dunes, estuaries, tidal and mud flats, and mangroves (Selvam et al., 2002). It is located in the southern part of Cuddalore District.

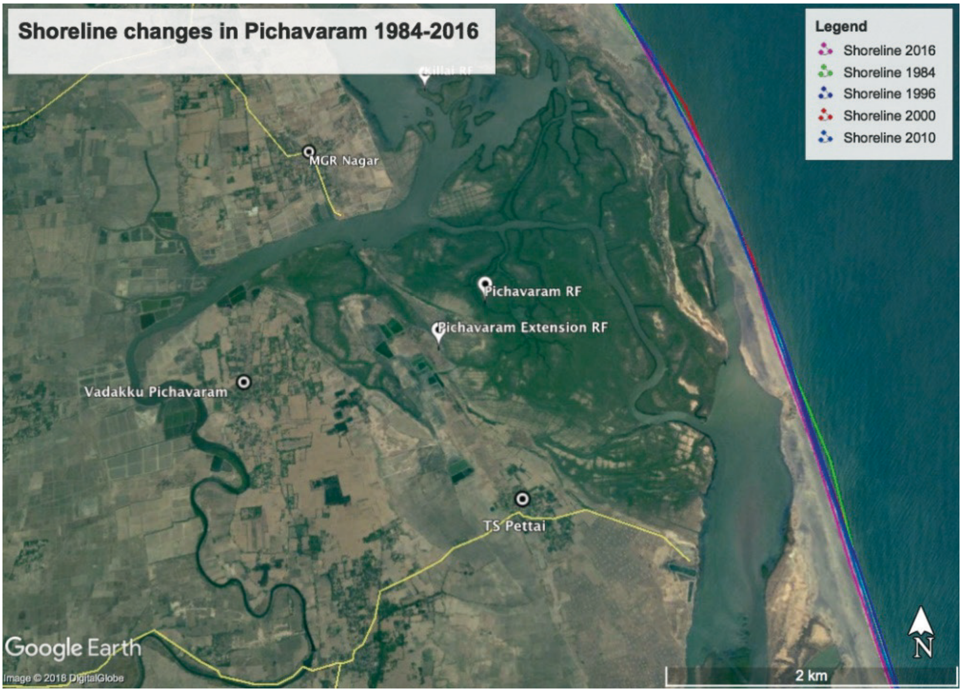
In terms of bathymetry, study conducted by Selvam et al. (2002: 23) in Pichavaram mangrove wetland shows that "in most of the areas the depth of the water is between 0.63 to 1.63 m except in the mouth region at Chinnavaikal where the depth ranges from 3.63 to 5.63 m" (Selvam et al., 2002: 23).

The *climate* of the region is "sub-humid with very warm summers" (Selvam et al., 2003a: 794). In terms of average rainfall, study conducted by Selvam et al. (2003a) shows that "the annual average rainfall (70 years) is 1310 mm and the annual average number of rainy days is 56. Most of the rainfall occurs during the northeast monsoon season (October to December), and nearly 70% of the rainfall occurs between November and December" Selvam et al. (2003a: 794).

During the northeast monsoon season (October-December), cyclonic storms are formed around The Bay of Bengal. Sixty cyclonic surges crossed Cuddalore coast during the past century (IMD eAtlas, 2011 in Saxena et al., 2013b). The low-lying and gentle slope geomorphology of Cuddalore coast has increased the vulnerability against inundation, flooding, and storm (Murthy et al., 2006). In terms of *oceanography*, the tide in Parangipettai Block coast is semi-diurnal and varies in amplitude by 15-100 cm in different seasons (Khan et al., 2016; Kathiresan, 2000). The *soil* is clayey and contains minerals and has poor drainage capacity. It retains salinity especially in areas characterized by degraded mangroves (Selvam et al., 2002).

Geomorphological dynamics become apparent through shoreline changes in Pichavaram, Parangipettai Block. An analysis of Google Earth maps over time show that the shoreline has been quite stable since 1984 (see Map 7.3). There has been a medium level of erosion (less than 5 meters per year) compared to other areas within the Tamil Nadu coast (Saxena et al. 2013a). The extent of sea level rise has been measured over a period of 93 years through the tide gauge station in Chennai.

Map 7.3 Map of shoreline changes in Parangipettai Block coast from 1984-2016



Source: Author's analysis based on Google Earth Images, 1984-2016

The rate of sea level rise has been identified as low (0.13 to 0.32 mm per year) with the rate of subsidence being 0.34 mm per year measured, as measured in Nagapattinam station (Khan et al., 2012; Dastgheib and Ranasinghe, 2014). Khan (2014) has calculated that in by the scenario of a 0.5 to 1 m sea-level rise, the sea level may rise by 53.70 cm by 2100, inundating 1,540 to 2,403 ha land in 12 villages within five towns/villages near Pichavaram Mangrove Forest. Furthermore, around 265 to 373 ha mangrove area will be inundated (Khan et al., 2012).

Biodiversity

Tamil Nadu coast hosts diverse coastal ecosystems, including mud-flat beaches, sand dunes, mangroves, and estuaries. However, in Parangipettai Block, mangrove is the dominant ecosystem. For administrative purposes, the mangrove forest is divided into three-reserve forests (RF): Killai RF, Pichavaram RF, and Pichavaram Extension (RF). The forest as a whole covers 1471.33 Hectares (Selvam et al., 2002) (see Table 7.3).

Table 7.3 Different categories of mangrove wetland in Parangipettai Block (1996)

Category	Killai RF (ha)	Pichavaram RF (ha)	Extension Area (ha)	Total (ha)
Healthy mangroves	8.11	370.07	21.24	399.42
Degraded mangroves	71.73	445.58	47.73	565.05
Water body	87.76	215.05	5.56	308.37
Sand dune	142.62	24.90	14.58	182.10
Casuarina	16.39	-	-	16.39
Total area	326.61	1055.60	89.11	1471.33

Source: Selvam et al., 2002

There are 13 mangrove species in Pichavaram mangrove forest with Avicennia marina dominating (see Table 7.4). The rich variety of species provides habitat for shrimp and fish and support a rich variety of flora and fauna (Sathyanathan et al., 2014). This condition is supported by previous research (Khrisnamurthy and Jeyabeelan, 1984) which found that the prawn production of Pichavaram mangroves was estimated at 110 kg/ha/year, whereas that of adjacent Vellar estuary's (which is devoid of mangrove) was only 20 kg/ha/year. Meanwhile, the production of fish in the Pichavaram mangrove was estimated at 150 kg/ha/year, whereas in Vellar estuary it was only 100 kg/ha/year. In addition, about 400 tonnes of penaeid prawns are harvested from the adjacent coastal waters every year (Khrisnamurthy and Jeyabeelan, 1984). About 74% of this catch is estimated as deriving from the mangrove nursery ground (see also 7.2)

Table 7.4 Mangrove species in the Pichavaram Mangrove Forest

Name of the species Family
1. *Acanthus ilicifolius* L. Acanthaceae
2. *Aegiceras corniculatum* (L.) Blanco Myrsinaceae
3. *Avicennia marina* (Forsk.) Vierh. Avicenniaceae
4. *Avicennia officinalis* L. Avicenniaceae
5. *Bruguiera cylindrica* (L.) Blume Rhizophoraceae

Table 7.4 *(continued)*

6. *Ceriops decandra* (Girff.) Ding Hou. Rhizophoraceae
7. *Excoecaria agallocha* L. Euphorbiaceae
8. *Lumnitzera racemosa* Wild Combretaceae
9. *Rhizophora apiculata* Blume Rhizophoraceae
10. *Rhizophora mucronata* Lam. Rhizophoraceae
11. *Rhizophora lamarckii* Rhizophoraceae
12. *Xylocarpus mekongensis* (Prain) Pierre Meliaceae
13. *Sonneratia apetala* Buch-Ham Meliaceae

Source: Selvam, 2002

Using remote sensing technology, it has been assessed that mangrove forest cover decreased between 1930-2011 from 1,165 ha to 941 ha (Gnanappazham and Selvam, 2011, and see Table 7.5). However, since mangrove restoration under the JMM (Joint Mangrove Management) (see 8.2), the mangrove forest area has increased by up to 941 ha from 1994 to 2011 (see Table 7.5). This has apparently increased the overall stability of the coastal system and provided a defense during the tsunami in 2004 (see Kathiresan and Rajendran, 2005). However, 5-10% percentage of the mangrove was damaged by the Indan Ocean tsunami in 2004 (DasGupta and Shaw, 2013).

Table 7.5 Total area of mangrove in Hectares (1930-2011)

Year	**1930**	**1970**	**1977**	**1987**	**1991**	**1994**	**1996**	**1999**	**2000**	**2002**	**2004**	**2006**	**2011**
ha	1165	880	627	486	426	411	458	461	584	710	793	858	941
%	2.02	1.52	1.08	0,84	0.74	0.71	0.80	0.80	1.01	1.23	1.38	1.49	1.63

Source: Gnanappazham and Selvam (2011)

Table 7.6 provides a summary of the physical/natural system to-be-governed assessment in Parangipettai Block. It shows that in Parangipettai Block, mangroves are suited to available conditions and will most likely survive for the next 100 years under the current rate of sea-level rise measured in this area.

Table 7.6 Summary of risks raised by the physical/natural SG in Parangipettai Block

Steps	Variables		Properties	Condition	Implication for governance
2. Assessment of system to be governed	2.a Physical	2.a.a Geomorphological	Diversity	Beaches, barrier dunes, estuaries, tidal and mud flats, and mangroves; 0.5- 4 meter above sea level (Selvam et al., 2002).	Mangrove ecosystem-based adaptation is suitable for the short-term.
			Dynamics	Erosion level less than 5 m per year; Land subsidence 0.34 mm per year (Khan et al., 2012).	
		2.a.b Oceanography	Diversity	Tide is semi-diurnal and varies in amplitude by 15-100 cm in different seasons (Khan et al., 2016; Kathiresan, 2000).	Higher wave exposure to mangroves potentially reduces the ability to survive.
			Dynamics	Climate change impact including sea-level rise and erosion (see geomorphological dynamics).	
		2.a.c Climate	Diversity	1310 mm annual rainfall (Selvam et al., 2003a: 794).	Higher precipitation is potentially positive to the growth of mangrove in its relation to reducing salinity.
			Dynamics	Sea-level rise 0.13 to 0.32 mm per year (Khan et al., 2012; Dastgheib and Ranasinghe, 2014).	Mangroves in this area will most likely survive as it will not reach 28 cm in 100 years/0.28 cm per year (Ross et al., 2000).
		2.a.d Soil	Diversity	Clayey and contains minerals (Selvam et al., 2002).	Higher risk of coastal flooding.
			Dynamics	Low permeability.	
2. Assessment of system to be governed	2.a Physical	2.a.e Biodiversity	Diversity	13 mangrove species are covering 941 ha (Gnanappazham and Selvam, 2011).	A high number of mangrove species makes the area less vulnerable and more stable.
			Dynamics	5-10% degradation due to coupe-felling, cyclones, and tsunami (DasGupta and Shaw, 2013).	
		2.a.f Infrastructure	Diversity	Sea-wall structure and industrial complex established in the northern region of Cuddalore District.	Currently no direct implication, however, can be a potential challenge in the future.
			Dynamics	There is no direct impact of coastal infrastructure on the health of mangrove. However, can be a threat in the future (i.e. erosion and pollution).	Integrated and sustainable coastal management planning could decrease the vulnerability and risk to coastal disaster.

Source: Author's analysis from secondary data

7.3.2 *Diversity and dynamics of social system-to-be-governed*

7.3.2.1 Social characteristics

A full discussion of the diversity, dynamics and scale linkages of the social SG in Parangipettai Block involves many variables. Therefore, as in the case of Demak District, Indonesia, I concentrate on demography, settlement patterns, and occupation. The aspect most relevant to my research is that of human dependence on local resources and coastal space, as this has implications for vulnerability with regard to coastal hazards.

Demography and settlement distribution

Parangipettai Block is a revenue unit consisting of 41 panchayat unions or local administrative bodies. There are five revenue villages and 17 hamlets in Parangipettai Block, Cuddalore District surrounding the mangrove forest in Pichavaram, where local people fish and farm (Khan et al., 2012; Selvam, 2003a). In the three hamlets selected as research cases, the latest population data (2014) shows that there are 237 households and 705 people from the tribal community living in MGR Nagar, 209 households and 923 people in TS Pettai and 224 households and 1152 people in Vadakku Pichavaram. Compared to population data in 2002, the population is increasing, except for TS Pettai, where it reduced from 1,124 people in 2002 to 923 people in 2014 (see Table 7.7). In 2002, there were in total 4,760 households and 17,781 people living in different mangrove user hamlets and villages near Pichavaram Mangrove Forest (Selvam et al., 2002). In total, for Parangipettai Block, the population also increased from 20,901 people in 2001 to 25,541 in 2011, implying a population density of 140 people per km^2.

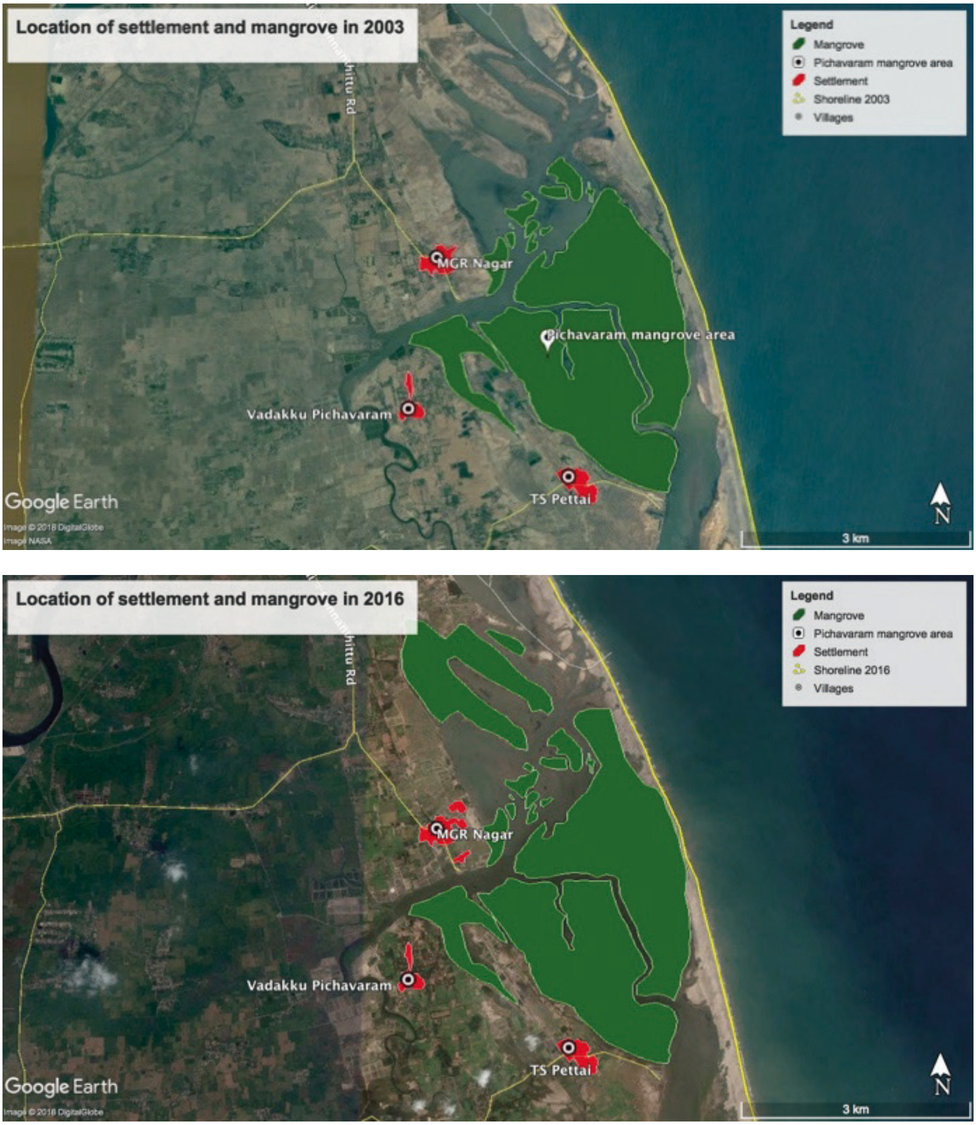
7

Table 7.7 Population figures in Parangipettai Block, select panchayat unions and case study villages (2001-2011)

Panchayat Union	Area (km^2) [1]	Population[1]		Village	Household		Population	
		2001	2011		2002[2]	2014[3]	2002[2]	2014[3]
Killai Town Panchayat	0.16	9,899	No data	MGR Nagar	150	237	494	705
Thandavarayan Sozhagan Pettai	33	No data	No data	TS Pettai	225	209	1,124	923
Pichavaram	70	No data	No data	Vadakku Pichavaram	196	224	976	1,152
Parangipettai Block	182	20,901	25,541	Total in three villages	571	670	2,594	2,781

Source: Cuddalore District Census Handbook, 2011[1]; Selvam, 2002[2]; Kodoth, 2014[3]

Map 7.4 Dynamics of distribution of mangrove and settlement near Pichavaram mangrove forest (2003 and 2016)



Source: Author's analysis based on Google Earth Image 2003 and 2016

In terms of distribution of settlement, the three villages are located behind the Pichavaram RF and Pichavaram extension RF. The settlement pattern is clustered and located in the low-lying areas, following the road network. MGR Nagar village is located very near to the water body of Pichavaram mangrove area as most of the community there are working as non-traditional fishers. Meanwhile, the TS Pettai village is located close to the mangrove forest, agricultural land, as well as the water body. Most of the people in TS Pettai, therefore are working as fishers and/or in the agricultural sector (farming and livestock holding). The residents of Vadakku Pichavaram hamlets are mostly working as farmers. They live close to their agricultural land (see Map 7.4). Satellite data on the distribution of settlements for 2003-2016 confirms this. Only in MGR Nagar did the coverage of the settlement increase (see Map 7.4).

Occupational diversity

A survey conducted in 2002 in 5 mangrove-user revenue villages located in Killai TP, Pichavaram Panchayat Union, and Thandavarayan Sozhagan Pettai, C. Manambadi and Thillaividangan in Parangipettai Block showed that fishing (36.6%) and agriculture (35.4%) were equally important with agricultural wage labour coming third (20%). This research, selected three hamlets in Killai TP, Pichavaram Panchayat Union and Thandavarayan Sozhagan Pettai, which were categorized based on the diversity of livelihood or occupational diversity, as case studies (see Table 7.7). As mentioned earlier, MGR Nagar hamlet is dominated by non-traditional fishers of tribal descent, Vadakku Pichavaram is a farming community with livestock holdings, and TS Pettai is dominated by traditional, caste-based fishers and agriculture (see Table 7.8).

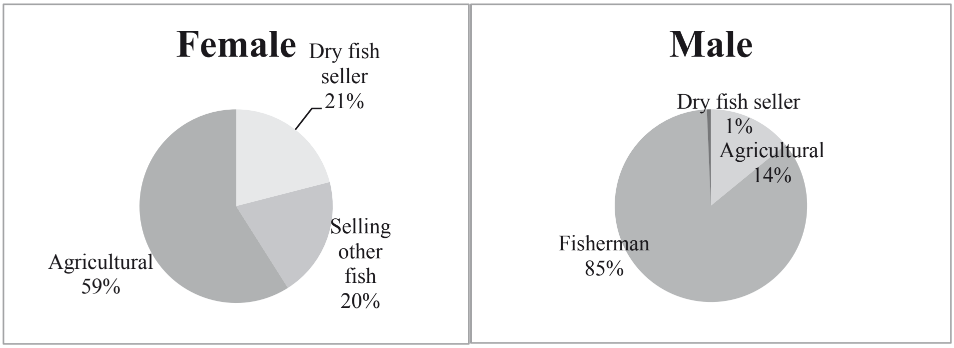
Table 7.8 Type of professional community in the research area in Parangipettai Block

Panchayat Union	Village	Type of community
Killai Town Panchayat	MGR Nagar	Non-traditional fishers /*Irula community (tribal pooulation)*.
Thandavarayan Sozhagan Pettai	TS Pettai	Traditional fishers and agriculture.
Pichavaram	Vadakku Pichavaram	Agriculture, including livestock holding.

Source: Selvam et al., 2002 and interview, I1-I2, 2016

To investigate further, 200 respondents were interviewed, 74% of which were male and 26% female (see Chapter 4). In terms of occupation, 85% of the male sample was working as a fisherman; 14% was working in the agricultural sector (14%). Of the female population, 59% were working in the agricultural sector, and 21% were working as dry fish sellers (see Figure 7.2).

Figure 7.1 Profile of respondents in Pichavaram mangrove forest



Source: Fieldwork survey, 2017, n=200

Occupational dynamics

The changes in the social SG are reflected in the occupational transition and perceptions of the importance of mangroves. Although data on occupational dynamics in time series are scarce, the changes in occupation can be deduced from the study of land-use change conducted through satellite image processing (Gnanappazham and Selvam, 2011). Results show that there is a growth in the number of aquaculture ponds in Pichavaram Mangrove Forest from 1994 onwards. In 1987, there were only 8 ha aquaculture ponds within Killai Reserve Forest region. The aquaculture pond area increased to 107 ha in 1994 and 627 ha in 1996. Some vacillations up and down have since taken place (see Table 7.9), potentially caused by landuse change back to agriculture due to off season (H1, H2). In addition, tourism development in Pichavaram Mangrove Forest is also diversifying the livelihoods of people. The government of Tamil Nadu is motivating tourists to visit the forest with traditional boats managed by the Forest Department. Tourists are not allowed to visit some core areas of the mangrove to prevent damage and minimize disturbances (Sandilyan et al., 2010).

Table 7.9 Total coverage of aquaculture ponds in Parangipettai Block (2002-2011)

Year	ha	% of the total area
1930	-	
1970	-	-
1977	-	-
1987	8	0.01
1991	8	0.01
1994	107	0.19
1996	627	1.09

Table 7.9 (continued)

1999	493	0.86
2000	599	1.04
2002	480	0.83
2004	468	0.81
2006	729	1.27
2011	560	0.97

Source: Gnanappazham and Selvam (2011) Singh et al., (2014)

There are approximately 2,600 people depending on the mangroves for fishing activities, whereby 68% belongs to a traditional fishing caste, and 32% is of tribal descent. These fishers live in 9 villages surrounding Pichavaram mangrove forest (Gnanappazham and Selvam, 2011). The tribal Irula community trace their history back to the time when they were nomadic. Their fishing methods include groping for prawn, or gathering/catching fish using a piece of fabric (bunding method) and recently using cast-nets (Selvam et al., 2003a).

The traditional fishers residing in TS Pettai fish in the mangrove waters using various crafts and gears, such as *thoni* (canoe) and cast nets (Selvam et al., 2003a). However, recently, outsiders have also started fishing in the mangrove backwaters to obtain prawn seedlings for aquaculture. This has contributed to changing the biophysical conditions of the mangrove forest and social tensions with increasing inter-community and inter-caste clashes (I4), increasing unemployment (Lakhsmi and Rajagopalan, 2000) and migration to larger cities (Lakhsmi and Rajagopalan, 2000; Singh et al., 2014). However, current migration trends are far from clear, but probably relatively low.

Agriculture characterizes Vadakku Pichavaram and TS Pettai, where most people mainly work in the agricultural sector (see Table 7.6). Table 7.10 shows that there has been increasing agricultural land cover which could possibly indicate more people working in agricultural sectors.

Table 7.10 Total coverage of agricultural land in Pichavaram mangrove forest (1991-2009)

Landuse	Area in 1991		Area in 2000		Area in 2009	
	ha	%	ha	%	ha	%
Agriculture area	15090	26	16,392	28.49	18,071	31.31

Source: Singh et al., 2014

Table 7.11 presents the risks generated by the natural and social SG in Parangipettai Block. It shows that many people live in the coastal area, with strong exposure to disaster. Moreover, local people are highly dependent on mangroves for livelihood and coastal protection. The combination of natural and social SGs has implications for GS and GI (see Chapter 8).

Table 7.11 Summary of risks raised by the natural and social system-to-be-governed in Parangipettai Block

Steps	Variables		Properties	Condition	Implication for governance
2. Assessment of system to be governed	2.b Social	2.b.a Demography and settlement distribution	Diversity	Lower density of population;	Higher population figures increases the exposure to erosion and flooding. Settlement pattern is not affecting the vulnerability of community.
			Dynamics	Slow growth of population, low rate of migration; static settlement pattern.	
		2.b.b Occupation and transition	Diversity	Traditional and non-traditional fishers, agriculture, livestock holding;	Higher direct livelihood dependency on mangroves could potentially increase the awareness of mangrove conservation.
			Dynamics	High dependency on mangroves for provisioning services; occupational transition to other occupation sometime happened due to season variability.	
		2.b.c Migration	Dynamics	No significant migration flow reported.	Social mobilisation could have high potential to support Eco-DRR governance effort.
	2c. Risk (physical and social SG) see also Table 7.6	Sudden-onset	**Hazard**: Cyclones are the major form of coastal disaster along the east coast of India (with tsunamis occurring occasionally). These can be categorized as a sudden type of disaster considering their intensity. **Exposure**: Higher number of people living in the coastal area, lower exposure due to mangrove shelter. **Vulnerability**: Less than Demak due to stable livelihood and high supporting services of mangroves.		-Evidence-based/science-based approach for informing policy and early warning system; - Ccoordinated, interdisciplinary, integrated and transboundary management; - More adaptive governance in responding to sudden shocks and managing uncertainties (e.g. mitigation, ecosystem conservation); - Effective learning process; addressing the uncertainties; - Sustainability.

Source: Author's analysis

7.4 Local people responses to the issue of mangrove degradation and tsunami

Local respondents in the three villages are aware of the importance of the mangroves, especially in the aftermath of the Indian Ocean Tsunami 2004. They have seen and experienced themselves how mangroves have protected them from the big waves (I1-I4; G4; H1-H4) (see 7.2 and Table 7.1).

The concerns of local people on mangrove conservation and the linkages with livelihoods are channeled and accommodated through a participatory rural appraisal (PRA) in 1997 conducted by a research-based NGO called MS Swaminathan Research Foundation (MSSRF) during the pre-assessment for establishing a tripartite joint programme for mangrove management called the Joint Mangrove Management Programme (JMM).

The *Irula* fisher concerns have been included through the PRA. Earlier, they had been restricted from using the mangrove and resources from the reserve area due to the lack of a community certificate (a document listing the caste of the community). However, after the initiation of village mangrove councils (VMC) by the JMM programme (see 8.2), they were able to raise their concerns (H2, I1) and have officially been recognized as a user of the mangrove (Selvam, 2010). The establishment of VMCs has resulted in self-defined rules to avoid the destruction of nature; moreover, sustainable livelihood trainings were organized (Selvam et al., 2004a; 2010). Local forest officers and panchayat leaders jointly work with other relevant stakeholders in the JMM programme, including local inhabitants and NGOs. The manner in which village mangrove councils are established and operate is presented in the next chapter (see 8.2).

7.5 Inferences

My analysis leads to six conclusions regarding coastal risk in Parangipettai Block and the challenges that are being posed to the governing system regarding coastal protection:

First, the problem of coastal defense is aggravated by land subsidence from 0.34 mm per year and an average sea level rise ranging from 0.13 to 0.32 mm per year, which can inundate the area in the future. However, past and current disasters largely belong to the sudden type of risk. There is still a lack of precise data on the existing sea-level rise, subsidence rate, and response of mangrove against climate change impact in Parangipettai Block. This could challenge the co-learning and adaptiveness efforts for future and long-term coastal disaster threats. While other sections of the Tamil Nadu coast have implemented different coastal protection strategies, in Parangipettai Block the main strategy consists of mangrove ecosystem-based adaptation.

Second, the mangrove area in Parangipettai Block has degraded substantially in the past due to unscientific management, which has impacted the livelihood of the mangrove-dependent community. There is also concern about the expansion of large-scale aquaculture and its impact on the mangroves. However, mangrove coverage is recently increasing again due to rehabilitation and the joint mangrove management programme. There is high evidence that the mangrove forest protected the villages from the enormous risk of loss of human lives during the Indian Ocean Tsunami in 2004.

Third, the settlement pattern of Parangipettai Block is clustered. A selection of villages in the block is well protected by the mangrove forest, as demonstrated in the tsunami incident of 2004. Other habitations are less well protected by mangroves.

Fourth, the inhabitants of villages located close to the mangrove forest depend directly on mangrove-based resources for their livelihood. Although out-migration does take place, the levels are relatively low. The rehabilitation of mangroves resulted in livelihood enhancement through higher productivity of fish and protection against the Indian Ocean tsunami. One can assume that the motivation to engage in ecosystem-based disaster reduction efforts is therefore high.

Fifth, natural and social trends in Parangipettai Block can only be viewed in the context of the larger region of which they are part. It includes the issue of sustainable and integrated coastal protection measures and infrastructure management. This has important consequences for governance and who should coordinate, which therefore cannot be handled on the local level alone.

Finally, research demonstrates that the Indian Ocean tsunami has resulted in on-going collective action among the population in Parangipettai Block, especially with regard to the mangrove management programme and the establishment of local committees (VMC). The extent to which this is matched and taken up by external governing actors is discussed further in Chapter 8.

CHAPTER 8

8

Governance of coastal ecosystem-based disaster risk reduction in parangipettai block, Tamil Nadu State, India

Chapter 8 : Governance of coastal ecosystem-based disaster risk reduction in Parangipettai Block, Tamil Nadu State, India

8.1 Introduction

The previous chapter discussed the nature of the problems of coastal disaster risk reduction in Parangipettai Block by scrutinizing the natural and social SG. It also discussed how local people responded to the problems that are occurring. Parallel to Chapter 6, which dealt with Indonesia, this chapter assesses the quality of the governing system and its interactions as it pertains to coastal risk in Parangipettai Block. I use interactive governance theory (see 3.3, 3.4 and 4.3) to ask: (1) How does the nature of the governing system and its interactions affect the governability of disaster risk reduction in Parangipettai Block? Special attention is to topics related to the pathways (see Chapter 3) of (a) coordination, (b) goodness of fit, (c) social mobilisation, and (d) learning and adaptiveness. My second question is: (2) What are the specific issues which enable or constrain such pathways? Section 8.2 provides an overview of governance efforts taken to address coastal risk in Parangipettai Block. Section 8.3 assesses the various governance agencies (government and non-government) that play a role in addressing coastal risk, examining the quality of coordination; goodness of fit of problems and goals (images), instruments and action (See 8.3.2); and responsiveness in relation to inclusiveness and social mobilisation (See 8.3.3). Section 8.4 focuses on governance interactions and enquires into issues of information sharing and power relations through a study of representativeness which corresponds to learning and adaptiveness.

8.2 A Bird's eye view of governing efforts in Parangipettai Block

This section discusses the governing actions taken by various governing actors to address the problems of coastal flooding in Parangipettai Block (see 6.2). The responses of the local population to ongoing problems were discussed in 7.4. Figure 8.1 presents an overview of the problems identified in Chapter 7 and the responses of various governing actors. Table 8.1 also includes a column on Parangipettai Block and Cuddalore District to understand the situation in a regional context. It is followed by, and to be read together with, Table 8.1, which depicts the chronological sequence of disaster governance events in the region.

Figure 8.1 Transect profile of Cuddalore District

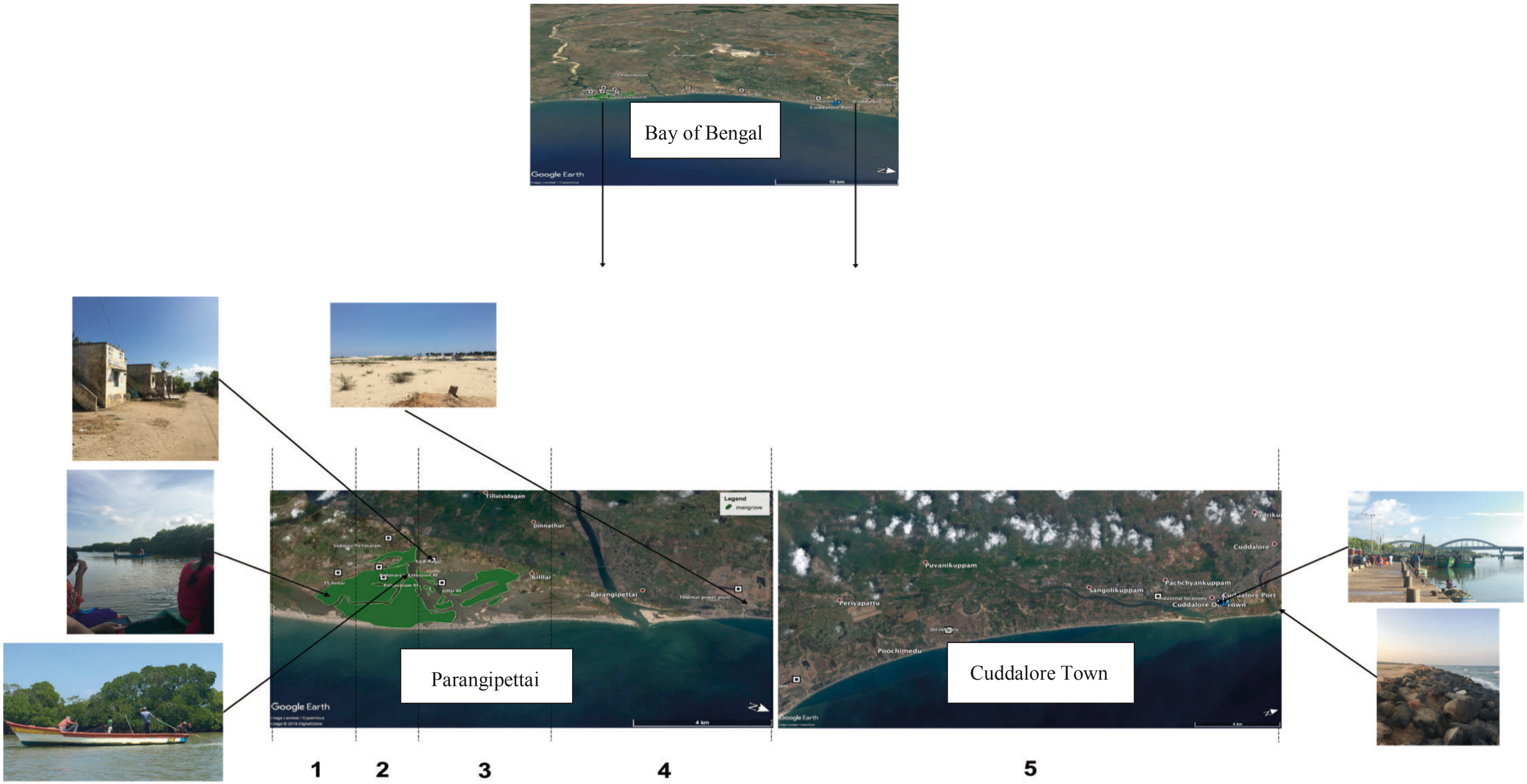


Table 8.1 Problem, action and actors in the case study area

Transect Unit	1	2	3	4	5
	TS Pettai, Parangipettai Block,	**Vadakku Pichavaram Parangipettai Block, Cuddalore District**	**MGR Nagar, Parangipettai Block, Cuddalore District**	**Parangipettai Block, Cuddalore District**	**Cuddalore Town**
Specific Problems	Degraded mangrove forest, and vulnerability of tsunami and storm, degraded livelihood due to degrading mangroves in the past, Vulnerability of tsunami and storm, environmental threat from the thermal power plant.			Vulnerability of tsunami and storm, environmental threat from the thermal power plant and industrial location near the coast	Future environmental threat from industrial location very near to the coast, vulnerability of tsunami and storm.
Actions	Joint Mangrove Management Programme/1993-2003.			Mangrove and Casuarina planting,	Construction of breakwaters, raising dunes, moving victims of tsunami to new, inshore habitations at a distance from the coast.
Primary governing actors	-MS Swaminathan Research Foundation (MSSRF); -Ministry of Environment and Forest (MoEF); -Local government (Panchayat); -Local communities.			- Annamalai University.	Agencies belonging to the state government of Tamil Nadu.

Source: Author modifications of Google earth image 2017; interviews and survey, 2014-2016

8

To overcome the mangrove degradation problem (see 7.2), the Joint Mangrove Management Programme (JMM) was started in 1997 financed by the Canadian International Development Agency (CIDA) and India-Canada Environment Facility (ICEF). It is the only programme that has been implemented by MS Swaminathan Research Foundation (MSSRF) with full support from the Ministry of Environment and Forest (MoEF), local government bodies (Gram Panchayats) and local communities (see 8.31) in the area related to mangrove conservation and livelihood improvement. The first year of the programme was dedicated to understanding the characteristics of the coastal system through research and a Participatory Rural Appraisal (PRA). In late 1998, JMM formed Village Development Mangrove Councils (VDMC) at the village-level to engage local people. VDMC was later replaced by Village Mangrove Councils (VMC). Another significant change was the development of new integrated mangrove fisheries farming (IMFF), which was piloted in several villages in Parangipettai Block as of 2011 (see Table 8.2).

Table 8.2 Chronological account of mangrove related programme in Parangipettai Block

Year	Events
1935-1970	-The coupe felling management of mangroves; -Evidence of mangrove degradation; -Reduction in fish, prawns, and crabs catch.
1990	-Initiation of Coastal System Research (CSR) Programme to study marine biodiversity, coastal agriculture, and coastal fisheries.
1993	-Identification of locations for a mangrove management programme; -Development of technique of mangrove restoration (Fishbone technique).
1997	-Initiation of joint mangrove management (JMM) programme by MSSRF and Tamil Nadu State Forest Department in Pichavaram.
1998	- PRA initiated in 2 villages (MGR Nagar, Vadakku Pichavaram); -Social mapping; -Resource mapping; -The formation of Village Development Mangrove Councils (VDMC) and Village Mangrove Council (VMC).
1999	-The identification of Mangrove Management Units (MMU) in each hamlet.
2004	-Development of integrated aquaculture method; -Indian Ocean Tsunami.
2011-2013	Integrated Mangrove Fishery Farming (IMFF) programme started.

Source: Selvam et al. (2002; 2003a)

Figure 8.2 mentions governing actors and both Figure 8.1 and Table 8.2 indicate that there has been a sequence of efforts to address the mangrove degradation problem in 3 villages. Table 8.3 focuses on Joint Mangrove Management as the main programme in Pichavaram mangrove forest, undertaken in collaboration between government agencies and foreign NGOs.

Table 8.3 Overview of JMM programme in Pichavaram mangrove forest, Parangipettai Block

Project:	Joint Mangrove Management (JMM) Programme.
Initiator:	Ministry of Environment and Forestry.
Collaboration with:	MSSRF and Forest Department of Tamil Nadu.
Type of approach:	Soft.
Period of project:	1993-2013.
Location:	Pichavaram, Parangipettai Block, Tamil Nadu India.
Activities/years:	-PRA/1998; -Establishment of Village Development Mangrove Councils (VDMC) and Village Mangrove Councils (VMC)/1998; -Identification of mangrove management unit (MMU)/1999; -Integrated Mangrove Fishery Farming (IMFF)/2011-2013.

Author's fieldwork (interview and focus group discussion), 2014; 2015; 2017

In 1993, MSSRF conducted a study to understand the biophysical conditions, resources, and patterns of utilization by different stakeholders. Following this study, a method of restoration called 'Fish Bone' was identified and implemented based on the consultation between experts and community (J2). This technique is built on local knowledge (Mukherjee et al., 2008, H1, J2). It aims at bringing in tidal water to help in flushing out the excess salinity in the soil. 'Fishbone', or land areas crisscrossed by channels in the shape of the skeleton of a fish, can be seen on satellite images of Parangipettai Block (see Figure 8.2).

Figure 8.2 The fishbone restoration technique in Killai Reserve Forest seen from aerial satellite image

Source: Google earth, 2016

Based on the initial study, MSSRF selected the villages and hamlets which are targeted in the programme, followed by the identification of MMU by the Village Mangrove Councils (VMC) in 1999. The selection of hamlets was based on the willingness of the local community to actively participate and support the programme (Selvam et al., 2010). Three of the hamlets are included in this research. To see the diversity of actions more clearly, I used the "transect method" (see Figure 8.1). Unit 1 covers TS Pettai Hamlet, unit 2 Vadakku Pichavaram Hamlet and unit 3 MGR Nagar Hamlet. In addition to the three hamlets, the neighbouring areas parallel to the Bay of Bengal coast are also mapped in order to understand the wider picture of problems along the Chidambaram Taluk. Unit 4 covers the Parangipettai and unit 5 Cuddalore Town, all located in Cuddalore District.

As mentioned in Chapter 7, the general problem of this coastline (unit 1-4 in Figure 8.1) is the vulnerability to coastal disasters including storms, floods, and tsunamis. In addition, the Pichavaram Mangrove Forest where the three hamlets are located suffered from mangrove degradation which in the past directly affected their livelihood especially in the fisheries sector. The Parangipettai Panchayat Town (Unit 4 in Figure 8.1) is also located nearby a thermal power plant which could potentially harm the environment (human, animal, and plants) by the air pollution it causes. Meanwhile, the northern part of Cuddalore District, especially in Pondicherry coast, has a higher risk of erosion and flooding (Muthusankar et al., 2017) and is also threatened by emissions from nearby chemical industries (Unit 5 in Figure 8.1).

To address the coastal disaster risks in this region, several actions have been taken. The degradation of the mangrove forest has triggered the JMM programme led by MSSRF in partnership with the MoEF, local government and local communities. It mainly focuses on the planting and conservation of mangroves. Meanwhile, in the neighbouring area of Parangipettai, mangroves have been planted as well by researchers and students of Annamalai University. Along the northern Cuddalore District coastline, breakwaters have been placed in some locations to protect the coast. Further description of the diverse actors and actions is under section 8.3.1.

The JMM programme is an international success story and best practice (Noguchi et al., 2012; DasGupta and Shaw, 2013). It is evidence-based and the participatory approach conducted by the MSSRF scientists prior to the inception of the programme was critical to its success. Furthermore, the participatory approach gained shape with the establishment of the Village Development Mangrove Councils (VDMC) and Village Mangrove Councils (VMC) as a permanent body to replace the VDMC. These bodies strove to involve all relevant actors including government authorities (through the Forest Department), MSSRF as implementing agency as well as members of the local community. Meetings of VMC are currently conducted to define common concerns and formulate an agenda for development, a mission, a set of goals and objectives, the roles and responsibilities of different actors, and the optimum size of the group. The intention is to ensure participation of all, including fishers, farmers, youth, and women. Actions are defined through consensus in the meeting and include mangrove planting, training, and the establishment of Village Knowledge Centres (VKC). After the VMCs were established, the MMU was formed. The MMU is a unit defined and selected by the members of VMC to implement the conservation programme established in 1999. The VMC and MMU have a detailed programme and strategy for funding.

In Chapter 7, I noted that the JMM programme has been quite effective, although there is still high uncertainty about future risks. In the following pages I discuss the quality of governance efforts and offset them against the overall capacities of the governing system and the magnitude of the problems that exist.

8.3 Examining the governing actors and their qualities

8.3.1 Governing actors and coordination

The governing system in Parangipettai Block is diverse in terms of *types and levels* of governing actors. This section discusses the diversity of actors and the vertical and horizontal relations among them which enable or constrain coordination efforts.

Four *types* of actors work on mangrove management and coastal disaster risk reduction in Parangipettai Block: (1) Government agencies; (2) Local NGOs; (3) village mangrove councils, and (4) research and scientific institutions (see Table 8.4). Each actor is responsible for implementing specific laws and policies with specific goals and instruments (see Table 8.5).

Table 8.4 List of relevant governing actors, goals and law and policies in Parangipettai Block

Actors	Level	Agencies	Goals	Laws and policies
Government agencies	National	-Ministry of Environment and Forest (MoEF).	Conservation and survey of flora and fauna, forest and wildlife; prevention of pollution; afforestation.	The Environment (Protection) Act Number 29/1989; Biological Diversity act 2002; Coastal Regulation Zone Notification, 2011.
	State level	Revenue Department; State Forest Department; Department of Environment; Department of Fisheries.	Providing relief and implementation of rehabilitation measures of natural calamities; land reforms; Conservation of biodiversity and ecosystem (i.e. forest for food security).	Disaster Management Act 2005; Tamil Nadu Forest Act 1882, amended in 2002; Scheduled Tribes and other traditional forest dwellers (Recognition of Forest Rights), Act 2006; Coastal Zone Management Plan State of Tamil Nadu (Drafting process, 2018).
	District level	District Collector Office.	Various programme, including disaster relief.	District Disaster Management Plan 2017, Cuddalore District.
	Local	Gram Panchayats.	Partner and programme implementer in the local level.	-
NGOs/Funding agencies	International	International Tropical Timber Organization (ITTO); Canadian International Development Agency (CIDA); India-Canada Environment Facility (ICEF).	Supporting the JMM programme.	Project document.
	National	MS Swaminathan Research Foundation (MSSRF); Building and Enabling Disaster Resilience of Coastal Communities (BEDROC); ENCONS; PEACE Foundation.	Conservation and documentation of mangroves; conducting JMM programme.	Project document.
Research and Academic	Int.	Institute of Development Studies in Sussex, UK.	Provide technical support.	-
	Nat.	Annamalai University; Anna University.	Support in research and data collection.	-
Local communities		Self-help groups including fishers, youth, and women, VMCs.	Conservation of mangrove and livelihoods.	-

Source: Author's analysis from focus group discussion and interview

Table 8.5 Laws, goals and instruments for Eco-DRR in Parangipettai Block

Topic	Relevant national and regional acts	Goals	Instruments
Coastal zone and small islands regulation	Coastal Regulation Zone Notification 2011.	Protect livelihoods of fisher and other coastal communities, and coastal conservation and protection.	Zoning of coastal area based on ecological sensitivity; Regulation of coastal development in ecologically sensitive areas, including mangroves and disaster-prone areas.
	Coastal Zone Management Plan State of Tamil Nadu (drafting process, 2018).	Coastal zone management in Tamil Nadu.	Regulation of coastal zone.
Disaster management	Disaster Management Act 2005.	Institutional mandates for disaster management.	Establishes the National Disaster Management Authority (NDMA).
	District Disaster Management Plan 2017, Cuddalore District.	Operationalizes disaster management at district-level.	Guidelines for district level disaster preparedness, prevention, mitigation and monitoring.
Environ-mental protection and mgt. act	The Environment (Protection) Act Number 29/1986.	Protect and improve environmental quality.	Regulations for development, industrial and construction activities.
Conservation of biodiversity and ecosystem	Biological Diversity Act 2002.	Conservation, sustainable use and equitable sharing of biodiversity resources.	Establishes the National Biodiversity Authority, State Biodiversity Boards and Biodiversity Management Committees at local levels.
Forest management	Forest (Conservation) Act (Number 69/1980 and amended in 1988)	Protection of forest land.	Regulation of development activities in forest areas.
	Tamil Nadu Forest Act 1882, Status: amended in 2002.	Protection of forestland in Tamil Nadu.	Regulation of development activities in forest areas.
	Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.	Recognizes forest rights of Scheduled Tribes and other traditional forest dwellers.	Framework for recording forest rights and regulation of these rights.

Source: Author's analysis on policy documents

(1) Government agencies

There are four levels in the formal government arrangement in Parangipettai Block case study. At the **international level**, the Ministry of Environment and Forest plays the main role in the provision of funding through a joint bilateral project with the government of Canada through the International Tropical Timber Organization, the Canadian International Development Agency (CIDA) and the India-Canada Environment Facility (ICEF). The programme, called Coastal

System Research (CSR), started in 1990. During the course and development of the CSR project in Parangipettai Block, other Ministries at the **national level** became involved, including the Department of Science and Technology (through the implementation of the Integrated Mangrove Fishery Farming Systems) and the Ministry of Earth Sciences (through the implementation of Greenhouse Gas Fluxes research in Pichavaram mangrove ecosystem) (H1-H3).

At **state level**, the government is involved through the Forest Department of Tamil Nadu, which is responsible for forest management. Other departments – such as Revenue Department, Department of Environment, Department of Fisheries, Tamil Nadu and Panchayat Raj Institutions – are also involved.

At district level, the District Collector is the main authority. His or her office has a coordinating role in the implementation at the lowest level of government in the rural area, which is called panchayati union. Furthermore, MSSRF as the only national research-based NGO has been given the responsibility of coordinating and implementing the joint mangrove management programme in the field.

At village level, the Gram Panchayat is the lowest level of government to govern the socio-economic development project. Its role is to support the implementation of the programme and join as a member of the village mangrove councils.

(2) Local NGO

The position of MSSRF[9] in the programme is central. It has been mandated by the international, national and state level governments to be the responsible institution to provide technical guidelines, lead, manage, and communicate with the local community. Besides its headquarters in Chennai, MSSRF also has field offices, in which the Chidambaram office is responsible for managing the programme in Parangipettai Block. The local NGOs such as Bedroc, ENCONS,

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[9] The MS Swaminathan Research Foundation (MSSRF) was established in 1988 as a non-profit trust, founded by Prof. Mankombu Sambasivan (MS) Swaminathan. He is known as the father of the green revolution in India. His work is notable in inventing a new bio-variety to increase productivity and combat the issue of food security and poverty in India. However, the green revolution concept he introduced was criticized for the social and environmental harm it caused including overexploitation of groundwater and the excessive use of pesticides to increase productivity (Shiva, 2016). The vision of MSSRF is to accelerate the use of modern technology for agricultural and rural development to improve lives and livelihoods of the community. Furthermore, the MSSRF follows a pro-poor, pro-women and pro-nature approach and applies appropriate science and technology options to address practical problems faced by rural populations in agriculture, food and nutrition (MSSRF, nd).

and Peace contribute in terms of connecting with local people and also contribute to joint publications (see Selvam et al., 2004a; H1). However, their involvement is under the guidance and lead of MSSRF with the main funding from the JMM programme (see Figure 6.4).

(3) Local community

During the planning and implementation of the JMM programme, local management units called Village Mangrove Councils were formed. In the VMC, representatives of the local community have an equal position with the Gram Panchayat[10], Forest Department officers, as well as the MSSRF. The VMC plans, implements, monitors, and evaluates the programme (see also 8.4.1.1).

(4) Research and scientific institutions

As a research foundation, the staff in MSSRF are mainly scientists and researchers (H1-H4). They are experts in different fields of study including biologists, ecologists, social anthropologists, and botanists (Selvam et al., 2010). MSSRF collaborates with universities, including Anna University and Annamalai University. University researchers are involved in conducting scientific research to support the project, ensuring the selection of suitable species for rehabilitation and evaluating the status of mangrove management in Parangipettai Block (J1, J3, and H2-H5).

In conducting the public rural appraisal method to implement the JMM programme, MSSRF was also supported by the Institute of Development Studies in Sussex, UK (Selvam et al., 2010). MSSRF has also been collaborating with different universities and scientific institutions and experts in several universities, including from Annamalai University (H2, J1, and J2).

8.3.1.1 Vertical and Horizontal analysis and the issue of coordination

The *vertical* relation between governing actors is reflected in the government structure in India. In the JMM Programme in Parangipettai Block the nodal Ministry of Environment and Forest has channeled foreign funding, established the programme and mandated the MSSRF as the

[10] Panchayat government in India can be divided into two types, (1) Formal and elected or *Gram Panchayat* and (2) the informal or customary panchayat called *Ur Panchayat.* In the case of Joint Mangrove Management Programme in Pichavaram area, based on the interviews conducted with local people and NGOs, the formal panchayat appears to have significant influence which is not the case with the informal panchayat (15-18; H5)

main partner to implement the programme. The state, district and local government play a role in supporting and operationalising its implementation.

The *horizontal* relation in the JMM Programme is reflected in the connections between and among governmental agencies at the state and district levels, NGOs, and local communities. The internal relation between government agencies at any one level, for example, is based on the sub-programme relevant to the strategic planning and activities of each department or agency. For example, in the case of the integrated fisheries management strategy, the Forest Department in Tamil Nadu made links with the Fisheries Department. The Revenue Department is involved when disasters occur. The in-depth interviews conducted with several department staff indicated, however, that the interactions take place more on an informal rather than a formal basis (G2, G4, G5).

The external relations between NGOs are led by the leadership of MSSRF. MSSRF has involved other local NGOs such as Bedroc, ENCONS, and Peace in the implementation and reporting of the JMM Programme (Selvam et al., 2010). Furthermore, MSSRF coordinates directly with donors from ITTO (International Tropical Timber Organization) and CIDA (Canadian International Development Agency).

Each type and level of governing actors has its own mandate, scope of interest, and network (see Table 8.4). However, to govern the problem and to upscale the solution for coastal erosion and flooding, a coordination effort at least in relation to this project has been undertaken. The MSSRF is tasked with the coordination, involving other relevant governmental agencies especially in the district and local level. The interactions take place mainly through formal meetings and discussions (i.e. Village Mangrove Councils meeting).

8.3.2 Governance and the Goodness of Fit

The diversity of governing actors of different origins contributes to the existence of diverse framings of images, instruments, and actions. Table 8.3 presents an overview of governing agencies their images, concretized as goals, instruments and actions.

Following the table, I examine the match, or fit, that exists between the images, instruments, and actions of the various agencies, concentrating on the agencies that play the largest role in the governing of coastal risk in Parangipettai Block.

8.3.2.1 Diversity of images of problem and goals

(1) Matching of problem images

Stakeholders agree about the problem of coastal disasters (see Table 8.3) and the cause in terms of degradation of the mangrove forest that occurred between 1935-1970 because of the 'coupe-system' where mangroves were clear-felled by rotation every 20-25 years for revenue generation (Selvam, 2004a; 2004b). Cattle grazing also contributed to the degradation of mangroves. which in turn has impacted on the livelihood of dependent local people. The role of climate variability and change was not much discussed.

(2) Matching of the goals and images

The objectives of the JMM programme are: (1) Conservation and documentation of mangrove ecosystems; (2) Rehabilitation of degraded mangrove ecosystem; (3) Monitoring of the state of mangroves using remote sensing technology; (4) Linking the ecological security of mangrove forests with the livelihood security of mangrove-dependent communities; (5) Promotion of participatory mangrove forest management and formation of Village Mangrove Councils; (6) Understanding the role of women and men in the conservation and sustainable and equitable use of mangrove forest; (7) Ensuring that the children of the mangrove forest communities have opportunities for education and health care; and (8) Spreading mangrove literacy for fostering public understanding of the significance of mangrove (see Selvam et al., 2010).

(3) Views on the matching of images of problem and goals

Turning to the view of local people in Parangipettai Block on the match between problems and goals, my survey shows that around half the respondents in the three coastal hamlets agree that everyone involved in the JMM programme has understood and has a similar opinion about the problems, its underlying causes and the goals (see table 8.6). Also, they believe that the goals of the coastal protection programme and the actions that have been taken by MSSRF fit well with the nature of the problem. The representatives of MSSRF and the Forest Department confirm this opinion (G2, G4, and H1-H4). In terms of actions, the JMM programme is the main programme carried out in Pichavaram mangrove forest.

Table 8.6 Survey results on the goodness of fit of images with problems

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Do governing actors understand well the problem and have the same opinion about the problem	Strongly Disagree: 0% Disagree: 1.5% Neutral: 14.5% Agree: 35.5% Strongly Agree: 48.5%	Strongly Agree. Mangrove degradation, sea-level rise, poverty, Strongly Agree. -local people awareness on the importance of mangroves.	Strongly Agree. -Mangrove degradation, sea-level rise, and poverty. Strongly Agree. local people awareness on the importance of mangroves.
Do governing actors understand the goals of coastal protection and have the same opinion about the goals	Strongly Disagree: 1,0% Disagree: 14.5% Neutral: 40.0% Agree: 42.0% Strongly Agree: 2.5%	Strongly Agree. -Mangrove restoration, livelihood improvement, raising local people awareness.	Strongly Agree. -Mangrove restoration, livelihood improvement, raising local people awareness.
Do governing actors understand that the problem and Goals in coastal protection programme with mangrove planting is matched	Strongly Disagree: 0.5 Disagree: 15.5% Neutral: 38.0% Agree: 43.5% Strongly Agree: 2.5%	Agree.	Agree.
The Actions taken by stakeholders is matched with problem and goals	Strongly Disagree: 1.0 Disagree: 15.0% Neutral: 38.5% Agree: 43.0% Strongly Agree: 2.5%	Agree. -Joint mangrove management programme.	Agree. - Joint mangrove management programme.

Source: Fieldwork survey, 2017

8.3.2.2 Diversity of instruments

The main law regulating coastal management in India is the Coastal Regulation Zone (CRZ, 2011) notification of 2011 and disaster risk reduction is also covered by eight other policies listed below: (1) Coastal Regulation Zone (CRZ) Notification 2011; (2) Coastal Zone Management Plans, state government of Tamil Nadu (currently still in drafting process); (3) Environment (Protection) Act Nr 29/1986; (4) Disaster Management Act 2005; (5) District Disaster Management Plan 2017, Cuddalore District; (6) Biological Diversity Act 2002; (7) Forest (Conservation) Act number 69/1980, amended in 1988; (8) Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; and (9) Tamil Nadu Forest Act 1882, amended in 2002 (see Table 8.7). Second, I discuss the legislation on four topics: (1) the implementation of disaster management, a concern closely related to coastal risk; (2) the ecosystem-based approach, which is relevant to the current ecosystem-based coastal protection effort in Parangipettai Block; (3) the financing of coastal protection, which is essential for the realization of plans; and (4) the structure of governance. Finally, I discuss the perception of governing actors regarding the goodness of fit of instruments among various thematic topics covered in each law.

Table 8.7 Legislation related to mangrove conservation for disaster risk reduction in Parangipettai Block

Topic	Relevant national and regional acts	Findings
Coastal zone and small islands regulation	-Coastal Regulation Zone Notification 2011; -Coastal Zone Management Plan State of Tamil Nadu (drafting process, 2018).	(+) Provide strong foundation to ensure that coastal development is considering the environmental sustainability and existing socio-economical activities of local fishers and other communities residing in the coastal area; Clearly pointing out the zone and policy regarding clearance for coastal development projects, include the consideration of ecologically sensitive areas as well as disaster-prone areas; (-) The successful implementation of CRZ is mainly dependent on the state coastal zone management plan, which will provide more details plan and impacting the local community; There are no further descriptions on the strategy to ensure the regulation enforcement and how to ensure the principle of justice and fairness can be incorporated in the plan.
Disaster management	-Disaster Management Act 2005; -District Disaster Management Plan 2017, Cuddalore District.	(+) Provide solid foundation of governance structure in all levels related to disaster management; Secure national, provincial, and regional budget allocation, including the regulation to allocate funds in all ministries and departments; Provide detail priorities of disaster management policy in District level; the alignment of disaster management plan across different departments in district level; (-) Environmental aspect only mentions as a sub-sector without explicit reference to the need of ecosystem conservation as a measure to reduce disaster risk; Focusing on sudden disaster and short-term prevention, no reference to ecosystem preservation and its linkages to reduce disaster risk; coastal protection measures are still geared towards hard infrastructure approach.
Environmental protection and management act	-The Environment (Protection) Act Number 29/1986.	(+) Clearly regulates permission and requirements for construction activities that will have indirect or direct impact on the overall quality of the environment, including in the mangrove forest; (-) The successful implementation of the Environment protection act is mainly dependent on the operationalization of the state; there is a lack of reference to possible threats in the future to the environment.
Conservation of biodiversity and ecosystem	-Biological Diversity Act 2002.	(+) Elaborates detail roles and responsibility of the three-tier of biodiversity authorities (national, state, local); (-) No strong reference to elaborate the meaning and purpose of “sustainable use of biodiversity and ecosystem”, including the linkage to climate change and disaster risk reduction.

8

Table 8.7 (continued)

Forest management	-Forest (Conservation) Act Number 69/1980 and amended in 1988; -Tamil Nadu Forest Act 1882, Status: amended in 2002; -Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.	(+) Includes clear regulation to protect the reserved forest; (-) Lack of reference to future threats to the forest and environment.

Source: Author's analysis on policy documents

The Coastal Regulation Zone (CRZ) Notification 2011[11] provides a guideline for zonation to determine areas which are permitted for certain activities. Four zones have been determined, including: (1) CRZ-1-Ecologically sensitive areas which are essential in maintaining the coastal ecosystem between low and high tide line. Several activities including the exploration of natural gas and extraction of salt are permitted; (2) CRZ-2- covers areas from up to the shoreline. In this area, unauthorized infrastructures are not allowed to be constructed; (3) CRZ-3-Rural and urban areas outside of CRZ-1 and CRZ-2. Several activities including agricultural and public infrastructure are allowed; (4) CRZ-4-Aquatic area to marine territorial limits. Fishing activities including fishing are permitted.

At state level, governments are required to formulate coastal zone management plans. The Environmental Protection Act regulates the environment assessment process for industries and other activities. This applies to the coastal area as well as those referred to in the CRZ 2011

[11] The Coastal Regulation Zone (CRZ) notification 2011 is the amended version of the CRZ 1991. The amendment was made possible through expert committee recommendations led by MS Swaminathan. The main critiques of the CRZ Notification 1991 include: (1) lack of explicit land rights for the fisher communities; (2) Lead of involvement and participation of coastal communities and civil society in the planning, implementation, monitoring and evaluation (see Sridhar, 2011). Krishnamurthy et al. (2014) stated that "several components modified from the CRZ Notification 1991 in the CRZ Notification 2011 are: (1) Inclusion of marine areas and the sea-bed upto 12 nautical miles and intertidal water bodies in the ambit of coastal regulation, (2) Formally recognizing the rights of traditional fisher communities in and to coastal spaces, and (3) Expressing concern on the cumulative impacts of ports on the coast, the report called for a comprehensive study on shoreline changes and a mechanism to address and control the excessive proliferation of ports. Importantly, the need for the formulation of a 'ports policy' with an environmental focus has now been accepted by the MoEF" Krishnamurthy et al. (2014: 660). In 2018, a draft of the newly amended CRZ Notification 2011 was released. Proposed changes related to the topic of this thesis include: (1) New universal high tide line demarcation for all regulatory purposes; (2) Delinked hazard map from the CRZ Notification and limit the purpose for disaster management; (3) Limits of the line of tidal influence body from 100m to 50m; (4) The non-development zone (NDZ) area are stipulated to all islands near the mainland as well as backwater island; (5) Simplified clearance mechanism, only activities in CRZ 1 and IV needs permission from the MoEF whereas in CRZ 2 and 3 clearance is needed from the CZMA.

Notification. Furthermore, the Disaster Management Act (2005) provides the foundation of the governance structure at the national to the district level through the establishment of national, state, and district disaster management agencies. Agencies at each level are obliged to develop a disaster management plan. In terms of biodiversity, the Biological Diversity Act 2002 regulates the conservation and sustainable use of bio-resources and equitable benefit sharing, including mangrove resources. The National Forest Conservation Act (1988) and Tamil Nadu State Forest Act (2002) mainly aim for the protection of forest areas from degradation. Furthermore, the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act ensures the recognition of scheduled tribe communities of their rights of the forest dwelling to land and resources.

The linkage between existing policy documents and disaster management

Disaster management has been already mainstreamed in all ministries and departments at national, state, and the district level through the enforcement of the Disaster Management Act 2005. This law states that a disaster management plan is required to be prepared by all ministries, and departments at the national, state and district level (G3). However, not all of these agencies have prepared the disaster management plan (G3). The Act also mentions a specific community-based disaster management approach. The disaster management plan mentions that local people and NGOs should plan and act for pre-disaster, during disaster and post-disaster phases by coordinating with the line departments. Among other relevant laws, only the Coastal Regulation Zone 2011 Notification also makes reference to disaster management.

The linkage between existing policy documents and ecosystem-based approach

The analysis shows that the most relevant legislation corresponding to the mangrove ecosystem-based disaster risk reduction programme is the CRZ 2011 Notification, which has the purpose of integrating coastal land use management, promoting coastal livelihoods, and conserve the marine environments. However, this policy has no reference to the use of biodiversity and ecosystems for the purpose of reducing risk. There is also a lack of reference to the role of local people and NGOs in the implementation of the notification, except for the disaster management plan at the district level.

Analysis on financing

The main source of funding for coastal protection efforts is from national, state, and district budgets. This is reflected in all laws considered. The JMM programme is financed through the MoEF budget which, in this case, is sourced from international funding (CIDA and ICEF).

Between 1998-2008, approximately 41 million Euro (33,624,113.00 RS lakhs) was available for the entire project (Lele and Gandhi, 2009). This does not imply that the ministry has enough finances for coastal protection across India.

Perception of the goodness of fit of instruments

Table 8.8 Survey results of the goodness of fit of instruments

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Are the rules/regulation existing in the whole system adequate	Strongly Disagree: 0% Disagree: 2,0% Neutral: 19,5% Agree: 47,5% Strongly Agree: 31,0%	Neutral. -The Coastal Zone Regulation (CRZ) Notification 2011 has provided a legal basis for mangrove protection; -However, the operationalization of the CRZ Notification 2011 needs to be assessed in detail.	Agree. -The Coastal Zone Regulation (CRZ) Notification 2011 has provided a legal basis for mangrove protection.
Are the existing rules/regulation implemented well	Strongly Disagree: 0,5% Disagree: 2,0% Neutral: 19,0% Agree: 47,5% Strongly Agree: 31,0%	Agree.	Agree.

Source: Fieldwork survey, 2017

In terms of the perception of local people, NGOs, and government authorities on existing laws, my survey and interview results reveal that the majority of local respondents (47.5% agree and 31% strongly agree), NGOs and governmental authorities are aware of the CRZ Notification 2011 (see Table 8.8). They (members of the local community, NGOs and government authorities) also claimed that the current implementation is up to par. However, several employees of NGOs perceived inadequacy in terms of the operationalization of CRZ Notification 2011. They argued that the notification is still too general and should provide more details in terms of local implementation in order to respond to the unique characteristics and context of different coastal areas. This statement has been confirmed by the interview I conducted with one pond farmer in Nagapattinam. Although he is not a resident of the three villages I studied, his story confirmed the problem he faces with site permission due to of the CRZ 2011 Notification. He stated:

"I have designed and built this tidal-fed mangrove fisheries pond, which has been endorsed by several NGOs and acknowledged as a sustainable mangrove-fisheries practice. However, I still face a problem with the site permission for this pond. I invest a lot in this pond, and this is where I received income. And yet, the government said that it is actually not permitted to have a pond here because it is in Zone 1 (based on CRZ)" (Personal Interview, I3, 21 February 2016).

8.3.2.3 Summary on the 'Goodness of fit' and the issue of coordination

At an organizational level, it appears that the images of the problem, goals, and solutions are more or less in line. There is scientific evidence of the root cause of the problems and unified goals, to conserve mangroves and improve livelihoods of the people in this project area. Furthermore, the linkage between the issue of disaster management and ecosystem-based approaches has been clearly reflected in the CRZ Notification 2011, which is the most relevant law. The CRZ Notification 2011 provides guidance for ecosystem protection and its use to reduce disaster risk, with strong reference to other relevant regulations.

8.3.3 Governance, responsiveness and the issue of social mobilisation

In terms of IG theory, the modes of governance available in Parangipettai Block consist of (mixtures of) all the three types (see Table 8.9). The **Hierarchical** mode is reflected through state-centric and top-down mandates in controlling and regulating the mangrove management by the central government. **Co-governance** is found in cooperation and equal involvement of diverse stakeholders within the board of the JMM programme. **Self-governance** is reflected through high involvement of the local community in the VMC.

Table 8.9 Different expressions of governance modes in Parangipettai Block

Modes	Forms of Implications
Self-	The establishment of VDMC and VMC led by community members; the establishment of self-help groups for livelihood improvement.
Co-	The involvement of government authorities and MSSRF as implementing NGO in the executive committee of VDMC and VMC.
Hierarchical	The financing and coordinating of the JMM programme by the government at different levels.

8.3.3.1 Diversity of modes

Hierarchical

The hierarchical mode of governing in the JMM project is reflected in the central government taking a major role in establishing core management regulations for the coastal zone (e.g. CRZ

Notification, see 6.2.3.1). The central government plays a core role in the international collaboration agreement and the allocation of funding. The Government through its nodal ministries are working on the topic of coastal and mangrove management are also in full charge in terms of deciding on the operationalization of the project. In the case of Parangipettai Block, MSSRF has been selected to implement the project (Selvam et al., 2003s; 2004a; DasGupta and Shaw, 2013). What is not clear is whether the decision to have this project comes at the cost of coastal protection elsewhere.

Co-governance

The co-governance modes in the JMM Programme in Parangipettai Block include: (1) stakeholders' cooperation in the JMM programme and (2) at the local level, the Village Mangrove Councils (VMC). The first type of cooperation involves different agencies at the international, national, and sub-national level which are involved in the JMM project (see 1.2.1). This type of cooperation effort occurred formally within the structure of the project. The second type of cooperation is mainly taking place at the village level. The VMCs play an important role in operationalizing the programme at the local level, with a regular meeting to inform all involved stakeholders (Selvam et al., 2004a; H2-H4).

Self-governance

Self-governance is also reflected in the community-based programme in the form of Village VDMC and VMC. Although initiated by the MSSRF together with the Forest Department agency, this Council is in itself run by the local communities (i.e. women's' group, fishers group, etc.). In its day-to-day operation, the VMCs are taking a major part in making decisions and self-governing their area (i.e. defining organizational structure of the VMCs, agreeing on institutional norms, as well as determining MMU in their area). Furthermore, the self-help groups in the villages also run independently after being formed and initiated by the MSSRF (Selvam et al., 2004a; H2-H4).

8.3.3.2 Responsiveness of modes, the issue of inclusiveness and social mobilisation

There is a diverse degree of responsiveness of governing actors to issues of coastal risk in Parangipettai Block. The hierarchical mode, which is mainly represented by the power of government agencies in formulating and implementing policy from national to local level, is responsive in word and deed to the issue of mangrove conservation and coastal risk in Parangipettai Block. This is reflected through the leadership and strategic plan of one nodal ministry (the Ministry of Environment and Forest), the availability of funding and the adoption of an ecosystem-based approach in coastal management law (CRZ Notification 2011)) (see 8.3.2.2). The responsiveness of co-governance modes in Parangipettai Block is shown through the lively collaboration and partnerships of MSSRF and community groups (e.g. the concrete outcome in the form of Village Mangrove Councils and Mangrove Management Unit). Lastly, the responsiveness of the self-governance mode can be viewed from the way mangrove groups and other community groups are reacting to the problem of mangrove degradation and the risk of tsunamis and cyclones. The establishment of joint initiatives and effective coordination efforts have increased the responsiveness of such self-governed modes.

Increased responsiveness may be caused by opportunities to participate in the various phases of planning, such as decision-making, implementation, monitoring, and evaluation and inclusiveness is viewed in the context of the involvement of government agencies at the regional level, NGOs, research communities, and local people.

Horizontal Inclusiveness

The set-up of the JMM programme is centralized and located in specific agencies, such as the State Forest Department. At the local level, the VMCs have provided a joint platform that acknowledges equal contribution from all members including representatives of the community, the Gram Panchayat, Forest Department and MSSRF as the implementer. An interview with a representative of the State Disaster Management Authority points out that the JMM programme has received a positive response and has complemented the work being done at the state level regarding disaster management. This suggests that there is a high acceptance of the way the project was set up and the selection of agencies involved.

Meanwhile, most local respondents claim that they are included in the planning (52% agree), implementation phase (94% agree), monitoring (88% agree) and evaluation (58.5% agree) of the programme (see Table 8.10). Although there were challenges at the beginning of the project, the NGOs claim that the inclusion mechanism strategy through the establishment of VMC has worked very well. Furthermore, there is apparently no significant problem regarding resources since they have built a sharing resources mechanism to run their activities. An external funding mechanism through a community loan and external sponsors has been arranged by VMC themselves (see Selvam, 2004a; 2004b, H1, I1, I2, I4).

Table 8.10 Survey results on inclusiveness in Parangipettai Block

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
Were local inhabitants included in the planning process of coastal protection programme?	Strongly Disagree: 0% Disagree: 0% Neutral:48% Agree: 52% Strongly Agree: 0%	Agree: - In the initial phase and early survey for project planning, communities in the village were included through meetings with PRA methodology; -The VMCs (and predecessor VDMCs) were established to create a community-based committee for the preparation of the JMM project	Agree: - The MSSRF has initiated the project with a science-based and participatory approach including communities in the deliberation;
Were local inhabitants included in the implementation process of coastal protection programme?	Strongly Disagree:0% Disagree: 0% Neutral: 2,0% Agree: 94.0% Strongly Agree:4.0%	Agree: -MSSRF team has facilitated the establishment of VMCs, provide technical support and guidance, facilitating micro-plan preparation, and establishing the management unit with the Forest Department; - The planning and implementation of the project were organized by local people through VMC;	Agree: - Local people are included in the mangrove restoration programme as well as in livelihood training;
Were local inhabitants included in the monitoring process of coastal protection programme?	Strongly Disagree: 0% Disagree: 0% Neutral: 10,5% Agree: 88,0% Strongly Agree: 1,5%	Agree: - Local people are involved in monitoring by reporting to the field coordinator or village head if there is any damage in hybrid structure or if there are any other complaints;	Agree: - MSSRF facilitated the process;
Were local inhabitants included in the evaluation process of coastal protection programme?	Strongly Disagree:0% Disagree: 0% Neutral: 36,0% Agree: 58,5% Strongly Agree: 5,5%	Agree: - VMC report progress to MSSRF -MSSRF produced the report of the JMM outcomes;	Agree: -MSSRF facilitated the evaluation process and reported the result to relevant government authorities

Source: Fieldwork survey, 2017

Hence, in the case of Parangipettai Block, the co-governance modes have been effective in realizing coordination, promoting inclusiveness and social mobilisation among different actors. Again, the effectiveness and sustainability of the ecosystem-based disaster risk reduction effort (see 3.4) depends on the mobilisation of society and the biophysical context. The existing structure and design of the JMM programme has accommodated mobilisation of resources of all actors at the level of planning (i.e. the identification of actors, organization, unit of management), implementation (i.e. planting), monitoring (i.e. conservation of mangroves) and evaluation (i.e. through the facilitation of VMC). The success of this project has clearly also depended on nodal coordination at the national (through MoEF) and state level (Forest Department) (see Table 8.11).

My research demonstrates that the initial trigger of change in the region is the realization by the MSSRF and its partners including the Forest Department, State of Tamil Nadu that poverty and mangrove forest degradation is interlinked, and this is fully supported by the Ministry of Environment and Forest, India. Furthermore, the evident role of mangroves as an effective barrier during the Indian Ocean tsunami has transformed the way governing actors interact among each other over time. This led to acknowledging and supporting mangrove ecosystem-based protection for estuaries.

Table 8.11 Summary of risks posed by the governing system in Parangipettai Block

Steps	Variables		Properties	Condition
3. Assessment of governing system	3.a Stakeholder mapping and governance elements	3.a.a Actors	Diversity	Many societal actors involved.
			Dynamics	Single coordination mechanism to deal with changes.
		3.a.b Images of problem	Diversity	Problem defined: mangrove degradation and risk of coastal disaster (short-term).
			Dynamics	Root causes generally agreed (i.e. mismanagement of mangrove conservation)
		3.a.c Law instrument	Diversity	Ecosystem-based approach issue is centralized under the CRZ Notification 2011.
			Dynamics	Amendments of CRZ Notification 2011and Forest Management Law which increase the property rights of tribal community.
		3.a.d Actions	Diversity	focus on a single integrated programme on mangrove conservation and livelihood improvement
			Dynamics	Lack of discussion on integrated soft and hard infrastructure in regional context (i.e. Tamil Nadu coast or east coast of India).
3. Assessment of governing system	3.b Responsiveness	3.b.a Modes	Diversity	Co-governance to self-governance.
			Dynamics	Strong democratic government, capable of responding to new societal challenges.

Table 8.11 (continued)

3. Assessment of governing system	3.c Risk (coping capacity/governability)	Sudden-onset	Lower risk and higher governability due to: **1. Coordination** (+) Clear and effective coordination mechanism led by national research-based NGOs with full support from the MoEF of India; **2. Goodness of fit** (+) Strong support of evidence-based science in identifying the causes of the problem; (+) Centralized and aligned policy under CRZ 2011 Notification; (+) Integrated project (i.e. joint mangrove management programme). **3. Social mobilisation** (+) High participation and inclusion in all levels. **Challenges:** (-) Lack of evidence-based research to deal with projections of future threats.

Source: Author's analysis

8.4 Governing interaction and the issue of power relations

The GI analysis focuses on the dynamics of interaction among all governing actors and a discussion on diversity and dynamics of co-learning and adaptiveness. Meanwhile power relations are addressed through assessing representativeness. This section concludes with an overview of the dynamics occurring within the realm of GI and the roles for scaling up learning and adaptive capacity of governing actors.

8.4.1 Presence and quality of co-learning and adaptiveness

This section discusses the quality of interaction among the governing actors in Parangipettai Block. Interactions within each type of governing actors are described first, followed by a discussion of the overall quality of the interaction among various actors, and the implication of interactions for the issue of learning and how it affects the adaptiveness of governing actors.

To deal with mangrove degradation and coastal disaster risk in Parangipettai Block, government agencies are generally basing themselves on specific strategic planning and work plans. This can sometimes lead to a lack of flexibility of government agencies to expand their network and to interact with other stakeholders (A3-A6). Meanwhile, the NGOs through the leadership of MSSRF have been able to join forces under one JMM programme.

The learning and adaptation process and outcome among actors in Parangipettai Block is assessed from three angles: *First* the knowledge generation and sharing process including the type of information and perception of local people and governing actors on the effectiveness of such information; *Second,* the perception of local people and governing actors on the existence of a learning process*;* And *third*, is the availability of adaptation strategies conducted by local people as a result of the learning process.

In Parangipettai Block, information shared by government authorities with local people to increase awareness of the need to conserve mangroves, as well as the preparedness to coastal disaster risks is reflected in the form of regular training classes, meetings, and informal education to students (H2-H5; I1-I3, J1). These trainings are facilitated by MSSR, in collaboration with the Forest Department of Tamil Nadu under a sub-programme called VKC.

Table 8.12 Survey results on knowledge generation and sharing in Parangipettai Block

Sub-variables	**Quantitative**	**Qualitative**	
	Local people n=200	NGOs	Government authorities
The knowledge generation and sharing content and mechanism has been adequate	Strongly Disagree: 0% Disagree: 4,5% Neutral: 30.5% Agree: 53.5% Strongly Agree: 11.5%	Agree. - Information is usually shared in the VMC and VKC meetings as well as village knowledge centre.	Agree. - Information related to the programme will tbe given during a meeting with VMC and VKC

Source: Fieldwork Survey, 2017

The survey results reveal that more than half of the local respondents agree that knowledge generation and sharing is adequate through the VKC; this conclusion is confirmed through in-depth interviews with members of the MSSRF team as well as government authorities (see Table 8.12).

Table 8.13 Survey results on learning in Parangipettai Block

Sub-variables	**Quantitative**	**Qualitative**	
	Local people n=200	NGOs	Government authorities
People have learned something together from the coastal protection programme	Strongly Disagree: 0% Disagree: 3,0% Neutral: 14% Agree: 34,5% Strongly Agree: 48,5%	Agree. - We have learned from local people, government authorities, and members of Gram Panchayats about existing problems in the area (mangrove degradation, decreasing raw biological material such as fishery product).	Agree. - We have learned about participatory and research-based approaches to tackle the mangrove degradation problem.

Source: Fieldwork Survey, 2017

The survey conducted in 2017 shows that more than three-quarters of the local respondents agree that they have experienced learning through the programme. This situation is also confirmed by the NGOs and government authorities (see Table 8.13).

The learning process and outcome among actors in Parangipettai Block occurred in tandem with the knowledge generation and sharing process. Government authorities, MSSRF staff, and members of research and academic institutions learn to understand the problem of coastal risk, the cause of mangrove degradation from the local people as well as the pollution from local industry. However, to restore the mangrove ecosystem, back to a healthy status, there is a common learning process among different actors. For local people, the learning they experienced is related to the causes of degradation, the benefits of mangroves, innovative techniques to plant them, and the practice of silvo-fishery farming (H1, H2, and I3). Meanwhile, the NGO representatives appreciate that local people have given their knowledge on the existing condition of coastal erosion and flooding and pointed out how to do PRA effectively[12]. Furthermore, since the JMM projects are implemented in multiple sites (thus also in Odisha and Andhra Pradesh), the public, NGO officials, and relevant government authorities are able to learn from the challenges, opportunities, and achievements in other states. The participatory approach that was employed in JMM projects was also new for all stakeholders, who learned by doing.

I analyse the adaptiveness aspect in Pichavaram mangrove forest by looking at how the governance system adjusts to changes. The form of coping and adaptation at the institutional level has already been discussed in section 8.2.2.3. I concentrate here on how local people cope with (and hope to adapt to) current and future coastal disasters. Since in Parangipettai Block, perturbations generally come in the form of sudden disasters, such as tsunami and cyclones, the MSSRF has successfully raised awareness of local people on the current and future coastal disaster threats through its capacity building activities in its JMM programme (Gasana and Borobia, 2004). This arguably enhances the effectiveness of adaptation strategies (see Adger et al., 2009; Saleem Khan et al., 2014). According to my respondents, the implementation of JMM programme has helped local people to build livelihood adaptation strategies with sustainable fisheries and integrated mangrove fishery farming method (I1-I3). This can be counted as an example of coping as well as adaptation. However, what is unclear is how climate variability and change will affect its local community and how local pollution will affect local mangroves.

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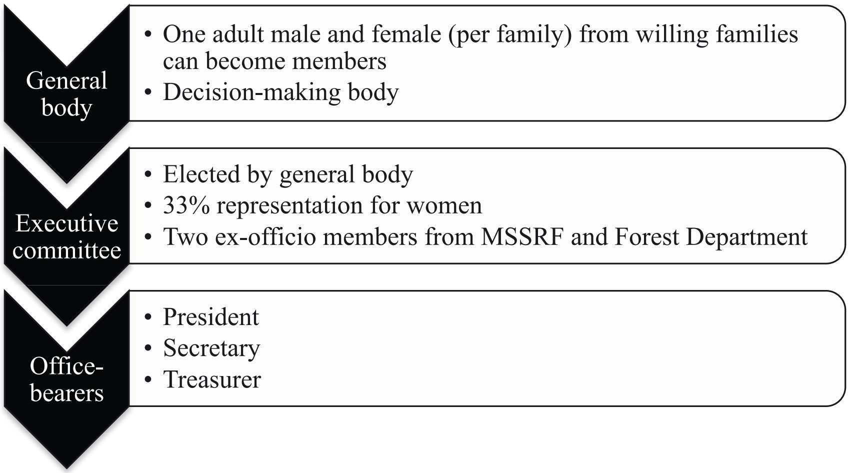
[12] The MSSRF in its 3rd publication series of Joint Mangrove Management in Tamil Nadu: Process, Experiences and Prospects- Part 3: Village Mangrove Councils (Selvam et al., 2004a: 15) are acknowledging challenges in forming community groups. They have been failed at least one time during the first initiatives to form Village Mangrove Councils in Vadakku Pichavaram. The challenges among others include: (1) Unclear mechanism to be adopted in forming village –level groups; (2) No formal application for membership was prepared; (3) No follow up process and (4) No clear-cut responsibilities

8.4.1.1 Representativeness

Representation is a way to include and bridge gaps between civil society and government. Representativeness is seen through the eyes of the local population represented in village-level institutions. The representations of governmental agencies therein are straightforward. The Forest Department of Tamil Nadu and NGOs are all represented in the VMC. The mechanism of representation of the local population takes place through a selection process conducted by the VMC members[13]. Only people who are the permanent residents of the village and people who are motivated and constantly express interest in helping with the programme can be included in the VMC (H1, H2, I1, I2). Figure 8.2 sketches the structure of the VMC in one of the three case study villages. This structure is apparently typical for all VMCs established in the context of JMM (H1, H2, I1, I2).

Figure 8.3 Structure of the Village Management Council (VMC) in MGR Nagar



Source: Modified from Selvam et al., 2004a.

Table 8.14 shows the result from a survey conducted regarding the representativeness mechanism. The survey results suggest that almost three-quarters of my respondents feel that the existing representation mechanism is fair and that they have equal opportunities and power to contribute and influence the JMM programme (see Table 8.14). There are still, however, some

[13] There have been eight VMCs established with total of 885 families as members. In total there are 675 Ha mangrove area has been restored and 2720 Ha mangroves area protected by the VMCs. Beside VMCs, there are 85 self-help groups have been formed with 815 members from eight villages (Selvam et al., 2004a)

local people who are not actively contributing to the programme. Respondents suggest that the number of non-participants is not significant (H1, H2, H3, I1, I2). Furthermore, there is still local politics involved, including the dominance of local leaders such as the gram panchayat.

Table 8.14 Survey results on representativeness in Parangipettai Block

Sub-variables	Quantitative	Qualitative	
	Local people n=200	NGOs	Government authorities
The representation mechanism for including local people is fair	Strongly Disagree: 0% Disagree: 0% Neutral: 17,0% Agree: 73,5% Strongly Agree: 9,5%	Strongly Agree. - Village meeting is done to measure and identify the interest of local people; - Influence of local politics exists, especially during the initial phase of group formation.	Agree. - We trust the quality of representation mechanism set up by MSSRF.
As individuals, people possess an adequate power to influence the process and outcome	Strongly Disagree: 0% Disagree: 0% Neutral: 14,0% Agree: 72,0% Strongly Agree: 14,0%	Agree. - There are still local community members who do not want to contribute to the programme.	Agree. - All people can join the JMM effort if they are motivated.

Source: Fieldwork survey, 2017

MSSRF staff members, however, acknowledge that during the initial phase of group and objective formulation, the influence of local politics existed (H1, H2, H3). To overcome this problem, the MSSRF team, together with the Forest Department staff were working together to approach the Gram Panchayat leaders in the area to gain their backing, as participation was considered very important to ensure the success of JMM programme (H1, H2, H3, H4, G2). Table 8.15 summarizes the GI assessment in Parangipettai Block.

Table 8.15 Summary of risks posed by governing interaction in Parangipettai Block

Steps		Variables	Properties	Condition
4. Assessment of governing interaction	4.a Quality of interaction	4.a.a Knowledge generation and distribution	Diversity	Knowledge is available on the role of mangrove to protect the coastal area and to leverage livelihood of people;
			Dynamics	Gaps: Science-based research on future trends of disaster and threats to ecosystems, as well as how they impact the case study region (i.e. subsidence, sea-level rise, future coastal development)

Table 8.11 *(continued)*

4. Assessment of governing interaction	4.b Enabling power relations	4.b.a Representativeness	Diversity	The establishment of VMCs and VKC in a democratic manner has increased the legitimacy of representations
			Dynamics	The acknowledgment of p rights of the tribal population in 2006 increased the legitimacy of their representation in decision-making;
	4c. Risk (Coping capacity/Governability)	Sudden-onset	Higher risk and lower governability due to: **1. Learning and adaptiveness** (+) Availability of information to mitigate the coastal risk; (+) Legitimate mechanism and scientific-based planting method and species selection; (+) Availability of an institutionalized learning platform; (+) High quality of representation. **Challenges** (-) Monitoring and updating knowledge and data resources to be able to adapt to future changes.	

Source: Author's analysis

8.5 Inferences

The problem of mangrove forest degradation and the linkage with local people's livelihood and welfare in Parangipettai Block has been addressed collectively by various stakeholders under one joint programme. The JMM programme, although largely funded by foreign donors, has been led by MSSRF as a domestic research-based NGO. MSSRF has been given the trust and delegated resources to provide direction to the programme by the Ministry of Environment and Forests, and is thus responsible for coordinating the effort among governing institutions. However, being a project-based approach, the challenge of the JMM programme is to ensure long-term conservation of the mangrove ecosystem and protection against future coastal disaster threats. Strategies for achieving coastal protection have changed over time and occur within the framework of governmental legislation as well as NGO activity. The totality of governing action has successfully solved a multi-dimensional problem, including restoration of mangrove forest, enhancement of livelihood and protection against coastal disasters. Some issues and factors affecting the governability of coastal risk have, however, also been identified in the governing system. Following the distinction of pathways (Chapter 4), they include:

1. *Coordination.* The governing system in the mangrove region of Parangipettai Block is diverse, but jointly coordinated; this enables the level of governability of the coastal erosion and flooding problem. Different types of governing actors at different levels jointly organized one coastal protection project, rehabilitated mangroves and increased the wellbeing of the mangrove-

dependent community. However, this mangrove risk reduction programme is not well integrated into the regular archives of the District Administration, which is a disabling factor.

2. *Goodness of fit.* There is a clear agreement on the root cause of the problem (especially regarding the degradation of mangroves) due to clear scientific evidence and the experience sourced from the local community. Still, knowledge is less certain in terms of data regarding the longer-term challenges of climate change (i.e. sea-level rise) and anthropogenic threats (i.e. land subsidence, pollution and erosion due to coastal development). The governance instruments related to coastal management that have been applied to the mangrove area complement each other to a large degree, which increases the goodness of fit with the action for applying an Eco-DRR approach to protect the area from coastal disaster and simultaneously improve the livelihoods of people.

3. *Responsiveness and social mobilisation.* The Eco-DRR project in Parangipettai Block has realized broad inclusion and participation of community members, where they are involved, almost in all project phases (planning, implementation and monitoring). Following the precepts of co-governance, greater inclusion of relevant stakeholders as well as a better social mobilisation strategy has been the essential element of the success of this programme and a key enabler.

4. *Learning and adaptiveness.* The quality of governing interactions, including the learning, and adaptiveness process are anchored in the implementation and monitoring of the JMM programme. The JMM programme, through the establishment of VMC and VKC, has provided an appropriate, inclusive mechanism and thereby enabled governability. Local people, NGO staff, and government authorities represented by forest officers are being involved. Although funding came from international funders, planning and implementation are fully executed by the MSSRF, which increases the legitimacy and sovereignty of such a project. Finally, the structure for the representation of stakeholders, including local inhabitants, in the VMC, has been designed with the goal of fairness in mind. This is an enabling factor for governability. However, there is evidence of powerplay and dominance by local elites, which potentially plays a disabling role.

CHAPTER 9

Comparative analysis

Chapter 9 : Comparative analysis

9.1. Introduction

This chapter compares the case studies of Demak District, Indonesia, and Parangipettai Block, India. The analysis aims to generate lessons from the two case studies using the governability assessment framework (see 3.4 and 4.3). It focuses on identifying the problem (see 5.2 and 7.2), characteristics of SG (see 5.3, 5.4, 7.3, 7.4) and GS (see chapter 6 and chapter 8). It also highlights the potential governing pathways including coordination, goodness of fit, social mobilisation, learning and adaptiveness (see also 3.4.2). The main question is: How can governing pathways increase the governability of coastal disaster risk? The sub-questions include: (1) What are the case-specific and general nature of the problem and the characteristics of the SG, which are affecting governability of disaster risk in Indonesia and India (see 9.2.2)?; (2) What are the case-specific and general problems of the GS, which are affecting governability of disaster risk in Indonesia and India (see 9.3)?; and (3) What are the case-specific and general problems of the GI, which are affecting governability of disaster risk in Indonesia and India (see 9.4)?

9.2 The nature of the problem and system-to-be-governed

Similar to the structure of the previous case study chapters (Chapter 5, 6,7 and 8), the nature of the problem (see 9.2.1), and the natural (see 9.2.2.1) and social SGs (see 9.2.2.2) will be discussed in this sub-section.

9.2.1 The nature of the problem

Demak District. The problems in Demak, Indonesia happening since the 1990s, are creeping land erosion and flooding. These problems are caused by changing patterns and intensity of waves, groundwater extraction and land subsidence, sea-level rise, mangrove cutting and land conversion (Marfai and King, 2008; Marfai, 2012; Winterwerp et al., 2014). Erosion resulted in damage to infrastructures and livelihoods. While governing actors agree upon the problem, there is disagreement on the root cause of the problems due to a lack of precise scientific data and information. In addition, erosion and flooding in Demak can be classified as a continuous threat, or a creeping or slow-onset disaster. Such problems require continuous and coordinated efforts among governing actors.

Table 9.1 Comparison of the nature of the problem

Variables	Demak District, Indonesia	Parangipettai Block, India
1.a Identification of problem	There is common agreement by policymakers, scientists, communities and the private sector on the problem of coastal erosion and flooding in Demak District.	There is agreement among policymakers, scientists, communities, and private sector on the problem of coastal risks.
1.b Embeddedness of the problem	Coastal erosion and flooding is believed to be a symptom of bigger problems occurring in the region due to the short-term (i.e. mangrove cutting) and long-term process.	The causes of mangrove degradation and the short-term coastal disaster threats and how they can be scientifically and politically tackled. The mangrove degradation problem that occurred previously is believed to have local rather than regional causes. Furthermore, in terms of the risk of coastal disasters (i.e. tsunami and cyclones), it is understood as a result of natural and social factors, which therefore requires an integrated, regional approach to ensure sustainability.
1.c Impact	Although the governing actors aim to produce concrete solutions with past and on-going projects, coastal erosion and flooding are still occurring up to present, inundating houses, reducing livelihood quality and contributing to out-migration.	Mangrove degradation has initially impacted the quality of livelihood of local inhabitants; the conservation efforts that took place afterwards, however, resulted in more prosperity (i.e. increasing productivity of fish, prawn, and other ecosystems) as well as reducing the risk and exposure to disasters.

Source: Author

Parangipettai Block. The problem in Parangipettai Block is coastal risk initially focused on mangrove forest degradation due to unscientific, coupe-felling. This problem is believed to be locally induced. The governing actors have agreed on the root cause of the problem, and also on the need to rehabilitate mangrove coverage. The Indian Ocean tsunami of 2004 led the focus on coastal protection. The existence of healthy mangrove forests was expected to reduce the impact of tsunamis and cyclones – which are of a sudden and high impact disaster type - in the area. Although scientists and some policymakers are aware of the long-term risks associated with climate change, these have not promoted public awareness. The Coastal Regulation Zone Notification (2011), however, partly anticipates the effects of climate change by shifting habitations 500 meters from the shoreline. However, to ensure sustainable disaster risk reduction effort using the help of mangroves, an integrated approach was felt to be required.

General features. Both case studies show that mangrove conservation and rehabilitation was selected to reduce disaster risk and leverage livelihoods. However, in order to effectively function to reduce coastal disaster risk for creeping and sudden disaster, conservation of existing mangroves was argued to be the first priority. Mangroves should be in healthy condition to function as a bio-shield and provide other ecosystem services (i.e. supporting and provisioning services). In addition, governing actors realized that there is a need for a science-based effort to identify the root causes of problems, and thereupon to formulate integrated and sustainable policies for disaster risk reduction (see Table 9.1).

9.2.2 System to-be-governed

9.2.2.1 Physical

Geomorphology, climate, oceanography and soil condition

Table 9.2 Comparison of the physical condition

Variables	Demak District, Indonesia	Parangipettai Block, India
Length of the coastal area of the case study	19.7 km*	17.6 km*
Geomorphology/ landform	Mud-flat beaches, estuaries and mangroves.	Beaches, barrier dunes, estuaries, tidal and mud flats, and mangroves.
Elevation	0-5 meter above sea level (Subardjo, 2004).	0.5 to 4 meter above sea level (Selvam et al., 2002).
Sea-level rise	Great variation of data, 0.5 cm to 8.3 cm per year (Marfai, 2014: 112; Utami et al., 2017: 285)	0.13 to 0.32 mm per year (Khan et al., 2012; Dastgheib and Ranasinghe, 2014)
Projection on sea-level rise	1,949 ha area in Demak will be inundated in 2030 (Suroso and Firman, 2018).	2,403 ha area in Pichavaram will be inundated in 2100 (Khan et al., 2012)
Erosion	5 - 50 m per year (Winterwerp et al., 2014)	Less than 5 m per year (Saxena et al. 2013a)
Land subsidence**	2.77 - 3.05 cm per year (Yuwono et al., 2018).	0.34 mm per year (Khan et al., 2012; Dastgheib and Ranasinghe, 2014).
Climate	1976 mm annual rainfall (BPS, 2016)	1310 mm annual rainfall (Selvam et al., 2003a: 794)
Oceanography	Tide is semi-diurnal and varies in amplitude by 60-120 cm in different seasons (BPS, 2016).	Tide is semi-diurnal and varies in amplitude by 15-100 cm in different seasons (Khan et al., 2016; Kathiresan, 2000).
Soil	Sandy silt loam, low permeability (Subardjo, 2004).	Clayey and contains minerals, low permeability (Selvam et al., 2002).
Infrastructure*	Sea-wall and reclamation of coastal area contributing to higher erosion rate.	Currently no direct implication of sea-wall or coastal infrastructures in Parangipettai, however, it can be a potential challenge in the future especially in terms of pollution from industrial areas nearby Parangipettai.
Risk (Hazard), short and long-term	High	Medium
Current governability	Lower governability	Higher governability

* Author's shoreline measurement from google earth, 2016

** Combination of physical factor exacerbated by anthropogenic process

Demak. Demak District is located in the northern part of the Java coast. Natural threats include a higher level of sea-level rise, the rate of land subsidence, the rate of erosion per year and potential of the inundated area. This is higher in intensity than in Parangipettai Block (see Table 9.2). Demak District has higher rainfall, which is possibly suitable for mangroves. However, tide amplitude and high waves could undermine the capacity for mangroves to grow. New coastal infrastructure along the coast is recognized as contributing to a higher erosion rate in Demak District. Aforementioned characteristics are contributing to the more dynamic and higher rates of coastal risk which potentially lower the level of governability.

Parangipettai. Similar to Demak District, Parangipettai Block is located on a flat landscape, but with a higher variation of elevation than Demak. Furthermore, sea-level rise, erosion rates, and land subsidence are also much lower than Demak. This indicates that generally, the coast in Parangipettai Block is more stable than Demak, although the risk of tsunamis and cyclones is higher than in Demak. Furthermore, there is no evidence that coastal infrastructures presently available in the area around Parangipettai Block are contributing to the demise of mangroves and thereby to a higher risk of coastal disaster. However, the existence and development of aquaculture an industrial area nearby Parangipettai Block could form a threat in the future, especially regarding the impact of pollution on the health of coastal ecosystems, including mangroves.

General features. Both Demak and Parangipettai have similar coastal geomorphologies. Mangroves grow very well in Parangipettai, meaning that the physical characteristics are currently stable and appropriate. However, since the external physical threats in Demak are larger (i.e. land-subsidence, sea-level rise and erosion rate), and from the challenges posed by the characteristics of the SG, it can be assumed that Parangipettai Block to be currently more governable than Demak, although sea level rise appears not to have been factored into the discussions as much as in Demak.

Biodiversity

Demak. In terms of biodiversity, in Demak, mangroves cover a smaller area than in Parangipettai (see Table 9.1). Furthermore, the number of mangrove species in Demak is limited to three species, all of which are known to attenuate wave action. Faturrohmah and Marjuki (2017) suggest that in 2012, 14% of the mangrove area could be considered degraded. The main cause of mangrove degradation in Demak is conversion to aquaculture activities. Overall, Demak is more vulnerable due to a smaller number of species and limited coverage of the coastal zone.

Parangipettai. There is 941 ha of mangrove forest in Pichavaram mangrove forest, which is home to 13 species. Degradation affects 5-10% of the mangrove area; it is attributed largely to the effects of the Indian Ocean tsunami (DasGupta and Shaw, 2013). It can be concluded that the general status of mangrove in the case study area in India is healthier than in the Indonesian case study area. This implies a higher governability of coastal risk in Parangipettai.

Table 9.3 Comparison of the biodiversity

Variables	**Demak District, Indonesia**	**Parangipettai Block, India**
Number of species	3 (Magdalena et al., 2015)	13 (Selvam, 2002)
Total mangrove area	254 ha (Faturrohmah and Marjuki, 2017)	941 ha (Gnanappazham and Selvam, 2011)
Percentage of degraded mangrove area	14% in 2012 (Faturrohmah and Marjuki, 2017)	5-10% in 2004 (DasGupta and Shaw, 2013)
The main reason of degradation	Land use conversion, erosion, and destruction by wave action	Coupe-felling resulting in salinization; tsunami
Health	High	Medium
Risk (Vulnerability)	High	Medium
Governability	Lower governability	Higher governability

Source: Author's analysis from secondary data

General features. Both case studies suggest that the mangrove ecosystem plays a role as bio-shield. They both possess mangrove species which are useful to attenuate wave action. However, the analysis demonstrates that the more complete the coverage of mangroves, the more mangrove species are available, the lesser the degree of mangrove degradation, protection is enhanced. Again, this shows that mangrove ecosystem conservation is essential in the effort to reduce disaster risk.

9.2.2.2 Social Characteristics

Demography, settlement distribution, and occupational transition

Demak. The analysis of demographic figures shows that the population density in Demak is higher than in Parangipettai Block. In 2014, the population in Demak was above one million, which is forty times as much as in Parangipettai Block. Some settlements close to the coast have already been moved inland because of flooding and erosion. Remaining settlements are highly dependent on the protection of mangroves as a barrier. In terms of occupation, there is less diversity of occupations in Indonesia with lower dependence on mangroves. Most people are working as traders, fishers, laborers and fish pond owners. Occupational transitions are more dramatic in Demak than in Parangipettai due to the incidence of erosion and the submersion of lands and ponds. Occupational transition as an adaptation strategy to new opportunities in the city too is occurring (see Table 9.5). Based on the analysis, it can be concluded that the higher the risk of disaster, the more chance there is of population movement.

Table 9.4 Comparison of demography and settlement distribution

Variables	Demak District, Indonesia	Parangipettai Block, India
Population	1,106,000 (BPS, 2016)	25,541 (Cuddalore District Census Handbook, 2011)
Density	1,318 people per km^2 (BPS, 2016)	140 people per km^2 (Cuddalore District Census Handbook, 2011)
Settlement distribution	Clustered along the river and sheltered by mangroves.	Clustered in hamlets according to caste and type of livelihood.
Out-migration	High	Medium
Current risk (Vulnerability)	High	Medium
Governability	Medium	High

Source: Author's analysis from secondary data

Table 9.5 Comparison of occupational status

Variables	Demak District, Indonesia	Parangipettai Block, India
Type of occupations	Traders, fishers, laborers, fish pond owners.	Traditional and non-traditional fishers, agriculture, livestock holding.
Level of dependency on mangrove for livelihood	Medium	High
The occurrence of transition/level	Yes/High	Yes/Medium
Risk (Vulnerability)	High	Medium
Governability	Lower governability	Higher governability

Source: Author's analysis from focus group discussion and interview

Parangipettai. Compared to Demak, there are less people exposed to disaster in Parangipettai (see Table 9.4). Furthermore, my analysis shows that local people in the surroundings and the mangrove forest reside in safer environments with lesser exposure to coastal threats and are protected by healthier mangrove forests. They live in clustered hamlets, with differences in occupational specializations (i.e. fishers and farmers). The diversity of occupations in Parangipettai is higher than in Demak. Local people are also more dependent on mangrove forests as mangroves have provided them with sufficient livelihood support. Although general knowledge on rural-urban migration trends in Tamil Nadu is available, there is a lack of information on this topic with regard to the population of Parangipettai Block, and on the possible relation with coastal disaster risk or lack of livelihoods. However, my research suggests that occupational transitions and migration are limited. This is presumably because of the successful mangrove management and livelihood improvement programme carried out through the JMM programme.

General features. Migration is a usual phenomenon, linked to the adaptation strategies of local people when facing disaster or livelihood disruptions. My case studies suggest that there is a correlation between creeping disaster and occupational transition. Sudden disasters like tsunamis and cyclones seem to be associated with temporary displacement. To increase the effectiveness of mangroves for reducing risk, livelihood development in mangrove-based conservation or Eco-DRR programme should be considered as an essential element in order to reduce social and economic vulnerability of people and to enable social mobilisation.

9.2.2.3 Community responses to coastal disaster

Table 9.6 Comparison of the community responses

Variables	Demak District, Indonesia	Parangipettai Block, India
Type of measures	Infrastructural: elevating houses, fixing roads; Other: planting mangrove and constructing the hybrid structure, occupation transition, migration.	Other: Planting mangrove, participating in livelihood training.
Consideration of future threat	High	Medium
Risk (Coping capacity)	High	Medium
Governability	Lower governability	Higher governability

Source: Author's analysis

Demak. The continuous process of erosion and flooding have caused stress among local people and led its coping and adaptation efforts. These include infrastructural as well as other measures. The structural measures include elevating houses and fixing roads, while other measures include occupation transition, migration and also planting mangroves (see Table 9.6).

Parangipettai. The degradation of mangroves in Parangipettai Block has impacted the livelihoods of inhabitants. Participation in the JMM programme was one of the only options available. Activities in this programme include the establishment of VMC, conservation of mangroves, and livelihood training. This programme can be argued to have increased communities' coping capacity.

General features. The communities in both case study regions are making use of infrastructural and other measures to respond to environmental degradation and coastal disaster risk. The local communities of Demak, which are currently undergoing more complex disaster-related problems, has also undertaken more types of measures (see 9.2.2). However, my analysis shows that local responses are still limited, and probably inadequate to deal with the much more serious future threats of sea-level rise.

9.2.3 *Summary of the nature of the problem, system-to-be-governed comparison*, risk profile, and governability

Table 9.7 Comparison of the level of risk and governability in SGs

Variables	Demak District, Indonesia	Parangipettai Block, India
Nature of the problem (Short term)	High	Medium
Physical condition	High	Medium
Biodiversity	High	Medium
Social characteristics	High	Medium
Risk	High	Medium
Governability (Coping capacity)	Lower governability	Higher governability

Source: Author's analysis

Demak District. My analysis of the nature of the problem and the characteristics of the SG (natural and social sub-systems) suggests that Demak has a lower level of governability. This is caused by a range of factors (see Table 9.7) that directly affect the level of risk in the coastal area. These include: (1) the incidence of slow-onset erosion. Although "creeping" in terms of frequency and intensity, the rate of erosion (up to 50 m per year), land subsidence (2.77-3.05 per year) and sea-level rise (0.5-8.294 cm per year) is actually fast-onset; (2) Demak has a larger coastal population and more exposed settlements; (3) There is a higher level of vulnerability due to unstable livelihoods and the relatively high levels of out-migration.

Parangipettai Block. The nature of the problem and the characteristics of the SG (natural and social sub-systems) in Parangipettai Block shows lower risk and higher levels of governability than in Demak District, at least in the short-term, is caused by several factors, including: (1) the risk of creeping, but of sudden or fast-onset disaster forms. There is a lower intensity of sea-level rise (0.13 to 0.32 mm per year), land subsidence (0.34 mm per year), and erosion (less than 5 m per year); (2) There is less exposure due to the smaller number of people living in the coastal area; (3) more stable patterns livelihood; and (4) existence of an effective mangrove shelter. The incentives to engage is mangrove-based disaster risk reduction efforts are therefore larger than in Demak District.

9.3 Governing efforts and governing system

This sub-section makes a comparison of governing efforts (see 9.3.1) and of governing systems (9.3.2). This sub-section also provides the comparison of GS quality (see 9.3.3), and finally presented the linkage between SG, GS, and potential governing actions/pathways (see 9.4). Like previous sections, it will start with the case-study specific comparison that is followed by general prepositions.

9.3.1 *Governing efforts*

Demak District. The various *in-situ* and *ex-situ* problems which are contributing to the erosion and flooding situation in Demak has led to fragmented governing efforts. The three most vulnerable villages in Demak host projects initiated by different governing actors (See 9.3.2.1 for details a). The most recent and significant DRR effort has been conducted by the Ecoshape and Wetlands International consortium, in collaboration with the Indonesian government (see 6.2).

Parangipettai Block. Government-supported JMM programme started in 1997 and is the only large-scale programme conducted in Pichavaram mangrove forest (see 8.3.1). The JMM programme has undertaken research and participatory rural appraisal in order to diagnose the characteristics of the coastal system. This was followed by a programme to institutionalize local communities' engagement in mangrove conservation (see 8.2). The project in Parangipettai Block was more centralized in terms of funding for the project, which was managed through the central government.

General features. It can be concluded that the two case studies incorporate project-based approaches to implement Eco-DRR. More unified and coordinated efforts are believed to lead to more successful outcomes (see 9.3.2.1).

9.3.2 *Governing system*

9.3.2.1 Actors and issues of coordination

Table 9.8 Comparison of the diversity of actors and the coordination mechanism

Variables	Demak District, Indonesia	Parangipettai Block, India
Number of actors/agencies involved	High	Medium
Number of actors/agencies in leading position	High	Medium
Availability of coordination mechanism/singular/multiple	Available/multiple	Available/singular
Current level of risk	High	Medium
Governability	Lower governability	Higher governability

Source: Author's analysis

Demak District. There are many actors involved in the efforts to govern coastal disaster risk in Demak. My research demonstrates that, in total, there are at least 29 governing actors at different levels involved with the topic of coastal management, disaster risk reduction, and ecosystem-based adaptation (see Table 9.8). At the national level, two ministries are currently involved in the recent BwN project. At the district level, three different agencies are involved, and at the sub-district and local levels, the offices of the sub-district, villages, and hamlets are involved. Vertical relations between governing actors are patterned on the typical hierarchical government structure, whereby the national government provides plans and direction to be executed at the sub-national levels. Meanwhile, horizontal relations between government agencies, NGOs and civil society are structured through the coordination mechanism in the form of a working group for mangrove management. However, my research shows that this working group is not yet functioning effectively. Coordination is also reflected in current project initiatives, such as the BwN project, where the government, NGOs and civil society are taking part. Such projects create other opportunities for structured exchange. Overall, the higher number of actors makes the Indonesian case study less governable, as it has to accommodate different interests, goals, and actions, and because the finance is channeled via NGOs.

Parangipettai Block. The number of actors involved in coastal protection in Parangipettai is smaller than in Demak. Field observations demonstrate that four actors are involved directly in the JMM programme, whereas at least 20 agencies ranging from national, state and local levels are involved indirectly. Similar to the Indonesian case, vertical relations characterize the government and run from the national to the state, district and Gram Panchayat levels. Horizontal interactions occur within the JMM programme and its coordination mechanism, where the MoEF, Forest Department, MSSRF, and local community units are regularly taking part.

General features. Both case studies have diverse governing actors involved in the realm of coastal disaster risk reduction. However, it can be concluded that the coordination mechanism of JMM in Parangipettai is more effective than the more dispersed mechanism found in Demak.

9.3.2.2 Goodness of fit

Table 9.9 Comparison of Goodness of fit of images and problem

Variables	**Demak District, Indonesia**	**Parangipettai Block, India**
Matching of problem and goals	Medium	High
Law instruments	Medium	High
Current Risk	High	Medium
Current governability	Lower governability	Higher governability

Source: Author's analysis

Demak. The lack of agreement of the root cause of flooding in Indonesia has resulted in a lack of fit between objectives and problem characteristics. The larger the number of actors, the bigger the challenges for matching of problems and goals. Each of the governing actors makes use of different multi-level policy instruments. In terms of themes, the issue of coastal management, disaster risk reduction, and ecosystem-based adaptation are regulated through different instruments. Although already coherent, there are still some contradictions (i.e. regarding the issue of livelihood enhancement, coastal development and the impact on erosion and flooding), which makes it difficult to prioritize and also to implement plans at the local level. The lack of goodness of fit has made Demak less governable (see Table 9.9).

Parangipettai Block. In comparison to Demak, the cause of mangrove degradation has been clearly identified and agreed upon by all governing actors in Parangipettai Block. EbA and DRR responses have been gathered in the CRZ Notification 2011, although challenges at the implementation level remain. However, there are future threats of environmental pollution and negative impacts of the expansion of aquaculture which are still to be properly anticipated and addressed by the governing actors, as are the long-term risks of climate change.

General features

In general, based on the synthesis from the two countries, the aspect of goodness of fit is impacted by the way problems and goals are framed and understood by different actors. Common understandings of the problem and its root causes will potentially lead to a more appropriate division of roles and responsibilities. Furthermore, regarding the policy instrument, the existence of national law or regulation that explicitly referr to an ecosystem-based approach is needed to ensure adequate implementation at lower levels. Most importantly, laws and regulations should complement and not contradict each other.

9.3.2.3 Governance modes, responsiveness, inclusiveness and issue of social mobilisation

Table 9.10 Comparison of governance modes, responsiveness, and social mobilisation

Variables	Demak District, Indonesia	Parangipettai Block, India
Dominant type of governance mode	Hierarchical to co-governance	Co-governance to self-governance
Responsiveness	Medium	High
Inclusiveness	Medium	High
Current risk	High	Medium
Current governability	Lower governability	Higher governability

Source: Author's analysis

Demak District. Despite the mixture of all types of governance modes in daily affairs, it is clear that the dominant type of governance lies in the range of hierarchical to co-governance modes (see Table 9.10). The national government still possesses the highest authority to decide priorities and select initiatives, networks and partners. In terms of implementation, the OISCA and BwN projects rely strongly on cooperation between governmental authorities, NGOs and local communities. However, responsiveness asks how dominant governing actors, which in this case, are government authorities, are responding to the inquiries of the people. This relates to the issue of inclusiveness. My research in Demak shows that there is a lack of meaningful inclusion in the phases of planning, monitoring, and evaluation; this has a negative effect on governability. Despite these weaknesses, there is potential to strengthen the co-governance mode and thereby to enable social mobilisation (see also 9.2.3.1). To improve governability in Demak, several actions can be taken, including reactivation of the Regional Working Group on Mangrove Management as a platform for coordination. The BwN project – which is a public private partnership initiative - can be upscaled as an opportunity for meaningful and inclusive interaction, which could enhance learning and adaptive capacity of governing actors, both individually and as a collective. My hypothesis is that EbA can be only achieved when there is sufficient social mobilisation to share resources, especially in social capital and sustainable finance and investment. This is important to maintain the mangroves quality and its services to protect the coastal area. However, it can only be realized if governing actors are responsive and foster inclusiveness in the governing process and there is sustainable finance available.

Parangipettai Block. In the case of Parangipettai, although the national government through MoEF plays a leading role, the JMM programme has been completely managed by MSSRF, the Forest Department of Tamil Nadu and the local communities, through what is known as the VMC. Collaboration is therefore the core of the programme. Furthermore, the self-governance mode is strongly reflected through the operation of VMC, which is mainly managed by the local committee. However, there is still concern about how to ensure sustainable funding and investment in the post-project implementation.

General features. The conclusion of this research is that co-governance and self-governance modes are probably more appropriate for effective Eco-DRR, although a directive role of government is required. These modes have more potential to facilitate inclusive and responsive governance thereby increasing social mobilisation, which is crucial for effective Eco-DRR (see 3.4.2). However, the project form of management raises concerns about the longer-term sustainability of Eco-DRR activities, which can only be handled under government supervision.

9.3.3 Summary of GS comparison, risk profile, and governability

Table 9.11 Comparison of the quality of the governing system in relation to risk and governability

Variables	Demak District, Indonesia	Parangipettai Block, India
Governing actors	Medium	High
Goodness of fit	Medium	High
Governance modes, responsiveness, inclusiveness, and social mobilisation	Medium	High
Current risk	Medium	High
Current governability	Lower governability	Higher governability

Source: Author's analysis

Demak District. The study demonstrates that Demak currently has higher risk and lower governability due to: (1) lack of an effective and sustainable coordination mechanism; (2) lack of sufficient evidence-base for informing policy, especially to deal with future threats; (3) ambiguity in legal instruments regarding the matters of disaster risk reduction, environmental protection and coastal management multi-level law instruments; (4) fragmented project-based actions in the mangrove-based ecosystem approach; and (5) lower responsiveness of co- and self-governance modes. However, there are opportunities for improving the governability of DRR in Demak. Strong features of the current situation are the existence of community mangrove groups, possessing awareness to conserve mangroves, and the current PPP mechanism, which could contribute to better coordination (See Table 9.11).

Parangipettai Block. In Parangipettai Block, there is lower risk and higher governability due to several factors including: (1) a clear and effective coordination mechanism led by a national research-based NGO with full support from MoEF of India and foreign funding channeled through the ministry; (2) strong support of evidence-based science in identifying the causes of and solution to the problems; (3) centralized and aligned government policy under CRZ 2011; (4) a well-integrated project gathering governing actors in a joint mangrove management programme; and (5) higher participation and inclusion of local stakeholders at all levels. However, challenges remain, especially with regard to being able to continuously address the problem of future climate-change-related threats.

9.3.4 GOVERNING INTERACTIONS AND POWER RELATIONS

9.3.4.1 Knowledge generation and sharing, representativeness, learning and adaptiveness

Table 9.12 Comparison of quality of knowledge generation and sharing, and learning and adaptiveness

Variables	Demak District, Indonesia	Parangipettai Block, India
Quality of knowledge generation and sharing	High	High
Representativeness	Medium	High
Current risk	High	Medium
Current governability (Coping capacity)	Lower governability	Higher governability

Source: Author's analysis

Demak District. My research suggests that the type of knowledge generation and sharing in Demak has generally been sufficient, especially in relation to the short-term risk of coastal flooding and the need for increasing preparedness of the local community. However, Demak generally faces higher risk and lower governability due to: (1) Gaps in terms of science-based information such as on the effects of climate change, planting methods and species selection as well as on future trends and how these may impact the case study area. This includes the impact of coastal development and reclamation in Semarang, sea-level rise and groundwater extraction and depletion (see also 5.3.1.1, 6.4.1, 9.2.3 and Table 9.11); (2) The lack of an adequate mechanism for achieving fair representation of the local community in the governance process; and (3) Lack of an institutionalized learning platform (i.e. inactive regional coordination mechanism). However, the availability of information to mitigate coastal risk could still be further developed (see Table 9.12).

Parangipettai Block. The information shared in the context of Parangipettai concerns the role of mangroves in protecting the coastal area and leveraging the livelihoods of people in the short-term. Parangipettai has lower risk and higher governability due to: (1) Availability of information to mitigate coastal risk; (2) legitimate local governance mechanism and scientific-based planting method and species selection (i.e. through the establishment of Mangrove management unit); (3) Availability of an institutionalized learning platform (through the establishment of VMC and VKC); (4) More fair representation of communities in the governing process. However, the challenges remain, such as with regard to the updating of knowledge and data resources to be able to adapt to future changes. Similar to Demak, there is limited information on the external factors within the natural and social SG domain, which could potentially thwart the health of the mangrove forest (i.e. the pollution, tourism, and aquaculture practice) and reduce its function as a bio-shield.

General features. Knowledge generation and sharing is effective when appropriate information helps society in learning about and adapting to current and future threats. However, the distribution of information most of the time is limited. Information shared through representation mechanism and learning platform should ensure fair representation and inclusion of vulnerable communities.

9.4. Inferences

Based on the comparison of the two cases, four conclusions can be drawn:

1. Short-term disaster risk efforts in Demak District, Indonesia is less governable, as there are more governance challenges in all three domains (i.e. SG, GS and GI). These challenges include: (1) high intensity of slow-onset disaster caused by coastal erosion, land subsidence and sea-level rise which eventually causes worse environmental degradation and higher impacts on society; (2) Less coverage and less healthy mangroves to protect the area from erosion and coastal flooding and larger population; (3) Higher number of governing actors with a limited coordination function; (4) Lack of goodness of fit, especially with regard to images of problem, legal instruments and actions; (5) Lack of responsiveness of governing actors to mobilise society and share resources, especially in sustainable finance and investment; (6) Lack of sufficient evidence-based research, especially to generate knowledge on future risk; and (7) Limited representation and inclusion of communities in the governing process. However, strengths or opportunities, include (1) the existence of local community organizations to support Eco-DRR efforts; (2) Existence of public private partnerships, which serves as an opportunity to strengthen multi-stakeholder and multi-level coordination; and (3) Availability of knowledge regarding mangrove planting and conservation.

2. Short-term disaster risk efforts in Parangipettai Block, India is more governable as there are fewer challenges and more effective governance arrangements. Current challenges in all three domains (i.e. SG, GS, and GI) include: (1) High risk of sudden disasters, including tsunamis and cyclones; and (2) Lack of evidence-based research on projecting future risk. However, strengths and opportunities include: (1) Healthy and stable mangrove ecosystems which are able to protect a major part of the coastal area from high waves and cyclones, especially as it has a smaller population; (2) A centralized coordination mechanism, led by the national ministry (MoEF) which receives foreign funding and a committed research-based NGO as implementer of the programme; (3) Goodness of fit, reflected through synchronized images of problem, supported by a centralized and integrated coastal management law which supports jointly managed actions;

(4) A co-governance mechanism at the local level, which undertakes DRR activities and livelihood enhancement too, and is helpful in achieving social mobilisation; and (5) A democratic representation mechanism which is designed to include community members through VMCs. By enabling a democratic political process, it reduces a potential conflict and sharing information to increase adaptiveness and learning.

3. Coordination of governing actors at different levels is more important in the case of creeping or slow-onset disasters such as in Demak. DRR efforts in such instances require regular updates of information and data regarding current and future risk of disaster. An effective coordination mechanism can help improve the goodness of fit, social mobilisation, and learning and adaptiveness to anticipate and better prepare for future risks, but cannot deal with the lack of financial resources.

4. In sum, the high diversity and dynamics of natural and social sub-systems that make up SGs create a demand for: an evidence-based/science-based approach to inform policy; coordinated, interdisciplinary, integrated and transboundary management; adaptation strategies that are able to manage uncertainties (e.g. mitigation, ecosystem conservation); and effective learning processes. At the same time the dynamics and scale problem, which allows seeing a bigger problem in terms of the constellation of spaces and integration requires both short and long-term thinking and transboundary coordination.

CHAPTER 10

Conclusion

Chapter 10 : Conclusion

10.1 Introduction

This chapter answers the main research question: “What factors contribute to the success of coastal ecosystem-based disaster risk reduction (Eco-DRR)?” and its seven sub-questions that provided structure to the analysis. The literature review on governing Eco-DRR approach has been elaborated in Chapter 2, while the concepts of interactive governance and governability, and their operationalization, have been covered in Chapters 3 and 4. Furthermore, two empirical case studies of Demak, Indonesia and Parangipettai, India have been presented in Chapters 5, 6, 7 and 8 and comparative analysis in Chapter 9.

The main research question alludes to ‘pathways’ assisting in making mangrove-based disaster risk reduction approach successful. The analysis of two case study settings highlighted the manifold challenges that pertain in coastal protection, identifying issues that contribute both to failure but also to success. These issues are clustered into four pathways- namely coordination, the goodness of fit, social mobilization, and learning and adaptiveness - which were identified from existing literature review (see 3.4), then compared in the two case study sites (see Chapter 9), and finally translated into four sets of governing actions. The first section of the current chapter (see 10.2) provides an overview of the pathways contributing to the success of coastal Eco-DRR and has a focus on the current time period until 2030. The following section considers the lessons learned for governance to anticipate future climate change impacts (See 10.3). I subsequently turn to the contribution of this thesis to science, both theoretical and methodological (see 10.4). Section 10.5 concludes the thesis with the aim of providing general recommendations.

10.2 Factors and pathways for successful ecosystem-based approach

This section summarizes the outcome of the analysis, which was commenced upon in the previous chapter (see 9.4) and focused on the identification of problems, characteristics of SG, GS, and GI taking place within and between the systems. Figure 10.1 and Table 10.1 present the factors which are considered crucial to improving the governability of EbA efforts. I will conclude using four governance pathways (i.e. coordination, the goodness of fit, social mobilisation, learning and adaptiveness). The four pathways, although explained individually, should be considered together, as the quality of the factors together will affect the success of governing actions and the governability of the system.

Figure 10.1 Factors and Pathways contributing to successful and governable Eco-DRR/EbA

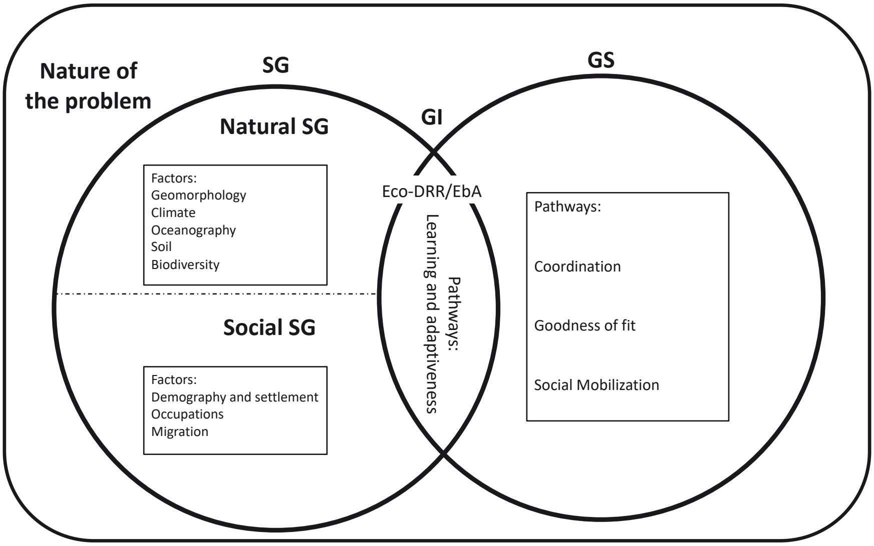


Table 10.1 Relation between pathways and sub-systems in an interactive governance perspective

Factors	Direct	Indirect
Coordination	GS: Diversity of actors.	Understanding the nature of the problem SG: size/scale; GI: Knowledge generation and sharing
Goodness of fit	GS: Diversity of actors.	Understanding of the nature of the problem SG: Fit of images, instruments, and actions; GI: Knowledge generation and sharing.
Social mobilisation	GS: Modes of governance; inclusiveness.	Understanding the nature of the problem SG: level of vulnerability of nature and social SG; GI: Knowledge generation and sharing; representativeness.
Learning and adaptiveness	GI: knowledge generation and sharing; representativeness.	Understanding the nature of the problem SG: Understanding the impact of the problem on the natural and social SG; GS: diversity of actors; modes of governance.

Source: Author

Table 10.2 Recommended pathways for improving governability

Pathways/Factors	Aspect	Nature of problem; **Geomorphology/climate/oceanography/soil/biodiversity; (N-SG); Demography and settlement/occupations/migration (S-SG)**
Coordination (GS)	*What*	Disaster risk reduction using mangrove DRR approaches that take the above factors into consideration.
	Who	Given the need for comprehensive protection of coasts, there is no other actor than the state that is capable of coordinating action in the long run. NGOs and business, however, can initiate and implement projects.
	How	Activate coordination platforms with clear membership and agenda, regular meetings, reports with action points, monitoring, evaluation, and funding. These platforms are also responsible for goodness of fit, social mobilisation and learning/adaptiveness (see below). Division of tasks (e.g. who is responsible for slow and for sudden disasters, and for environmental impact assessment of coastal development projects on mangrove systems).
Goodness of fit (GS)	*What*	Improving the coherence of images, goals, instruments (including institutions) and action, while prioritizing the removal of contradictions.
	Who	If policy coherence is to be achieved, a specified coordinating state agency is necessary, but can build upon suggestions and recommendations from other parties (civil society/business/science).
	How	Coordinator organizes open arenas for debating coherence and adequacy of approach; reaching out to actors in related fields for policy integration.
Social mobilisation (GS)	*What*	Improving effectiveness and efficiency of mangrove DRR approaches, as well as their legitimacy among coastal populations.
	Who	If mangroves are to be grown and maintained, the involvement of local populations is critical. This can be done through participation in decision-making and implementation, with livelihood sustenance being a factor of importance.
	How	Creating support for the policy approach, and short-term and long-term incentives for participation.
Learning/adaptiveness (GI)	*What*	Knowledge under conditions of uncertainty about the natural and societal causes of the problem, its impacts and the range of possible solutions, including knowledge about the contextual conditions under which mangrove ecosystems will be able to address sea level rise in the short- and long-term.
	Who	If iterative learning and adaptiveness is to be achieved, monitoring and evaluation has to take place, followed by a redesign of the governing system. Scholars can play a role in preventing ossification, while all governing actors take part.
	How	Preventing loss of institutional memory, the establishment of the data management system, public awareness and wide knowledge sharing; establishing formal linkages between academic, policy institutions and local communities.

Source: Author

10.2.1 Coordination

Coordination is a collective action of efforts among groups of individuals to achieve a common goal when individual self-interest would be inadequate to achieve the desired outcome (Ostrom 1990 and see 3.4.1). Coordination is originally mentioned as a potential "governing action" by Kooiman (2003: 72). Based on the analysis of the two case studies, it can be deduced that a higher diversity of actors may pose bigger challenges to the governability of Eco-DRR (see 9.3.2.1). A leadership (of institutions and individuals) that could facilitate effective coordination effort is crucial to anticipate the complexity caused by a higher diversity of actors. However, the quality of a GS is shaped by other factors than coordination too, as the GS constitutes a response towards the characteristic of the problem, as well as the challenges raised by the natural and social system to-be governed (see Figure 10.1 and Table 10.1). There is a dynamic interaction within and between the systems requiring assessments in relation to one another (see 3.2.2).

In terms of the 'nature of the problem', it is likely that a more dynamic and complex issue will require the involvement of diverse actors with other capabilities. For instance, the case in Demak is more dynamic in terms of its physical and social SG; it faces inter-scale and embedded problem, which requires careful handling with a strong inter-disciplinary involvement of diverse actors. Coordination between these actors is then important. Within the SG domain, there are several conditions that play a role in governability. There are three factors in the natural SG, which are driven by geomorphology, climate, oceanography, soil and biodiversity: (1) speed of disaster onset, (i.e. slow-onset, erosion lead to flooding that happened continuously, versus the sudden-onset, tsunami, and cyclones); (2) degree of disaster (i.e. higher degree versus lower degree of sea-level rise and land subsidence); and (3) quality of the available mangrove ecosystem (i.e. less healthy and uneven coverage and distributions versus healthy forest). Specific social SG factors which affect governability include: demography and settlement distributions (i.e. leapfrog settlement versus clustered), occupational diversity and transitions (stable jobs versus unstable jobs), as well as the rate of out-migration (high rate versus the low rate of out-migration). Finally, although coordination is mainly categorized in GS, it also has a strong element of GI. In terms of GI, coordination may enable adequate and fair distribution of knowledge generation and sharing thereby improving governability.

Furthermore, in a more general sense, Indonesia as a country needs to govern larger coastal length than India, where Demak is only one small (rural) area of and less of a priority compared to the urban coastal area. Indonesia faces huge challenges to govern its coastal regions. In the context of national coastal management, priority has to be made, especially to ensure the larger prosperity of community. Against this background, coordination is a crucial pathway which can improve the governability of Eco-DRR in Demak, Indonesia.

The coordination that would work, however, should be led by the state in the long run. NGOs and business, however, can initiate and implement projects. Actions include: (1) Activation of coordination platforms with clear membership and agenda, regular meetings, reports with action points, monitoring, evaluation and funding; and (2) Division of tasks (e.g. who is responsible for slow and for sudden disasters, and for environmental impact assessment of coastal development projects on mangrove systems). It should also be noted that more effective coordination triggers useful side effects for the other pathways/actions (i.e. goodness of fit, social mobilisation, learning, and adaptiveness) (see Table 10.2).

10.2.2 Goodness of fit

The goodness of fit is a match of images of problem, regulation, and action (see Kooiman et al., 2005, and Chapter 3). A coordinated effort will help to ensure appropriate prioritization of problems and the undertaking of disaster risk reduction issue in an integrated way. The goodness of fit is mainly discussed within the domain of GS (see Figure 10.1 and Table 10.1). The higher diversity of actors will generally produce more diverse images of problems, goals, instruments, and actions. Thus, there will be issues of ensuring goodness of fit among actors horizontally (at any one societal level) and vertically (between societal levels), for governing coastal disaster risk reduction (i.e. disaster management, coastal management, biodiversity, and conservation, etc.).

In terms of the 'nature of the problem', the more wicked and embedded it is, achieving goodness of fit will be more challenging as there is an absence or lack of common agreement among relevant stakeholder and an absence of stopping rules (see 5.2, 7.2 and Table 9.1). The goodness of fit could reduce the wickedness of the problem by facilitating consensus that can be accepted by the governing actors. The lack of appropriate goodness of fit in the Indonesian case study was explained by reference to the inadequate understanding of the problems and the SG at hand. When there is no understanding of what problem should be prioritized, for example, in regards to the contestation between the need of constructing waterfront protection infrastructure in the city of Semarang and the consequences of certain development to the rural area of Demak, it is difficult to expect an effective response from governing actors.

Finally, in terms of GI, an adequate presence and quality of knowledge generation and sharing is argued to be achieved with a good common understanding of the problem through evidence-based data. The relative absence of science as a tool to understand future threats will hamper efforts for Eco-DRR and climate change adaptation.

In order to improve the coherence of images, goals, instruments (including institutions) and action, priority for actions should be given to the removal of contradictions. A specified coordinating state agency is necessary but can build upon suggestions and recommendations from other parties (civil society, business, and science). This can be done by opening arenas for debating coherence and adequacy of approach; reaching out to actors in related fields for policy integration (see Table 10.2).

10.2.3 Social mobilisation

As a process by which individuals or sections of society mobilise in order to effect social change, I argue that social mobilisation is included within the domain of GS responsive governing modes and inclusiveness play an enabling role (see Table 10.1). The two case studies demonstrate that more collaboration (co-governance) effort among relevant actors and networks in governing the Eco-DRR helps to facilitate social mobilisation for mangrove planting and maintenance. This is shown in the case of India, where co-governance design is reflected through the Joint Mangrove Management and the establishment of Village Mangrove Councils (VMC) at the local level, which played a crucial role in achieving successful Eco-DRR and EbA.

Turning to the variables of 'the nature of the problem' and 'characteristics of the SG', it is clear that these contribute to the profile of disaster risk as well as the vulnerability of the local people. A sudden type of disaster tends to trigger more social mobilisation than a creeping type of disaster. This is shown in the case of Parangipettai Block. The Indian Ocean Tsunami in 2004 influenced the way people and other governing actors perceived the importance of conserving mangrove to increase protection against coastal disaster. Meanwhile, in Demak District, local people tend to accept the situation as the 'new normal' and daily adapt to the continuous erosion and flooding rather than mobilizing for long-term actions. In terms of GI, I argue that social mobilisation will be enabled by a learning process (see section 10.2.4) as it constructs the awareness of the people and other governing actors. Representativeness, on the other hand, generates a sense of ownership of the problem and togetherness in jointly working towards solutions.

The involvement of local populations is critical to improve the effectiveness and efficiency of mangrove DRR approaches, as well as their legitimacy among coastal populations. This can be done through participation in decision-making and implementation, with livelihood sustenance being a factor of importance. There is a need to create support for the policy approach, and short-term and long-term incentives for participation (see Table 10.2).

10.2.4 Learning and adaptiveness

Learning and adaptiveness is part of the realm of the '**Governing interaction**'. Learning can be defined as the collaborative or mutual development and sharing of knowledge by multiple stakeholders (both people and organizations) through learning-by-doing (see Armitage et al., 2009). Meanwhile, adaptiveness is defined as the capacity to adapt to change. Adequate and appropriate knowledge shared among governing actors was expected to accelerate the process of learning and thus help people to adapt better to existing and future disaster and climate risk. The Eco-DRR approach, which was selected as the main focus of this thesis is, in fact, is a product of learning and adaptiveness from the failure of hard infrastructure alone in reducing coastal disaster risk in, e.g., tropical estuaries. Against this background, I argue that Eco-DRR is a form of governing interaction (see Figure 10.1 and Table 10.1). Furthermore, the sources of learning can be divided into scientific and local or indigenous knowledge. Both types of knowledge construct an understanding of the nature of the problem and the SG in order to formulate a solution. In the context of Eco-DRR and EbA in general, crucial information to ensure learning and increase adaptiveness includes the value of the ecosystem to become part of the solution. Besides adequate information, the way information is shared also plays a key role. The case of Demak, Indonesia shows that knowledge availability could be an opportunity to further strengthen the mitigation effort using Eco-DRR. However, these knowledges are not shared adequately due to lack of fair representation. Meanwhile, in the case of Parangipettai Block, India, knowledge exists, however still lack of future consideration (i.e. environmental threats and impact of climate change). However, there is a better representation mechanism in sharing knowledge through VKC as a knowledge sharing platform.

For effective learning and adaptiveness to be achieved, information should also be fairly distributed and shared among people. Within the domain of GS**,** I argue that the quality of learning and adaptiveness of society to coastal disaster differs according to who is distributing such information. Integrated and co-knowledge generation and sharing (i.e. with emphasize on an integrated effort for learning, such as through a platform), tends to be more successful than fragmented ones (i.e. learning and co-knowledge generation through separate projects). The case of India reveals that the establishment of a Village Knowledge Centre (VKC) helped to distribute information in an integrated and fair manner. Again, coordination became crucial to ensure that knowledge generation and sharing, as well as the process of learning and adaptiveness are effective (see 3.4.2).

Knowledge under conditions of uncertainty about the natural and societal causes of the problem, its impacts and the range of possible solutions, including knowledge about the contextual conditions under which mangrove ecosystems will be able to address sea level rise in the short- and long-term. However, to ensure iterative learning which improves adaptiveness in the long-term, monitoring and evaluation has to take place, followed by a redesign of the governing system. Scholars can play a role in preventing ossification, while all governing actors take part. It is also very important to prevent the loss of institutional memory. There should be an establishment of a data management system, public awareness, and wide knowledge sharing, as well as formal linkages between academic, policy institutions and local communities (see Table 10.2).

10.3 Future scenarios

The four pathways to ensure successful Eco-DRR/EbA have been presented in the previous section. However, the remaining questions are, will mangrove ecosystems continue to be relevant in enabling biodiversity and providing supporting, regulating and provisioning services in the face of future climate change impacts, and given the growing land subsidence and coastal pollution? The incorporation of climate change adaptation perspectives is revisited in this section with the help of four development storylines with a perspective on the time period until 2080, as offered by IPCC's special report on emission scenarios (SRES) (see also 4.3.1.6).

Table 10.3 The SRES storylines

Storyline	Description
A1	-Very rapid economic growth; -Global population that peaks in mid-century and declines thereafter; -Rapid introduction of new and more efficient technologies; -Convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income; The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system; -Fossil intensive (A1FI); -Non-fossil energy sources (A1T), or; -Balance across all sources (A1B).
A2	-Very heterogeneous world. self-reliance and preservation of local identities are the underlying themes; -Fertility patterns across regions converge very slowly, resulting in continuously increasing global population; -Economic development is predominantly regionally oriented and per capita economic growth; - Fragmented and slower technological changes.
B1	-A convergent world with the same global population that peaks in mid-century and declines thereafter; -Rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies; -The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.
B2	-Emphasis is on local solutions to economic, social, and environmental sustainability; -Continuously increasing global population at a rate lower than A2; -Intermediate levels of economic development; -Less rapid and more diverse technological change than in the B1 and A1 storylines; -Emphasis on Environmental protection and social equity; -Focuses on local and regional levels.

Source: IPCC (2000)

Based on the SRES scenarios (see Table 10.3 and Table 10.4), the global population will continue to increase, especially under the A1 storyline. However, the storyline B1 shows the most stable population and GDP per capita. It also shows the lowest level of sea-level rise compared to 1990 as baseline year (22 cm in 2080).

Table 10.4 Global Socio-economic and sea-level rise scenario in the 2080s

Year	Storyline	Global Population (billions)	GDP per capita (Thousands US 1990 $)	Sea-level rise (cm)
1990	-	5.3	3.8	0
2080s	A1	7.9	52.6	34
	A2	14.2	13.0	28
	B1	7.9	36.6	22
	B2	10.2	20.0	25

Source: Nicholls and Tol (2006)

So, what is the utility of mangrove ecosystems under such different circumstances? Mangrove ecosystems obviously have a long history of successful adaptation in tropical estuaries to various dynamics of sea-level rise since the Holocene period (see Alongi, 2008). The coping capacity of mangroves is dependent on the sedimentation volume, input and space which could enable mangroves to accrete or move inland (see Alongi, 2008 and 2.3.2). Based on existing research, mangroves could adapt to rising sea-level up to 23-27 cm per 100 years (see Ross et al., 2000 and section 2.3.2) when it receives sufficient sedimentation load to move inland or towards the sea. This data is clearly varied based on different geographical characteristics, and there is still a lot of uncertainty and lack of understanding within the scientific world on the response of mangrove to sea-level rise and climate change impact. The current data on mangroves' ability to cope with a rising sea-level indicates that mangroves will possibly not survive in the medium and long-term, as the SLR projections are for 90 years (see Table 10.4). Given that even if all countries implement their Paris Agreement obligations, the global community is nowhere near stabilizing global temperatures at 2°C above pre-industrial levels – a key issue remains whether and under what conditions soft Eco-DRR can be an effective medium and long-term solution ni tropical and sub-tropical estuaries.

10.4 CONTRIBUTION TO SCIENCE

10.4.1 THEORETICAL ASPECT

This research advances theory in two ways.

First, this study broadens the application of interactive governance theory, which has been elaborated most with regard to capture fisheries, to the field of ecosystem-based disaster risk reduction. The field of Eco-DRR governance still lacks integrated assessment tools that combine both natural and social knowledge and can enable better policy design (see Chapter 2). I have applied interactive governance theory to Eco-DRR and tested the governability assessments framework developed by Chuenpagdee and Jentoft (2013) (see Chapter 3 and Chapter 4).

Second, this research has reduced the very extensive framework provided by Chuenpagdee and Jentoft (2013), narrowing it down to four pathways that play a role in improving governability. The process to produce pathways was inspired by the work of Kooiman to formulate potential action to increase governability (see Kooiman, 2003). Progress was made by refining, testing and analyzing through moving iteratively from theory to case study and vice versa, also making use of inputs from the discipline of human geography. At the same time, this research has added more detailed steps to operationalize the governability assessment framework. The additions include, (1) the analysis of the setting and context of the problem and hypothesis (step 1.1). The measures selected focus on the identification of the problem, its embeddedness, including the causes and the impact of the problem rather than indicators to assess the wickedness of the problem; analysis of the specific demands for governance based on the current characteristics of SG (step 2.1); (2) identification of the availability of governing system qualities and pathways to improve the governing system quality (Step 3.1); (3) identification of the availability of governing system qualities and pathways to improve the governing system quality (step 4.1) and (4) analysis of the relevance of governability assessment result with additional point of reference (e.g. global/local policy/findings on spatial and temporal aspect) (Step 6) (see Table 10.5).

Table 10.5 Expansion of governability assessment framework instruments[14]

Assessment step	Targets (Where to look)	Features (What to look for)	Measures (What to look at)
Step 1 Identifying the nature of the problem	Coastal disaster risk, the direct and indirect causes and the impact of the problem.		Identification of the problem; The embeddedness of the problem; The impact of the problem.
Step 1.1 The setting the context-building and hypothesis.			
Step 2 Examining system properties	Governing actors.	Identification of the governing actors;	Prevalence of system properties (i.e. diversity, dynamics, and scale);
	Natural system-to be governed.	Identification of relevant dependent variables (e.g. geomorphology, oceanography, climate, soil, biodiversity, etc.);	Prevalence of system properties (i.e. diversity, dynamics, and scale);
	Social system-to be governed.	Identification of relevant dependent variables (e.g. demography, occupational diversity and transition, migration, etc.).	Prevalence of system properties (i.e. diversity, dynamics, and scale).
Step 2.1 Identification of the implication/ needs for governance based on the demand from specific characteristics of system-to-be-governed.			
Step 3 Evaluating the governing system	Governing system.	4. Identification of governance elements (i.e. images, instruments, and actions);	Behaviour, decision mental models, institutional arrangements, implementation based on the prevalence of system properties (i.e. diversity, dynamics, and scale);
		5. Identification of governance modes (i.e. self-, co-, and hierarchical);	Awareness, learning, sensitivity, conflicts based on the prevalence of system properties (i.e. diversity, dynamics, and scale).
Step 3.1 Identification of risk and available governing system qualities and factors/pathways to improve the governing system quality (i.e. coordination, goodness of fit, social mobilisation and learning and adaptiveness),			
Step 4 Governing interactions analysis	Governing interactions.	7. Presence and quality of interactions	Knowledge generation and sharing, co-learning, adaptiveness based on prevalence of system properties (i.e. diversity, dynamics, and scale);
		8. Enabling and restrictive role of power relations	Inclusiveness, representativeness, participation based on prevalence of system properties (i.e. diversity, dynamics, and scale).
Step 4.1 Identification of risk and available governing system qualities and factors/pathways to improve the governing system quality (i.e. coordination, goodness of fit, social mobilisation and learning and adaptiveness).			
Step 5 Governability assessment: composite analysis of steps 1-4.			
Step 6 Analysis of the relevancy of governability with an additional point of reference (e.g. global/local policy/findings on spatial and temporal aspect).			

Source: Author

[14] The system properties of complexity and performance of orders are excluded

10.4.2 Methodological aspect

10.4.2.1 Methodological Strength

The governability assessment framework used in this research (Chuenpagdee and Jentoft, 2013) (see Table 4.1) has several strengths. First, it provided a set of structured steps for applying and assessing governability. Second, it provided a clear structure of outcomes, which made the identification of enabling and disabling factors of governability improvement easier (i.e., identification of problems; examination of system properties; characteristics of governing systems; characteristics of governing interactions; and governability assessments aggregates). Third, the methodological analysis allowed for disaggregation of problems into natural and social aspects. Fourth, the examination of governing systems and governing interactions also provides a clear map of structures within institutional settings, as well as socio-political analysis of interactions and behaviours among actors through their interaction. Finally, governability assessments as an aggregate of overall capacity and quality of each governability assessment factors has helped this research by providing a comprehensive and integrated natural, social, and political analysis which can be helpful to structure problem and formulating fit for purpose solutions.

10.4.2.2 Methodological reflections

There are two reflections on methodology. First, the Governability assessment framework is generally difficult to apply in its entirety as it is wide-ranging includes variables at a high level of abstraction (Song et al., 2018). It, therefore, tends to go beyond the capacities of any single researcher. I initially applied the framework proposed using all four steps (see Table 4.1). However, the result was an unclear storyline. I concluded that the governability assessment framework should be adjusted based on the research questions, the existence of data, and the degree of depth that one aims to achieve. In my case, I decided to focus on the elements of diversity and dynamics, leaving out complexity. Similarly, I was not able to pay systematic attention to the meta-governance order, focusing on first- and second-order governance. Furthermore, I did not investigate the financial constraint of the diverse actors in disaster risk management.

My application of the framework resulted in three specific recommendations:

1. Adjustment of questionnaires and instruments

There is a need to unfold and translate the concept of governability assessments to different questions for different methodologies. More specific tailored indicators have to be developed based on the variables defined or selected from the governability assessment framework. It is also important to explore ways of translating these indicators to survey and in-depth interview questions.

2. Adding weighed indicators of Step 1-4 for formulating governability assessments aggregates

The weighing process for prioritization of indicators needs further in-depth insight, using qualitative approaches such as ethnographic studies or FGD.

3. Adding multi-site, multi-disciplinary and long-term study for testing the governability assessment framework

Multi-site and multi-disciplinary studies would be helpful to test and validate the framework to assess the governability of Eco-DRR. Furthermore, there is a need to investigate the normative elements, including the aspect of meta-governance through a long-term study.

10.5 General conclusion

1. Mangroves as Eco-DRR measures will probably only be effective for the **problem** of low to moderate sudden and creeping type of disaster. In terms of **natural SG**, mangroves will probably be effective only in: (1) tropical and sub-tropical estuaries and the event of (2) a low and slow net sea level rise, taking into account subsidence rates; (3) when the mangroves and supporting ecosystems are healthy; and (4) there is detailed scientific knowledge. In terms of **social SG**, mangroves may only be effective when local people are able to engage in and maintain the mangroves, and there is strong public involvement, finance, and coordination (i.e. reflected from stable occupation and livelihood, secured neighbourhoods, and high social capital to support social mobilisation).

2. In terms of the **GS**, to govern Eco-DRR successfully, governing systems should: (1) resonate (match) the characteristics of risk (derived from characteristics of natural and social system-to-be-governed), goals and actions; (2) be sufficiently backed up by strong public involvement and effective co-governance modes; (3) be in line with regulations in relevant domains (biodiversity, coastal management, disaster management, etc.) from national to local level; (4) move from project-based to long-term, programmatic and systemic measures; and (5) involve a statutory

body led by a nodal government agency to ensure long-term results. However, there are major costs involved in Eco-DRR efforts. Foreign, project-based funding, such as in the two case studies, is generally not sustainable. More research is therefore needed on how to make the system viable and affordable for the national and sub-national governments.

3. In terms of **GI,** the mangrove-based approach as an Eco-DRR approach is expected to be effective in tropical and sub-tropical estuaries when: (1) there is sufficient science and knowledge (i.e. regarding risks and technical aspect for implementation) and (2) the information is distributed fairly to enable public learning to increase adaptiveness to coastal disaster. However, there is an urgent need for evidence-based knowledge to understand the problem, its causes and the formulation of solutions.

4. Based on the review of theory and case study analysis using the governability assessment framework, four pathways for the improvement of governability were investigated in this research. These pathways are not stand-alone and exclusive but rather interlinked with each other in ways that differ from one context to another. The pathways include: (1) Coordination. To handle the diversity of actors, coordination is needed. However several factors should be considered, including the (a) speed of disaster as the problem, (i.e. slow-onset erosion that happens continuously and requires continuous coordination effort) and (b) the embeddedness of the problem (i.e. inter-scale problem requires a strong inter-disciplinary involvement of the diverse actors); (c) Size of the region and its variated characteristics and solution approaches; (d) Priority (i.e. in the context of national coastal management, Eco-DRR (and adaptation to environmental change in general) is not usually prioritized when compared to economic development. Finally, good coordination is crucial as it enables all the following four pathways; (2) Goodness of fit. A long-term effort, with trial and error and with strong, centralized leadership from the national government will reduce the contradictions available in the governing system by facilitating consensus and bridge interests; (3) social mobilisation, which requires: (a) a responsive co- and self-governance mode and (b) a strong support from a statutory body at the national level which is responsible for mobilizing resources; and (4) learning and adaptiveness, which requires: (a) the existence of a learning platform for knowledge exchange; (b) understanding in the wider society of the problem, its causes and its impact (and constructed by) to their natural and social SG to improve adaptiveness; (c) Integrated and co-knowledge generation and sharing; and (d) adequate and fair means of stakeholder representation.

5. The SRES scenario analysis suggests that mangroves may be effective in the short-term, but in the medium to long-term, the effectiveness may diminish as extreme weather events became

more severe and sea-levels rise faster than mangroves can cope with. This requires more hybrid approaches even in tropical estuaries.

6. The Interactive governance approach and governability assessment framework is useful for assessing the relevance of Eco-DRR. It provides an analytical structure and a guide for integrated natural, social, and political analysis. However, to provide clearer storylines, the governability assessment framework should be carefully contextualized based on the research inquiry with appropriate adjustment based for the level of detail that one aims to achieve. Long-term and in-depth research would be needed in order to appropriately address and elaborate the issue of meta-governance, and the financial resources necessary for any governance approach. My research shows that despite government support, both in Indonesia and India, the mangrove-based disaster risk reduction programmes are more projects undertaken primarily by non-governmental and financed by foreign actors. This raises the question whether coastal developing countries have the scientific, organizational, networking and financial resources to undertake programmatic, systematic coastal disaster risk reduction governance in the short-term, let alone address the growing long-term coastal disaster risks as a result of climate variability and change. The dependence on foreign funding may be a critical limiting factor in reducing coastal disaster risk -- whether ecosystem-based or hybrid approaches. There may be no long-term sustainable solution than mobilizing local people to protect themselves.

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Appendix A Operationalization of the governability assessment[15]

A.1 Definitions of assessment step 2

Step 2: Examining system properties

Targets (Where to look): Natural and social system-to-be-governed, governing system, and governing interaction

Features (What to look for):

1. **Diversity**

Definition: "Diversity is qualitative differences of interacting societal entities" (Kooiman, 2003: 232); "Diversity as it relates to resource units and relevant stakeholders; that is, we explore the heterogeneity and quantity of system elements, and investigations into this characteristic focus on system components" (Chuenpagdee and Jentoft, 2013: 340).

2. **Dynamics**

Definition: "Dynamics is tensions within and between interactions" (Kooiman, 2003: 232); "Dynamics relates to the fact that these systems are likely not inert, but they may be unstable and change over time. In particular, the assessment targets interactions; how system components actively influence each other, provide inputs and feedback to each other, and how they make the systems change either gradually or in leaps and bounds" (Chuenpagdee and Jentoft, 2013: 341).

Operationalization in this thesis

2.a Natural system-to-be-governed (Physical):

What kind of diversity exists within the natural system-to-be-governed which influence the level of risk to coastal flooding and the implementation of Eco-DRR projects?

Variables:

2.a.a Geomorphology

2.a.b Oceanography

2.a.c Climate

2.a.d Soils

2.a.e Biodiversity

2.b Social system-to-be-governed (Social):

What kind of diversity existing within the social system-to-be-governed which influence the level of risk to coastal disaster and the implementation of Eco-DRR projects?

Variables:

2.b.a Demography and settlement distribution

2.b.b Occupational diversity and transition

2.b.c Migration

2c. Risk: How is the component of hazard, exposure, and vulnerability in the research area?

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[15] Many of the definitions shown in this section are directly derived from Kooiman (2003: 231-232) and Chuenpagdee and Jentoft (2013: 340-343)

A.2 Definitions of assessment step 3

Step 3: Evaluating the governing system

Targets (Where to look): Governing system

Features (What to look for):

1. Diversity and
2. Dynamics (see definition in A1) on each of below variables:

3a. Goodness of fit of elements

3.a.a Governing actors: All relevant governing actors who are directly involved in the current Eco-DRR initiatives

3.a.b Images: "Mental pictures as guidelines for governing interactions" (Kooiman, 2003: 231); "Dominating mental models from which the governing system draws its inspiration, direction, and goals" (Chuenpagdee and Jentoft, 2013: 343)

Operationalization in this thesis

Perception of each stakeholders on the understanding of problems and goals of programmes; Perception of the goodness of fit of images

3.a.c Instruments: "the means (steering mechanisms) employed by the governing system in order to realize the goals that are inspired by these images" (Chuenpagdee and Jentoft, 2013: 343)

Operationalization in this thesis

Relevant rules and regulation; perception of the stakeholders on the adequacy of regulation; perception of the implementation of rules and regulations; perception of the goodness of fit of images and instruments

3.a.d Actions: Actions is a "will-power available in governing interactions" (Kooiman, 2003: 231); "Actions pertain to the choices made with regard to the implementation of the instruments, such as enforcement, monitoring and surveillance, and the readiness to act on these choices" (Chuenpagdee and Jentoft, 2013: 343)

Operationalization in this thesis

Types of actions taken by stakeholders; perception on the sufficiency of actions and the goodness of fit of actions with images and instruments

3.b Responsiveness of modes

3.b.a Self-governance: self-governance is "a mode of governance consisting of predominantly Autonomous governing entities (interferences)" (Kooiman, 2003: 231); Self-governance, "refers to capacity of social entities to govern themselves" (Chuenpagdee and Jentoft, 2013: 21).

Operationalization in this thesis

Perception of responsiveness of each stakeholder in self-governing their own community

3.b.b Co- governance: "a mode of governing consisting of collaborating or co-operating governing entities (interplays)" (Kooiman, 2003: 231); Co-governance "involves stakeholders working in cooperation with civil society actors and government" (Chuenpagdee and jentoft, 2013: 343)

Operationalization in this thesis

Perception of responsiveness of each stakeholder in conducting collaboration

The perception of inclusiveness of local community on the participation in the coastal protection programme, starting from planning, implementation, monitoring, and evaluation

3.b.c Hierarchical governance: "a mode of governing consisting of authoritative relations between societal entities (interventions)" (Kooiman, 2003: 231); "Hierarchical governance is basically a top-down, command-and-control system that places governments at the apex of the pyramid" (Chuenpagdee and Jentoft, 2013: 343)

Operationalization in this thesis

Perception of satisfaction of each stakeholder on their responsiveness to tackle existing and emerging issues during the course of the programme

3.c Risk

Operationalization in this thesis

Quality of coping capacity/governability

A.3 Definitions of assessment step 4

Step 4: Governing interactions analysis

Targets (Where to look): Governing interactions

Features (What to look for)

1. Diversity and
2. Dynamics (see definition in A1) on each of below variables:

4.a Presence and quality of interactions

4.a.a Knowledge generation, sharing and distribution: type of interaction and various media through which the system-to-be-governed and the governing system communicate with each other (Chuenpagdee and Jentoft, 2013)

Operationalization in this thesis

The process to generate knowledge and the content of information shared to the local people and communities, the media, and perception on the satisfaction

4.b Enabling power relations

4.b.a Representation

Operationalization in this thesis

Mechanism of selecting stakeholders; perception on fairness; and perception on ability of each stakeholders to influence the process and outcome of the programme

3.c Risk

Operationalization in this thesis

Quality of coping capacity/governability

A.4 Emission scenario

Storyline	Brief characterization
A1	The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B)
A2	The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.
B1	The B1 storyline and scenario family describes a convergent world with the same global population that peaks in midcentury and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.
B2	The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

Source: IPCC (2000)

Appendix B List of institutions and interview codes

B.1 Demak District, Indonesia

Focus	Scale	Agency	Website
Disaster management	National	National Disaster Management Agency (BNPB)	https://bnpb.go.id/
	Province	Department of Environment and Forestry Central Java Province	http://dlhk.jatengprov.go.id/
	District	Disaster Management Authorities- Demak District	-
	Sub-District	Sayung Sub-District office	-
	Local Level	Village office- Bedono, Sriwulan and Timbulsloko Village and selected hamlets within the villages	-
		Mangrove groups	
	NGO	Wetlands International	https://www.wetlands.org/
		OISCA	www.oisca-international.org/
	Universities	International to national universities	-
Coastal- Environmental conservation and Ecosystem-based protection (Mangrove)	National	Ministry of Marine Affairs and Fisheries	kkp.go.id/
	Province	Department of Environment and Forestry Central Java Province	http://dlhk.jatengprov.go.id/
	District	Office of Environment- Demak District	-
		Office of Marine Affairs and Fisheries- Demak District	http://dinlutkandemak53.blogspot.com/
		Office of Agriculture- Demak District	https://dinpertandemak.wordpress.com
		Bureau of Regional Planning and Development (BAPPEDA)-Demak District	-
	Local Level	Village office- Bedono, Sriwulan and Timbulsloko Village and selected hamlets within the villages	-

Focus	Scale	Agency	Website
		Mangrove groups	-
	NGO	Wetlands International	https://www.wetlands.org/
		OISCA	www.oisca-international.org/
	Universities	International to national universities	-

B.2 Parangipettai Block, India

Focus	Scale	Agency	Website
Disaster management	National	National Disaster Management Agency- Ministry of Home Affairs	https://ndma.gov.in/
	State	State Disaster Management Authorities- Revenue and relief Department- Tamil Nadu	https://ndma.gov.in/en/tamil-nadu-sdma-office
	District	District Disaster Management Authorities- Cuddalore District	https://cuddalore.nic.in/disaster-management/
	Local Level	Panchayat and municipality	-
		Self-help groups	-
	NGO	MS Swaminathan research foundation	www.mssrf.org/
	Universities	International and national	-
Coastal- Environmental conservation and Ecosystem-based protection (Mangrove)	National	National Centre for Sustainable Coastal Management	ncscm.res.in/
	State	State Forest Department- Tamil Nadu	https://www.forests.tn.gov.in/
	District	District Forest Department- Cuddalore	https://www.forests.tn.gov.in/pages/view/dist-cuddalore
	Local Level	Panchayat and municipality	-
		Village Mangrove Councils	-
	NGO	MS Swaminathan Research Foundation	www.mssrf.org/
	Universities	International to national	-

B.3 Interview Details

Study Area	Interviews	Pseudonym	Institutions
Indonesia	20	A1-A6; B1-B4; C1-C4; D1-D2; E1; F1-F3	A: Governmental agencies B: NGOs C: Mangrove groups and local leaders D: Researchers and science communities E: Private sectors F: Local people
India	37	G1-G11; H1-H8; I1-I11; J1-J7	G: Governmental agencies H: NGOs I: Local people J: Researchers and science communities

Appendix C Survey questions

C.1 Demak District, Indonesia

1. Nature of the problem

1.1.1.a. What are the problems in coastal protection in your area?

1.1.1.b. Can you indicate the priority or ranking of the problem?

1.1.2.a. Can you specifically indicate if there is any solution which will protect the coastal area from disaster entirely?

2. Governing System

2.1.1 Goodness of fit of images

2.1.1.a. What do you think are the goals and/or direction in the coastal protection programme?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.1.b Stakeholders (government, NGO, local people) involved in coastal protection understood well the problem and have the same opinion about the problem

2.1.1.c Everyone involved in coastal protection understood well the goals of coastal protection and have the same opinion about the goals

2.1.1.d The understanding of stakeholders (government, NGO, local people) on Problem and Goals in coastal protection programme with mangrove planting is perfectly matched

2.1.1.e The Actions taken by all stakeholders (government, NGO, local people) are matches with one another

2.1.2 Goodness of fit of instruments

2.1.2.a What are the relevant rules and regulation related to coastal protection in your village/hamlet?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.2.b The rules/regulation existing in the whole system is adequate

2.1.2.c The existing rules/regulation is implemented well

2.1.3 Goodness of fit of actions

2.1.3.a What are the actions taken by you and family related to coastal protection program?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.3.b Do you think the actions taken are sufficient to tackle the problem?

2.2.2. Responsiveness of self-governance modes

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.2.2.a The mangrove groups are responsive to new problems/concerns

2.2.2.b The NGOs is very fast in responding the new problems/concerns

2.2.3. Responsiveness of co-governance modes

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.2.2.a The government are responsive to new problems/concerns

2.2.2.b The government is very fast in responding to the new problems/concerns

2.2.4. Responsiveness of hierarchical governance modes

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.2.4.a You are included in any discussion with the government authority

2.2.4.b You are very satisfied with state authorities' work in general in protecting the coastal area

3. Governance Interaction

3.1.1. Information sharing

3.1.1.a. What kind of data or information has been shared for coastal disaster protection programme?

3.1.1.b How is the data or information regarding to coastal protection has been shared among the actors? (through which media)?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.1c. The information sharing mechanism has been adequate (for your individual need)

3.1.2. Co-Learning

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.2.b I have learned something from the coastal protection programme together with other stakeholders

3.1.2.b.i What kind of learning do you experience?

3.1.3 Adaptiveness

3.1.3.a Have you ever experienced the extreme changes regarding to coastal disaster magnitude or conflicts due to changing social-political change?

a. Yes

b. No

If yes, please explain:

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.3.b You are adapting well to social-political changes such as conflict and increasing intensity of the disaster

3.2. Enabling and restrictive role of power relations

3.2.1 Inclusiveness

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.2.1.a I am included in the planning process of the coastal protection programme

3.2.1.b I am included in the implementation process of the coastal protection programme

3.2.1.c I am included in the monitoring process of the coastal protection programme

3.2.1.d I am included in the evaluation process of the coastal protection programme

3.2.2. Representativeness and participation

3.2.2.a How is the mechanism for representation in coastal protection issue? (How do you pick)

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.2.2.b The representation mechanism for including local people is fair

3.2.3.c Do you feel as an individual, you possess an adequate power to influence the process and outcome?

C.2 Parangipettai Block, India

1. Nature of the Problem

1.1. You are living close to the sea. Does this create any special difficulties for you?

1.2. If yes, please indicate the ranking from the most significant problem:

1.3. Living next to the sea, are you concerned about your physical security?

1.4 Is coastal protection an urgent need?

1.5 Can you specifically indicate if there is any solution to the problems mentioned above?

2. Governing System

2.1 Goodness of fit of elements

2.1.1 Goodness of fit of images

2.1.1.a Have you heard of the programme called Joint Mangrove Management (JMM)?

2.1.1.b Do you know who is conducting this programme?

2.1.1.c Do you think mangrove planting is a good way to improve coastal protection?

2.1.1.d What kind of protection does mangrove planting provide (against tsunamis/cyclones/sea level rise)?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.1.e My Gram Panchayat understands the need for coastal protection and supports the JMM programme.

2.1.1.f My Ur panchayat understands the need for coastal protection and supports the JMM programme

2.1.1.g MSSRF involved in coastal protection understood well the problem

2.1.1.h Local people involved in coastal protection understood well the problem

2.1.1.i Everyone (gram, ur panchayat, MSSRF, local people) involved in coastal protection understood well the goals of coastal protection and have the same opinion about the goals

2.1.1.j Understanding of Problem and Goals between gram, ur panchayat, MSSRF, local people in coastal protection programme with mangrove management programme is perfectly matched

2.1.1.k The actions taken by the gram, ur panchayat, MSSRF, local people are matches with one another

2.1.2 Goodness of fit of instruments

2.1.2.a Does your Gram Panchayat issue rules with regard to coastal protection (or, to mangrove management?

2.1.2.b What are the relevant rules and regulation related to joint mangrove management programme in your village by ur panchayat?

2.1.2.c What are the relevant rules and regulation related to joint mangrove management programme in your village by village council?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.2.d The rules/regulations existing in the whole system are adequate

2.1.2.e The existing rules/regulation are implemented well

2.1.3 Goodness of fit of actions

2.1.3.a What are the actions taken by you and family related to coastal protection/mangrove management program?

2.1.3.b What are the actions taken by gram panchayat related to coastal protection/mangrove management program?

2.1.3.c What are the actions taken by ur panchayat related to coastal protection/mangrove management program?

2.1.3.d What are the actions taken by MSSRF related to coastal protection/mangrove management program?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.1.3.e. Do you think the actions taken by you and family are sufficient to tackle the problem?

2.1.3.f Do you think the actions taken by gram panchayat are sufficient to tackle the problem?

2.1.3.g Do you think the actions taken by ur panchayat are sufficient to tackle the problem?

2.1.3.h Do you think the actions taken by MSSRF are sufficient to tackle the problem?

2.2 Responsiveness

2.2.1 Responsiveness of co-governance modes

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.2.1.a Is your gram panchayat responsive and fast to new problems/concerns regarding coastal protection?

2.2.1.b The ur panchayat are responsive to new problems/concerns

2.2.1.c The MSSRF is responsive to new problems/concerns

2.2.1.d The ur panchayat is very fast in responding to the new problems/concerns

2.2.1.e The MSSRF is very fast in responding to the new problems/concerns

2.2.2 Responsiveness of hierarchical governance modes

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

2.2.2.a. You are included in discussions related to the joint mangrove management programme

2.2.2.b You are very satisfied with your Gram Panchayat's contribution to the joint mangrove management programme

2.2.2.c You are very satisfied with ur panchayat's work in joint mangrove management programme

2.2.2.d You are very satisfied with MSSRF's work in general in joint mangrove management programme

3. Governing Interaction

3.1. Presence and quality of interactions

3.1.1. Information sharing

3.1.1.a. Are MSSRF and its partners sharing information regarding mangrove management and coastal protection?

3.1.1.b What kind of information has been shared for coastal disaster protection programme?

3.1.1.c How is the information regarding to coastal protection has been shared among the actors? (through which media)?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.1.d. The information sharing mechanism has been adequate (for your individual need)

3.1.2. Learning

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.2.a. You have learned something from the coastal protection programme

3.1.2.b. What kind of learning do you experience?

3.1.3. Adaptiveness

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.1.3.a You feel that gram panchayat showing an effort to hearing and taking a suggestion from you on mangrove management programme

If yes, what are the efforts?

3.1.3.b You feel that ur panchayat showing an effort to hearing and taking a suggestion from you on the mangrove management programme

If yes, what are the efforts?

3.1.3.c You feel that MSSRF showing an effort to hearing and taking suggestion from you on the mangrove management programme

If yes, what are the efforts?

3.1.3.d You feel that you are trying to hear and taking a suggestion from other people (gram, ur panchayat, and MSSRF) for a better mangrove management programme

If yes, what are the efforts?

3.2. Enabling and restrictive role of power relations

3.2.1 Inclusiveness

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.2.1.a I feel included in making the decision of location and design of mangrove to be planted

3.2.1.b I feel included in the planting of mangroves

3.2.1.c I feel included in monitoring the progress of mangrove planting

3.2.1.d I feel included in contributing to the report of the progress of mangrove planting to MSSRF

3.2.2. Representativeness and participation

3.2.2.a. How do people get selected to participate in the work of mangrove management programme?

Likert scale perception statement (Extremely Agree; Agree; Neutral; Disagree; Extremely Disagree)

3.2.2.b. The representation mechanism for including local people is fair

3.2.3.c. I feel that I have an adequate chance to influence the process and outcome of the mangrove management programme

C.3 In-depth interview questions (for both case studies)

Step 1 identifying problem wickedness

1.1.What are the problems in the coastal area?

1.2. The existence of stopping rules: How do you know if the problem(s) are solved? Is there any parameter/indicator? (open quest)

1.3. The embedded nature of the problem: What are other issues that are embedded in coastal protection and mangrove protection? (open quest)

1.4. Cost and reversibility or prescribed solution: List any of solutions for protecting the coastal area and their degree of effectiveness

1.5. What do you think is missing from the existing solution and should be done to protect the coastal area? (open question)

Step 2 Prevalence of system properties

2.1 Natural system-to-be-governed - Perception on how diverse- what are the social system elements - Secondary data and expert review (i.e. on coastal geomorphological condition and mangrove) (Target 3)

2.1.1. What components of natural system-to-be-governed which are impacted by the coastal disaster?

2.1.2. How diverse the ecological and environmental components?

2.1.3. How complex the relationship among ecological components?

2.1.4. How the ecological components actively influence each other?

2.1.5. How do they adapt to changes?

2.1.6. How do they learn from the dynamics?

2.1.7. What are the relevant scales and how they confine relationships and network/ boundaries of Natural SG?

2.2 Social system-to-be-governed; Perception of how diverse, complex, dynamic- what are the social system elements

2.2.1. Who is impacted by the coastal disaster?

2.2.2. Can you list the actors involved in coastal protection program? (Individuals, groups, GO, and NGO) responsible for coastal protection in the coastal area

2.2.3. How social system components actively influence each other?

2.2.4. How do they adapt to changes in relation to different actors involved coastal protection programme in the coastal area?

2.2.5. What are the trends, shocks, and other temporal uncertainties associated with coastal protection in the coastal area?

2.2.6. What are the relevant aspects across scales (administrative and geographical) of the coastal protection in the coastal area?

Step 3 Evaluating the governing system

3.1 Goodness of fit (Target 1 and 2)

3.1.1. What is the problem you perceived in coastal protection issue in the coastal area?

3.1.2. What are the most appropriate goal and direction for protecting the coastal area? Has this been clearly formulated and discussed?

3.1.3. What are the rules to govern and solve the governing system?

Is the current structure of your organization accommodate the task effectively?

Is the current financial arrangement/allocation has been adequate?

3.1.4. What actions have been taken to implement the instruments which have been taken by you/your institutions?

3.2 Responsiveness of modes

3.2.1. What is the current mode of governance in the coastal protection?

a. Decentralized b. Centralized c. In between

3.2.2. Do you agree that the current mode is the most effective way?

a. Yes b. No

3.2.3. Why? (In respect to your answer on question number 2)

3.2.4. Is there any conflict or challenges in interacting with actors at a different level?

a. Yes b. No

3.2.5. If yes, what is the manifestation?

3.3 Performance of orders

3.3.1. What is the consistency of three governance orders in coastal governance?

3.3.2. How effective is the three governance orders in coastal governance?

3.3.3. How transparent is the three governance orders in coastal governance?

3.3.4. How each of orders deals with the promotion of justice?

Step 4 Governing interactions analysis

4.1 Presence and quality of interactions

4.1.1. How is the data or information has been shared among the actors?

4.1.2. What is lacking from information sharing?

4.1.3. How is the balance of learning from existing information?

4.1.4. How to adapt if there are no effective interactions

4.2 Enabling and restrictive role of power relations

4.2.1. Is civil society get involved in the decision-making process?

4.2.2. In which steps are they get involved?

4.2.3. How is the current representation mechanism?

4.2.4. What is lacking and how the representation should be selected?

Appendix D Supporting letter

D.1 LETTER OF PERMISSION FOR RESEARCH IN INDONESIA

PEMERINTAH PROVINSI JAWA TENGAH
BADAN PENANAMAN MODAL DAERAH
Alamat : Jl. Mgr. Soegiopranoto No. 1 Telepon : (024) 3547091 – 3547438 – 3541487
Fax : (024) 3549560 E-mail :bpmd@jatengprov.go.id http ://bpmd.jatengprov.go.id
Semarang - 50131

REKOMENDASI PENELITIAN
NOMOR : 070/2860/04.5/2016

Dasar : 1. Peraturan Menteri Dalam Negeri Republik Indonesia Nomor 07 Tahun 2014 tentang Perubahan atas Peraturan Menteri Dalam Negeri Republik Indonesia Nomor 64 Tahun 2011 tentang Pedoman Penerbitan Rekomendasi Penelitian;
2. Peraturan Gubernur Jawa Tengah Nomor 74 Tahun 2012 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis Pelayanan Terpadu Satu Pintu Pada Badan Penanaman Modal Daerah Provinsi Jawa Tengah;
3. Peraturan Gubernur Jawa Tengah Nomor 22 Tahun 2015 tentang Perubahan Kedua Atas Peraturan Gubernur Jawa Tengah Nomor 67 Tahun 2013 tentang Penyelenggaraan Pelayanan Terpadu Satu Pintu Provinsi Jawa Tengah.

Memperhatikan : Surat Kepala Badan Kesatuan Bangsa dan Politik Daerah Istimewa Yogyakarta Nomor : 074/2568/Kesbangpol/2016 Tanggal 29 September 2016 Perihal : Rekomendasi Penelitian

Kepala Badan Penanaman Modal Daerah Provinsi Jawa Tengah, memberikan rekomendasi kepada :

1. Nama : ANNISA TRIYANTI,S.Si.,M.Sc
2. Alamat : TAMAN MERUYA ILIR BLOK C-1 NO 29 RT 016 RW 004 KELURAHAN MERUYA UTARA, KECAMATAN KEMBANGAN, JAKARTA BARAT, PROVINSI DKI JAKARTA
3. Pekerjaan : DOSEN NON PNS/MAHASISWA DOKTOR

Untuk : Melakukan Penelitian dengan rincian sebagai berikut :

a. Judul Proposal : THE GOVERNANCE OF COASTAL DISASTER: CASE STUDIES OF ECOSYSTEM-BASED DISASTER RISK REDUCTION IN INDONESIA AND INDIA
b. Tempat / Lokasi : SEMARANG DAN DEMAK JAWA TENGAH
c. Bidang Penelitian : GEOGRAFI
d. Waktu Penelitian : 15 Oktober 2016 s.d. 05 November 2016
e. Penanggung Jawab : PROF DR MUH ARIS MARFAI
f. Status Penelitian : Baru
g. Anggota Peneliti : Nuringtyas Yogi Jurnawan, Lintang Murpratiwi, Galih Dwi Jayanto, Afid Nurkholis, Ghalih Nur Wicaksono, Ghina Nur Fithriana, Yuli Widyaningsih, Tri Mulia Annisa
h. Nama Lembaga : UNIVERSITAS GADJAH MADA YOGYAKATA

Ketentuan yang harus ditaati adalah :

a. Sebelum melakukan kegiatan terlebih dahulu melaporkan kepada Pejabat setempat / Lembaga swasta yang akan di jadikan obyek lokasi;
b. Pelaksanaan kegiatan dimaksud tidak disalahgunakan untuk tujuan tertentu yang dapat mengganggu kestabilan pemerintahan;
c. Setelah pelaksanaan kegiatan dimaksud selesai supaya menyerahkan hasilnya kepada Kepala Badan Penanaman Modal Daerah Provinsi Jawa Tengah;
d. Apabila masa berlaku Surat Rekomendasi ini sudah berakhir, sedang pelaksanaan kegiatan belum selesai, perpanjangan waktu harus diajukan kepada instansi pemohon dengan menyertakan hasil penelitian sebelumnya;
e. Surat rekomendasi ini dapat diubah apabila di kemudian hari terdapat kekeliruan dan akan diadakan perbaikan sebagaimana mestinya.

Demikian rekomendasi ini dibuat untuk dipergunakan seperlunya.

Semarang, 17 Oktober 2016

KEPALA BADAN PENANAMAN MODAL DAERAH
PROVINSI JAWA TENGAH

PEMERINTAH PROVINSI BPMD JAWA TENGAH

SUJARWANTO DWIATMOKO

UPT PTSP BPMD 17 Oktober 2016

D.2 Letter of invitation for research in India

INSTITUTE FOR OCEAN MANAGEMENT
ANNA UNIVERSITY
CHENNAI – 600 025

PROGRESS THROUGH KNOWLEDGE

INSTITUTE FOR OCEAN MANAGEMENT ANNA UNIVERSITY

Prof.Dr.S. SRINIVASALU, M.Sc., M.Phil., Ph.D
DIRECTOR

Date: 7th December 2015

Invitation letter

To
Ms. Anissa Triyanti
Ph.D Scholar,
Amsterdam Institute for Social Science Research (AISSR)
Department of Geography, Planning and International Studies
Faculty of Social and Behavioural Sciences
University of Amsterdam
The Netherlands

Dear Ms. Trianti,

I am glad to invite you to Institute for Ocean Management, Anna University, Chennai, India to carry out your research work "**The governance of coastal disaster risk reduction in Indonesia and India**"in collaboration with our Institute between **1st February and 30th April 2016** without any financial commitments to Anna University.

During this period we can target **Pichavaram Mangroves** in the southeast and southwest coast of India in Tamil Nadu. This region possesses 1,100 m wide mangroves located between a lagoon and T. S. Pettai village absorbed most of the energy during the 2014 Indian Ocean tsunami, resulting in zero damage to life and minimal damage to property. The neighbouring village of Muzhukkuthurai, which had no mangrove buffers, suffered five deaths and heavy damage to private and public assets.

A detailed study on the roll of mangroves as coastal shelter belt for Coastal flooding is necessary to understand the governance of coastal disaster risk reduction. This study in this field will help us in evaluating the ecosystem services of mangroves.

I also invite you deliver a special talk on the above topic at Institute for Ocean Management, Anna University, Chennai and to interact with our faculty and students.

With best Regards,

S. Srinivasalu 7/12/15

Phone: (91) 44-22357506/22300108/22200159/22357491 Fax: (91) 44-22200159
E-mail: directoriomau@gmail.com, ssrinivasalu@gmail.com, ponmozhisrini2001@yahoo.com, ssrinivasalu@annauniv.edu

D.3 Ethics approval from the University of Amsterdam

Universiteit van Amsterdam

Department of Amsterdam Institute for Social Science Research (AISSR)

Nieuwe Achtergracht 129B
1018 WS Amsterdam

The Netherlands
T +31 (0)20 525 6686
http://www.uva.nl

http://ethiek.fmg.uva.nl

Date
13-07-2017

E-mail
w.p.m.vandenwildenberg@uva.nl

Subject
Approval notice

Project title	The Governance of Coastal Disaster: Case Studies of Ecosystem-based disaster risk reduction in Indonesia and India		
Project#	2015-AISSR-4649		
Project collaborators	owner erb consultant	Annisa Triyanti Karen Kraal	A.Triyanti@uva.nl K.Kraal@uva.nl

The research project titled *"The Governance of Coastal Disaster: Case Studies of Ecosystem-based disaster risk reduction in Indonesia and India"* (filed as 2015-AISSR-4649) submitted by Annisa Triyanti with the guidelines formulated by the Ethics Review Board of the Faculty of Social and Behavioral Sciences, University of Amsterdam, The Netherlands, and has been approved by the aforementioned Ethics Review Board on October 5th, 2015.

Sincerely,

Wery P.M. van den Wildenberg, PhD

Chair Ethics Review Board (FMG-UvA)
University of Amsterdam

13-07-2017 18:05:21 1/1

Abbreviations and acronyms

BwN	Building with Nature
CBD	Convention of Biological Diversity
COP21	Conference of the Parties 21 on Climate Change
CSR	Coastal System Research
CRV	Coastal Resilient Village programme
CRZ Notification	Coastal Regulation Zone Notification
DRR	Disaster Risk Reduction
EbA	Ecosystem-based approach
Eco-DRR	Ecosystem-based disaster risk reduction
GS	Governing System
GI	Governing Interaction
HFA	Hyogo Framework for Actions
IPCC	Intergovernmental Panel on Climate Change
IG	Interactive Governance
IMFF	Integrated Mangrove Fisheries Farming
JMM	Joint Mangrove Management Programme
KEMENPUPR	Kementerian Pekerjaan Umum dan Perumahan Rakyat/ The Ministry of Public Works and Human Settlement
KKMD	Kelompok Kerja Mangrove Daerah/ Regional Working Group for Mangrove Management
MMA	Marine Management Area
MMU	Mangrove Management Unit
MMAF	Ministry of Marine Affairs and Fisheries
MPWHS	Ministry of Public Works and Human Settlement
MSSRF	MS Swaminathan Research Foundation
MoEF	Ministry of Environment and Forest India
NGOs	Non-governmental Organization(s)
PA	Paris Agreement
PPP	Public Private Partnership
RJPMD	Rencana Program Jangka Menengah Daerah/ Medium Term Development Plan
SES	Socio-ecological System

SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SG	System-to-be-governed
SRES	Special Report on Emission Scenarios
VDMC	Village Development Mangrove Councils
VMC	Village Mangrove Councils
VKC	Village Knowledge Center

English summary

Growing Coastal Risks

Coastal disasters such as tsunamis, coastal erosion, and flooding are occurring with increased frequency and intensity, threatening the lives and livelihoods of millions of coastal residents. Contextual factors exacerbate vulnerability and often disproportionately affect the poor and marginalized. The Sendai Framework for Disaster Risk Reduction (SFDRR), The Paris Agreement on Climate Change (PA) and the Sustainable Development Goals (SDGs) all recognize the value of ecosystem-based disaster risk reduction (Eco-DRR) such as through mangrove plantations.

Research question

Hence, this thesis addresses the question: "What factors contribute to the success of coastal, mangrove-based disaster risk reduction strategies?" Sub-questions include: (1) What are the characteristics of coastal disasters, and what is the specific utility of ecosystem-based protection approaches (Eco-DRR)? And (2) What lessons can be learnt for governing effective coastal ecosystem-based disaster risk reduction in short-term and long-term?

Methodology

This thesis is based on a structured review of ecosystem-based DRR and governance literature and makes use of interactive governance theory as well as two case studies on rural mangrove planting in Demak District, Central Java, Indonesia and Pichavaram mangrove forest in Parangipettai Block, Tamil Nadu, India. The case studies include review of policies and other secondary sources, in-depth interviews with 57 stakeholders, two focus group discussions, participative observation, and surveys with 400 respondents and mapping to highlight short-term and long-term analysis (see Chapter 4). The case studies do not examine the national context in India and Indonesia in detail, so there is a limit to the possibility of upscaling the result.

State-of-the-art of ecosystem-based disaster risk reduction

The literature on Eco-DRR covers coral reefs, sand dunes, seagrass, and mangroves. I focus on mangroves since they are known to possess higher effectiveness. The literature shows that mangrove-based risk reduction can be (a) cost-effective; (b) socially and environmentally friendly, and (c) provide diverse ecosystem services, especially supporting, provisioning and regulating services. However, the limits of using mangrove-based DRR are that they: (1) can be only grown under specific ecological conditions in tropical and sub-tropical estuaries; (2) can only address some types of disasters like slow-onset coastal flooding and low magnitude tsunamis; and not fast-onset high magnitude tsunamis and storms and; (3) may not be able to cope with the impacts of climate change (i.e. Mangrove ecosystem-based DRR will be effective only when there is good information regarding the specific ecological conditions within tropical estuaries, the type, frequency and nature of potential disasters and possible scenarios of climate change impacts. Unlike other coastal defense measures, mangrove-based DRR requires both scientific knowledge about the conditions under which they will be effective in disaster relief and community participation in order to grow and maintain the mangroves. This calls for incentivizing community participation. This study also reviews the literatures in governance approach to Eco-DRR. It shows that many disciplines are not adequately covered in the existing approaches. The existing approaches have a strong natural and ecological science approach; their inclusion of socio-political analysis especially at the local level is quite limited except in the case of adaptive governance. Second, most analysis is highly constructive and not adequately critical and reflective or systemic. Third, the methods do not allow for a thorough analysis of local situations often either in themselves or in the way they are applied by the scholars that utilize them. What is also clear is that the insights of interactive governance theory have not yet been applied to ecosystem-based disaster response approaches – as it was conspicuously absent in the literature search. There were also few case studies of the region I am interested in – namely India and Indonesia – and especially at the local level (Chapter 2).

Interactive Governance Theory

This study applies interactive governance (IG) theory, which addresses wicked problems and the factors influencing governability (i.e. the overall capacity for governance). IG assumes that governability is impacted by the characteristics of the natural and socio-political system-to-be-governed (SG), the governing system (GS), as well as the governing interactions (GI). It helps to assess the interaction processes within and among different sub-systems in societal systems. Furthermore, it allows the identification of disabling and enabling factors through a 5-step assessment framework extended from the model developed for capture fisheries, which includes: (1) identifying the nature of the problem; (2) examining SG properties; (3) evaluating the GS; (4) analyzing the GI; and finally, (5) assessing the governability and influencing factors for leveraging the capacity and quality to govern (see Chapters 3 and 4). Based on IG theory, I identified four governing pathways which might contribute to the success in governing Eco-DRR: coordination, goodness of fit, social mobilisation and learning and adaptiveness (see

Chapter 3). These factors guide the investigation in each case study on how to lower risk and improve governability.

Case study: Demak District, Central Java, Indonesia

Problem and system-to-be-governed (SG)

In the context of Indonesia with more than 17,000 islands and a coastline of 81,000 km, I have chosen to focus on Demak District in Central Java, because it currently faces devastating rates of erosion and exposure to the impact of sea-level rise as well as investment in mangrove-based disaster risk reduction measures. This area had abundant mangroves in 1740 which have since decreased in coverage. Since 1980, the mangroves have been converted to shrimp ponds or degraded because of coastal development of new infrastructural works in the neighbouring city of Semarang, exposing local people to frequent floods, sinking hamlets and reduced income, especially in Sayung Sub-District. Since 2015, international NGOs have been promoting a replanting programme, combining the mangrove ecosystems with semi-permeable structures to help sedimentation. The mangrove coverage is still, however, geographically limited, and young plantations have a lower protective capacity. Although mangroves are cost-effective (see Chapter 1), funding for mangroves-based DRR project is mostly coming from abroad.

The research identified three key factors affecting governability in the natural system-to-be governed. First, in terms of speed, Demak faces mostly creeping disaster risk. Second, in terms of the degree of disaster, it suffers an annual coastal erosion of 5-50 m of shoreline; annual land subsidence of 10-17 cm from groundwater extraction and heavy construction in the surrounding area and flooding from sea-level rise of 0.5-8.294 cm annually since the 1980s. Third, in terms of the quality of the mangrove, coastal development has led to reduced coverage, there are only three species of mangroves left implying a lower resilience; however, relatively low pollution and supporting ecological condition in this area make it possible for mangroves to grow.

In the social system-to-be governed, I look at one of the 14 sub-districts of Demak with a total population of 33,900 people in 2015. These people are dependent directly or indirectly on the mangrove for their provisioning (i.e. capture fishing and silvo-fishery production) and regulating services (i.e. flood protection). Three social factors affect the success of coastal mangrove ecosystem-based DRR, which include: (1) the high density of population in combination with fragmented settlement pattern, which impedes protective coverage; (2) the occupational transitions that are taking place and reduce reliance on the natural environment; and (3) the high-level of out-migration which effects the willingness and ability to perform the mangrove planting programme (Chapter 5).

Governing system (GS)

Current strategies for achieving sustainable coastal protection are varied (e.g. mangrove planting, hybrid structures, and capacity building). The governing system (GS) in Demak is diverse in terms of types and levels of governing actors. Each of the governing actors possesses different interest, goals, expectations, capacities, and limited coordination

This research identified three factors which are important to assess governability. First, in terms of actors, coastal flooding in Demak has been addressed by multiple, diverse actors in which

international NGOs have played an important role. Second, in terms of matching of images of the problem, instruments, goals, and action, there is lack of agreement between stakeholders on the root cause of the problem (e.g. land subsidence, sea-level rise, growth rate and damage potential of mangroves and other natural threats). The problems and the levels at which coastal flooding occurs is at variance with the capacities of the governing system, especially at the regional and local level.

Meanwhile, the governmental coordination mechanism has been inactive, which has led to a fragmented approach. Each of the governing actors is also mandated by a different set of multi-level regulations (or laws). The coastal management regulation includes a "bio-eco region" perspective but does not fully integrate the ecosystem approach and lacks inter-sectoral linkages. Third, in terms of the responsiveness of governance modes, the co-governance mode is shown through the collaboration and partnerships of NGOs and community groups (e.g. in the case of OISCA project with community groups in Bedono village), as well as the public-private partnerships established by the national government and the Wetlands International and Ecoshape consortium. However, they have been unable to include community groups and resource shortage has led to competition over funding among different community groups (Chapter 6).

Governing interaction (GI)

I assessed the governing interactions occurring in Demak by considering two aspects that are bundled into one factor. First, I investigate the effectiveness of knowledge generation, sharing, and distribution. Information is commonly shared by government authorities with local people to increase preparedness as part of the coastal disaster risk reduction effort. My survey shows that the information being shared includes knowledge on flooding and inundation, the mangroves planting programme, the planning of infrastructure work conducted by the government (i.e. construction of road and breakwater) and the NGOs (construction of hybrid structure and information on other development plans in the villages, i.e. the construction plan of breakwater and seawall). Second, in terms of distribution and representativeness, although unsuitable ways of planting mangrove have been reported previously, the NGOs have transferred knowledge to local people as part of the learning by doing the process to adapt to present and future coastal threats. However, local politics hamper the fair representation of local people in receiving information and part taking in the programme. (Chapter 6).

Risk and governability

This study identifies how the qualities of governance pathways affecting the governability of coastal disaster and the Eco-DRR effort and simultaneously increase the risk. The results include: (1) Coordination: governing systems are diverse and fragmented, which reduces the governability of coastal erosion and flooding and efforts to rehabilitate mangroves and revitalizes coastal area; (2) Goodness of fit: there is a lack of agreement on the root cause of the problem (i.e. regarding the impact of coastal development in Semarang to flooding in Demak) which is partly due to a lack of scientific evidence to integrate Eco-DRR approach in reducing erosion and flooding problem, and unclear mandates on who should manage the coastal erosion and flooding problem; (3) Social mobilization: Eco-DRR projects in Demak have not yet realized broad inclusion and participation of local people in the coastal protection projects besides assistance in implementation. Following the precepts of co-governance, greater inclusion of relevant stakeholders as well as a better social mobilisation strategy would enable governability; (4) Learning and adaptiveness: the process leading to learning, and adaptiveness which has been happening so far, have reached some milestone. However, the changing landscape of coastal disasters will require continuous learning.

Furthermore, there remains a high dependency of the government on foreign sources of funding with regards to Eco-DRR projects in Demak. This raises challenges in terms of legitimacy, sovereignty and in achieving sustainability (Chapter 6). However, the Public Private Partnership model has recently been developed through Building with Nature Indonesia (in collaboration with Indonesian Ministry of Marine Affairs and Fisheries, Ministry of Public Works and Human Settlement and Dutch Ecoshape consortium) provides an opportunity to strengthen a co-governance approach. This could facilitate coordination, matching of problems, goals, instruments, and actions, the mobilization of resources as well as the enablement of sustainable learning and adaptiveness. (Chapter 6).

Case study: Parangipettai Block, Tamil Nadu, India

Problem and system-to-be-governed (SG)

India has a coastline of 7,517 km long, including a mainland coastline (5,423 km) and the islands (2,094 km). I have focused on Parangipettai Block in Cuddalore District, Tamil Nadu State. I selected this area since it was heavily affected by a coastal tsunami in 2014 and regularly undergoes storms; moreover, this area partially uses mangrove ecosystem services to reduce the impact of the disaster. There is evidence that the mangroves have protected the lives of villagers from the enormous risk of loss of human lives during the Indian Ocean Tsunami in 2004. However, mangroves in this area degraded substantially in the past due to unscientific management called coupe-felling practices, which also impacted the livelihood of the mangrove-dependent inhabitants (i.e. mangrove-based fisheries). Mangrove coverage is recently increasing again due to the Joint Mangrove Management (JMM) programme led by the MS Swaminathan Research Foundation (MSSRF). Despite the good quality of the mangroves, external threats to mangrove health still exist, including the expansion of chemical industries which could pollute the mangrove ecosystem and the expansion of large-scale aquaculture which could encroach on the mangrove areas. Without appropriate sustainable management, developing tourism activities could also serve as a threat to the existence of mangroves (Chapter 7).

I identified three factors affecting governability in the natural SG. First, in terms of the net speed, Parangipettai Block mostly faces the sudden type of disaster, such as cyclone and tsunamis. Second, in terms of the degree of disaster, it faces annual land subsidence of 0.34 mm and an annual sea-level rise of 0.13 - 0.32 mm. Third, in terms of the quality of mangroves, the physical condition (i.e. geomorphology, climate, oceanography, soil, and biodiversity) indicated high suitability, with the total of 13 original species in a healthy condition.

In terms of social SG, I considered 3 out of 41 panchayat unions in Parangipettai Block with a total population of 25,541, identifying three factors that influence governability. The population shows a slow increase, and settlements are clustered, which provides the opportunity for natural protection; moreover, the rate of out-migration is low. Like in Demak, local people are also dependent directly or indirectly on the mangroves for its provisioning (i.e. increase fish and silvo-fishery production) and regulating services (i.e. cyclone protection and reduced impact of a tsunami).

Governing system (GS)

Like in Demak, strategies for achieving sustainable coastal protection have changed over time, and occur within the framework of governmental legislation as well as NGO activity.

I considered the way in which the qualities of four governing pathways affect governability. First, in terms of actors, the short-term problem of disaster risk reduction has been addressed collectively by stakeholders under the Joint Mangrove Management (JMM) Programme that is being implemented in Parangipettai Block. Mainly funded by foreign donors, the JMM programme has been led by the MS Swaminathan Research Foundation (MSSRF) a local research-based NGO. MSSRF has been given the trust and resources to provide direction to the programme by the Ministry of Environment and Forest (MoEF), and leads the coordination effort among governing institutions (i.e. State Forest Department, Gram Panchayat and village-level government). Second, in terms of matching of images, instruments, goals, and action, the images of the problem (i.e. mangrove forest degradation) appear to match the goals, (i.e. conservation and the maximization of ecosystem services for coastal protection and livelihood improvement) as well as the actions (i.e. planting mangrove and training with community participation). The ecosystem-based approach is also explicitly included in the governmental Coastal Regulation Zone Notification 2011; this policy document make strong inter-sectoral references, including to the realm of disaster management, forest, and biodiversity conservation. Third, in terms of the responsiveness of governance modes, the totality of governing actions has successfully addressed the multi-dimensional problem, including restoration of mangrove forest, enhancement of livelihood and protection (coping capacity) against coastal disasters with a strong co-governance model (Chapter 8). The main disabling factor is that the mangrove-planting activities by JMM are not integrated solidly into the coastal protection activities of the district administration and the larger region.

Governing interaction (GI)

Governing interactions are assessed through two aspects that are bundled into one factor. First, in terms of the effectiveness of knowledge generation, sharing and distribution, government authorities, local people, MSSRF, and research and academic institutions have learned to understand the nature of the problem and the cause of mangrove degradation. To restore the mangrove ecosystem, there is a common learning process among different actors. For local people, this includes knowledge about the cause of degradation, the benefits of mangroves and innovative techniques to plant them, and the new practice of silvo-fishery farming in the mangrove restoration area. Meanwhile, the NGOs have learnt from the local people about the existing condition of coastal erosion and flooding and understood how to conduct Participatory Rural Appraisal (PRA) methods effectively. Second, regarding the representativeness of the process within the local community, a Village Knowledge Center (VKC) has been established to accommodate learning processes in a more inclusive way. Government authorities, together with MSSRF and local people, have partaken in meaningful participatory processes through the operation of the councils. Although MSSRF initially had difficulties in gaining the trust of the local communities, the leadership, and long-term, sustainable efforts have helped them to build a comprehensive and legitimate programme (see Chapter 8).

Risk and governability

The qualities of the governing pathways potentially affecting the risk of disaster and governability have been identified as follows in the governing system: (1) Coordination: the governing system in Parangipettai is diverse, but jointly coordinated, this increases the level of governability of the mangrove conservation and protection against storm surges and tsunami; (2) Goodness of fit: there is clear agreement on the root causes of the problem (especially regarding the degradation of mangrove) due to clear scientific evidence and also the experience sourced from the local community. The regulatory (law) instruments related to coastal management complement each other, which increases the goodness of fit with the current action for integrating the Eco-DRR approach; (3) Social mobilization: my research suggests that the Eco-DRR approach in Parangipettai Block has realized broad inclusion and participation of the community in the coastal protection projects, where villagers are involved almost in all phases (planning, implementation, and monitoring). The past experience of the Indian Ocean Tsunami has generated collective action among the population, ewhich is evident in the JMM programme, the Village Mangrove Councils (VMC) and the Village Knowledge Centres (VKC). Following the precepts of co-governance, greater inclusion of relevant stakeholders, as well as a better social mobilisation strategy, have been essential elements in the success of this programme; and (4) Learning and adaptiveness*:* the quality of governing interaction, including learning, and adaptiveness process have been ensured since the planning phases throughout the implementation and monitoring of the JMM programme. The JMM programme, through the establishment of VMC and VKC, has provided an inclusive mechanism. Local people, NGOs, and government authorities represented by forest officers are being involved. Although funding came from international donors, the planning and implementation have been fully executed by the MSSRF as a national research-based NGO, which increases the legitimacy and sovereignty of such a project. Despite all the positive aspects of the governance approach in the Indian case study, challenges still exist, especially to ensure the availability of data to anticipate future climate change impacts (i.e. sea-level rise) and anthropogenic threats (i.e. land subsidence, pollution and erosion due to coastal development) as well as to ensure a long-term and sustainable approach after the project has ended (see Chapter 8). Moreover, the integration of the mangrove project with regular coastal protection activities of the district administration remains a point of attention.

Juxtaposition

The analysis of the **nature of the problem** shows that the level of governability in the case study of Indonesia is generally lower than in India due to a difference in the nature and the direct and indirect causes of the problem and the way in which the projects for coastal protections have been designed. Furthermore, there is no clear agreement on the root cause of the problem due to lack of consistency and precise scientific data and information (see Chapter 9). Regarding the **natural system-to-be-governed (N-SG)**, both Demak and Parangipettai have a similar coastal geomorphology, are located in a flat topography and have similar soil characteristics with lower permeability. Mangroves in Demak covers a smaller area (i.e. 254.38 ha) than Parangipettai (i.e. 941 ha area) and include limited species (i.e. three species), compared to Parangipettai (i.e. 13 species). In 2012, the degraded mangrove area in Demak reached 13.8% of the total area, caused by conversion to aquaculture activities, a high erosion rate, and destructive waves. It is higher than Parangipettai (i.e. is around 5-10%), where the cause of degradation is mainly the Indian Ocean tsunami of 2004. The general status of mangroves in India is healthier than in Indonesia, which suggests lower risks and higher governability (see Chapter 9). The analysis of the **social system-to-be-governed (S-SG)** reveals that there are more people exposed in the highly eroded area and patches settlement pattern in three villages in Demak than in all 17 hamlets with a clustered settlement pattern surrounding the Pichavaram Mangrove Forest, Parangipettai Block, in India. There is a higher rate of occupational transition which potentially contributes to the higher rate of migration in Demak compared to the case of Parangipettai. High migration rates indicate more population dynamics, which could reduce the social cohesion and effectiveness of social mobilisation. Communities in both case studies are incorporating structural and non-structural measures to respond to environmental degradation and threat to different types of coastal disaster risk. However, the responses are still limited to addressing the immediate expressions of coastal disaster, with the large-scale future threats of climate change, which exceed community capacities, ahead (see Chapter 9).

The analysis of the **governing system (GS)** reveals that there are many government agencies, ranging from national to the local level, international and local NGOs, and self-governed community mangrove groups in both case study areas. In terms of matching of images, instruments, goals, and action my research revealed that the image of the problem is clear in both case studies. However, the image of the root causes of the problem in Demak is still in dispute. Although governmental agencies (central to local level) with responsibilities for coastal disaster risk reduction are complementary, the mandates of specific governing actors for managing the erosion problem are still unclear, and there is still ambiguity in the prioritization of livelihood advancement, environmental protection, and coastal development. Meanwhile, in Parangipettai, the regulation and law are relatively complementary and coherent, despite the remaining challenges with regard to implementation. Furthermore, Demak is facing more challenges than Parangipettai Block in governing the coastal disaster risk reduction effort due to the inactive coordination mechanism which is supposed to provide a space for knowledge generation and sharing, learning, adaptation, inclusiveness, and fair representation. In Parangipettai Block, the wide range of actors in the JMM programme is more coordinated through the leadership and existence of statutory body led by the MoEF and the MSSRF (see Chapter 9).

In terms of **governing interaction (GI)**, the type of knowledge generation, sharing and distribution in Demak has generally been sufficient, especially relating to the day-to-day risk of coastal flooding and mitigation (i.e. wave height, mitigation strategy using hard and soft infrastructure at the household and community level). However, this is not the case in terms of science-based information on the future trends and how it impacts on the locality of the case study (i.e. the impact of coastal development and reclamation in Semarang, sea-level rise and groundwater extraction and depletion). In the case of Demak, the representativeness of the local community in DRR activities is still low as it is dominantly through the representation of village elites, which effects the distribution of information. In Parangipettai, there is limited information on the external and future natural and social activities which may potentially thwart the existence and health of the mangrove forest (i.e. the pollution, tourism, and aquaculture practice) and reduce its function as a bio-shield against disaster. Furthermore, in terms of representativeness, the establishment of VMC in the three research villages in Parangipettai has created a solution for the problem of representation. Women, youth and other population categories are represented through a democratic election process. They are regularly informed through the VKC on various topics of relevance to coastal protection (see Chapter 8 and Chapter 9). Based on the analysis above, overall, the case of Demak District, Indonesia is higher in terms of risk and lower in terms of governability compared to Parangipettai Block, India.

Pathways to improve governability of Eco-DRR/ EbA

Based on the problems and enabling conditions identified in the two case studies, I investigated four potential governing pathways which could increase governability of Eco-DRR and EbA and made linkages with other factors (Chapter 10). It appears that all governing pathways are relevant to the case studies in Indonesia and India, and all of them possess qualities that contribute to the governability of Eco-DRR:

1. *Coordination.*According to IG theory, a high diversity and number of actors within the domain of GS are necessary to respond to diverse problems and diverse feature of system-to-be-governed. However, this condition also produces specific challenges in terms of coordination and building consensus. In order for coordination to work, I return to the four variables discussed with regard to the 5-steps of governability (see Chapter 4). First, regarding the problem, there are three determinants, including: (1) speed of disaster as the problem, (i.e. slow-onset, erosion lead to flooding that happened continuously); (2) the embeddedness of the problem (i.e. inter-scale problem requires a strong inter-disciplinary involvement of the diverse actors); and (3) the impact.

Within the SG domain, several conditions determine the chances of successful coordination, including: (1) size of the area to be governed and its heterogeneity. The size relates to the second conditions which are (2) priority (i.e. in the context of national coastal management, Eco-DRR is not usually included in priority, compared to economic development). Finally, in terms of GI, good coordination will enable adequate and fair distribution of knowledge generation and sharing in order to improve the governability. Strong coordination is needed in both case studies, although due to a more complex and embedded problem, the Demak case needs more effort to increase the effectiveness thereof. It can be expected that effective coordination will trigger a domino effect which enables the quality of other pathways too (i.e. goodness of fit, social mobilisation, learning, and adaptiveness). The coordination effort should, however, be led by the state, as it is the only actor that plays an enduring role. NGOs and business, however, can initiate and implement projects.

2. *Goodness of fit.* When images of problem, goals, and instruments among actors in the GS fit together, an Eco-DRR approach can be more effective. The most successful mechanism, in this case, is shown by the Indian case study. It is formed through long-term efforts, with trial and

error and with strong, centralized leadership from the national government. First, in terms of the problem, the tougher and more embedded it is, achieving goodness of fit will be more challenging as there is an absence or lack of common agreement among relevant stakeholders, and an absence of stopping rules. Goodness of fit can be buttressed by facilitating consensus on the nature of the problem and its solutions. The lack of goodness of fit demonstrated in the Indonesian case study is due to inadequate understanding of the problem and the issues affecting the SG. When there is no understanding of what problem should be prioritized, for example with regard to contestation between the need of constructing waterfront protection infrastructure in the city of Semarang and the consequences of certain development to the rural area of Demak, it is difficult to expect an effective response from governing actors.

Finally, in terms of GI, an adequate presence and quality of knowledge generation and sharing can be achieved through evidence-based data. The relative absence of science as a tool to understand future threats hampers the efforts toward Eco-DRR and climate adaptation.

In order to improve the coherence of images, goals, instruments (including institutions) and action, priority should be given to the removal of contradictions. A specified coordinating state agency is necessary, but it can build upon suggestions and recommendations from other parties (civil society, business, and science).

3. *Social mobilisation.* Within the GS, a responsive co– and self-governance mode, supported by an efficient statutory body at the national level is needed. Although the national, focal institution should be collaborative with other stakeholders in order to ensure sustainability, government authorities at the national level should take the main responsibility to control the Eco-DRR process. A sudden type of disaster tends to trigger more social mobilisation than a creeping type of disaster (i.e. The Indian Ocean Tsunami in 2004 has been a wakeup call on the importance of conserving mangrove to increase protection against coastal disaster). Meanwhile, in Demak District, local people tend to accept the creeping disaster as the "new normal" and adapt to the continuous process of erosion and flooding rather than mobilising for long-term actions. In terms of GI, I argue that social mobilisation is enabled by the learning process and representativeness, as it constructs awareness omong local people and other governing actors, a sense of ownership of the problem and togetherness in working towards solutions. The involvement of local populations is critical to improve the effectiveness and efficiency of mangrove DRR approaches, as well as their legitimacy. This can be done through participation in decision-making and implementation, with livelihood sustenance being a factor of importance.

4. *Learning and adaptiveness.* The existence of a learning platform for knowledge exchange is crucial to ensure the sustainability of the Eco-DRR effort. Knowledge should be updated and validated, and learning outcome should be monitored. This can assist in the adaptiveness of society when facing disaster risk and climate change impact in the future (see Chapter 10). Effective learning and adaptiveness can only be achieved through understanding in the wider society of the embedded nature of the problem and how the problem impacts (and constructed by) its natural and social SG. Therefore, information should be fairly distributed and shared among people. Within the domain of GS, I argue that the quality of learning and adaptiveness of society to coastal disaster differs according to how such information is disseminated. Integrated and co- knowledge generation and sharing tend to be more successful than when it is fragmented. The case of India reveals that the establishment of a Village Knowledge Centre (VKC) helps the distribution of information in an integrated and fair manner. Again, coordination became crucial to ensure that the knowledge generation and sharing and process of learning and adaptiveness is effective. However, to ensure iterative learning, which improves adaptiveness in the long-term, monitoring and evaluation have to take place, followed by a redesign of the governing system. Scholars can play a role in preventing institutional ossification.

To ensure successful Eco-DRR in the future, long-term strategies are important. Whether mangrove-based approaches remain relevant depends on local circumstances as well as on the unfolding of climate change scenarios. Although mangroves may have a role to play, other approaches too may need to be considered. Here, the concept of EbA (which includes larger scope and scales for climate change adaptation) should be the ultimate goal. Thus, the effectiveness of EbA depends on the success of the Sendai Framework, Paris Agreement, and SDGs to be able to guide us to arrive at the B1/B2 world (i.e. environmental awareness and behavior are high and reduced anthropogenic threats to climate change impacts). Finally, there is an urgent need to articulate the role of all stakeholders. Referring to the current relevant global policies, this thesis confirms that government should take a central role in providing enabling conditions, guidance and coordination, thereby ensuring transparency, accountability, and compliance.

My research shows that despite government support, both in Indonesia and India, the mangrove-based disaster risk reduction programmes are mainly projects undertaken primarily by non-governmental and financed by foreign actors. This raises the question whether coastal developing countries have the scientific, organizational, networking and financial resources to undertake programmatic, systematic coastal disaster risk reduction governance. The dependence on foreign funding may be a critical limiting factor in reducing coastal disaster risk -- whether ecosystem-based or hybrid approaches. There may be no long-term sustainable solution than mobilizing local people to protect themselves.

NEDERLANDSE SAMENVATTING

Toename kustrisico's

Kustrampen zoals tsunami's, kusterosie en overstromingen doen zich met toenemende frequentie en intensiteit voor en bedreigen het leven en het levensonderhoud van miljoenen kustbewoners. Contextuele factoren verergeren de kwetsbaarheid en hebben vaak een onevenredige invloed op armen en gemarginaliseerden. Het Sendai Framework Disaster Risk Reduction (SFDRR), de Paris Agreement (PA) en de Sustainable Development Goals (SDGs) erkennen allemaal de waarde van op ecosystemen gebaseerde rampenrisicovermindering (*Ecosystem-based Disaster Risk Reduction*, ofwel Eco-DRR), zoals door middel van mangrovebossen.

Onderzoeksvraag

Vandaar dat dit proefschrift de vraag behandelt: "Welke factoren dragen bij tot het succes van kustbeschermingsstrategieën op basis van mangrove-gerelateerde Eco-DRR?" Deelvragen zijn onder meer: (1) Wat zijn de kenmerken van kustrampen en wat is het specifieke nut van Eco-DRR? En (2) Welke lessen kunnen hieruit worden geleerd voor het beheersen van rampenrisicovermindering op korte en lange termijn?

Methodologie

Dit proefschrift is gebaseerd op een gestructureerde verkenning van Eco-DRR en de literatuur over beheer (*governance*) en maakt gebruik van de Interactieve Governance (IG) theorie en twee case-studies over mangroves op het platteland van Demak District, Midden-Java, Indonesië, en Parangipettai Block, Tamil Nadu, India. De case-studie methodologie omvat verkenning van beleid en andere secundaire bronnen, diepte-interviews met 57 stakeholders, 2 focusgroepdiscussies, participatieve observatie, ruimtelijke analyse, en enquêtes met 400 respondenten om zodoende de korte- en langetermijn perspectieven te verstaan (zie Hoofdstuk 4). De case-studies besteden echter minder aandacht aan de nationale context in India en Indonesië, waardoor de mogelijkheden om het onderzoek op te schalen beperkt zijn.

State-of-the-art van op Eco-DRR

De literatuur over Eco-DRR bestrijkt koraalriffen, zandduinen, zeegrassen en mangroven. Ik concentreer me op mangroven, omdat bekend is dat ze bij zeegerelateerde rampen een hoge effectiviteit hebben. Uit de literatuur blijkt dat mangrove-gebaseerde risicovermindering (a) kosteneffectief kan zijn; (b) sociaal en milieuvriendelijk is, en (c) diverse ecosysteemdiensten aanbieden, met name ondersteunende, provisionerende en regulerende diensten. De beperkingen van het gebruik van op mangrove gebaseerde DRR zijn echter dat mangroves: (1) alleen kunnen worden gekweekt onder specifieke ecologische omstandigheden in tropische en subtropische estuaria; (2) alleen een aantal soorten rampen, zoals langzaam invallende kustoverstromingen en tsunami's met een lage intensiteit, kunnen helpen voorkomen; en (3) mogelijk niet in staat zijn om de gevolgen van klimaatverandering het hoofd te bieden.

In tegenstelling tot andere kustverdedigingsmaatregelen vereist op mangrove gebaseerd DRR zowel wetenschappelijke kennis over de omstandigheden waaronder deze effectief kunnen zijn en gemeenschapsparticipatie om de mangroves aan te planten en te onderhouden. Deze studie onderzoekt ook de literatuur over de benadering van Eco-DRR op het gebied van beheer. Mijn verkenning laat zien dat gangbare disciplines te weinig rekening houdend met sociaal-politieke analyse. Wat ook duidelijk is, is dat de inzichten van de IG-theorie nog niet zijn toegepast op ecosysteembenaderingen, en dat er weinig case-studies naar dit onderwerp zijn verricht in India en Indonesie (zie Hoofdstuk 2).

Interactieve Governance Theorie

Deze studie past de IG-theorie van Jan Kooiman (2003) toe, die ingewikkelde maatschappelijk problemen (*wicked problems*) en de factoren die het beheer beïnvloeden in detail onderzoekt. IG gaat ervan uit dat beheer wordt beïnvloed door de kenmerken van het te beheren subsysteem (het zg. *system-to-be-governed,* ofwel SG), het besturingssubsysteem (*governing system,* ofwel GS) en de interacties daartussen (*governing interactions,* ofwel GI). De SG wordt verdeeld in een natuurlijk en een sociaal gedeelte (*natural SG*, en *social SG*). Een volledige GI analyse maakt het mogelijk om factoren die van invloed zijn op de beheersbaarheid (*governability*) via een beoordelingskader te identificeren. Dit kader, dat ontwikkeld is door Chuenpagdee en Jentoft (2013), verloopt in de volgende vijf stappen: (1) het identificeren van de aard van het betreffende probleem; (2) het onderzoeken van de SG-eigenschappen; (3) de evaluatie van de GS; (4) het analyseren van de GI; en tenslotte (5) het beoordelen van de algehele *governability* en de factoren die haar beïnvloeden (zie hoofdstuk 3 en 4). Op basis van de IG-theorie identificeerde ik vier invalshoeken, of benaderingen, die een bijdrage kunnen leveren aan het succes van Eco-DRR: coördinatie, aansluiting (*goodness-of-fit*), sociale mobilisatie, en leren en aanpassingsvermogen (zie Hoofdstuk 3). Deze benaderingen geven richting aan de verkenning van elke case-studie.

Case study: Demak District, Midden-Java, Indonesië

Probleem en het te besturen systeem (SG)

In de context van Indonesië met meer dan 17.000 eilanden en een kustlijn van 81.000 km, heb ik ervoor gekozen om me te concentreren op het district Demak op Midden-Java, omdat het momenteel te kampen heeft met verwoestende erosie en blootstelling aan de gevolgen van zeespiegelstijging en investeringen in op mangrove-gebaseerde maatregelen ter beperking van rampen. Dit gebied bezat in het verleden overvloedige mangrovebossen die sindsdien in omvang zijn afgenomen. Sinds 1980 zijn veel mangroven omgevormd tot vijvers voor de kweek van garnalen of gedegradeerd vanwege de ontwikkeling van nieuwe infrastructurele werken in de naburige stad Semarang. Hierdoor wordt de lokale bevolking, vooral in het subdistrict Sayung waar ik me op concentreer, blootgesteld aan frequente overstromingen alsook een vermindering van lokale inkomstenbronnen, in de visserij en de landbouw. Sinds 2015 bevorderen internationale NGOs een herbeplantingsprogramma door bestaande mangrove-ecosystemen te versterken en te combineren met semi-permeabele structuren. De mangrove-dekking is echter nog steeds geografisch beperkt en het is bekend dat jonge plantages een lagere beschermingscapaciteit hebben. De financiering van deze DRR-projecten komt meestal uit het buitenland.

Het onderzoek identificeerde drie factoren die van invloed zijn op het beheer van het natuurlijke SG. Ten eerste, heeft Demak vooral te maken met een langzaam wassend rampenrisico. Ten tweede, in termen van de mate van ramp, lijdt het aan een jaarlijkse kusterosie van 5-50 m kustlijn, een jaarlijkse bodemdaling van 10-17 cm (door grondwaterwinning en zware constructie in de omgeving) en zeespiegelstijging van 0,5-8,3 cm per jaar. Ten derde heeft de ontwikkeling van de kust geleid tot een afname van het aantal mangrovesoorten, wat een verminderde veerkracht impliceert.

In Sayung subdistrict, waar in 2015 33.900 mensen woonachtig waren, zijn de bewoners direct of indirect afhankelijk van de mangroves voor toeleveringsdiensten (m.n. uit de visserij en de silvo-visserijproductie) en regulerende diensten (m.n. bescherming tegen overstromingen). Drie sociale factoren beïnvloeden het succes van het kustbeheer: (1) de hoge bevolkingsdichtheid in combinatie met een gefragmenteerd vestigingspatroon, dat de beschermende dekking van mangroves belemmert; (2) de beroepsmatige transities die momenteel plaatsvinden en de afhankelijkheid van de natuurlijke omgeving doen verminderen; en (3) het hoge niveau van migratie naar de stad, dat de bereidheid en het vermogen om het mangrove-aanplantprogramma uit te voeren beïnvloedt (Hoofdstuk 5).

Het Besturingssubsysteem (GS)

De huidige strategieën voor het bereiken van duurzame kustbescherming zijn gevarieerd (bijvoorbeeld mangrovebeplanting, hybride structuren en capaciteitsopbouw van actoren). Het GS in Demak is divers in termen van soorten en niveaus van actoren. Elk van de actoren bezit verschillende interesses, doelen, verwachtingen, capaciteiten en coördinatievermogens.

Dit onderzoek identificeerde drie factoren die belangrijk zijn om de beheersbaarheid te beoordelen. Ten eerste, wat betreft actoren, is kustoverstroming in Demak aangepakt door diverse actoren waarbij internationale NGO's een belangrijke rol hebben gespeeld. Ten tweede, wat betreft het aansluiting vinden tussen percepties van het betreffende probleem, instrumenten, doelen en actie, is er een gebrek geconstateerd aan overeenstemming tussen belanghebbenden over de precieze oorzaken van de zich voordoende problemen. De problemen en de niveaus waarop kustoverstromingen plaatsvinden, komen bovendien niet overeen met de capaciteiten van het besturingssysteem, vooral op regionaal en lokaal niveau. Ondertussen is het coördinatiemechanisme dat door de overheid is opgezet inactief, wat heeft geleid tot een gefragmenteerde aanpak. Elk van de actoren blijkt gemandateerd door andere wettelijke regelingen.

Ten derde komt de *co-governance* stijl van bestuur tot uiting in de samenwerking en partnerschappen van NGOs en gemeenschapsgroepen, evenals in de *public-private partnerships* die zijn ingesteld door de nationale overheid en het consortium Wetlands International en Ecoshape. Het tekort aan financiële middelen heeft echter wel geleid tot concurrentie tussen verschillende gemeenschapsgroepen (Hoofdstuk 6).

Besturingsinteracties (GI)

Ik heb de GI die in Demak plaatsvonden onderzocht middels de effectiviteit van het genereren, delen en distribueren van kennis. Mijn onderzoek toont aan dat overheidsinstanties en NGOs informatie met lokale mensen delen om de paraatheid te vergroten. Deze informatie omvat kennis over overstromingen, het mangroves-aanplantprogramma, de planning van infrastructuurwerken uitgevoerd door de overheid (d.w.z. aanleg van wegen en golfbrekers) en de activiteiten van NGOs (constructie van hybride structuur en informatie over andere ontwikkelingsplannen in de dorpen). De werkwijze van de lokale politiek belemmert echter de eerlijke vertegenwoordiging van lokale mensen bij de kennisneming van informatie en het deelnemen aan programma's. (Hoofdstuk 6).

Risico en bestuurbaarheid

Deze studie identificeert hoe genoemde factoren bijdragen aan de eerder genoemde vier benaderingen van beheer. Deze omvatten: (1) Coördinatie. Besturingssystemen in Demak district zijn divers en gefragmenteerd, wat het beheer van kusterosie en overstromingen en inspanningen om mangroven te rehabiliteren en kustgebieden revitaliseert doet verminderen; (2) Aansluiting tussen de diagnose van het bestaande probleem, de doelen en de mandaten van verschillende actoren alsook de beschikbare instrumentaria is beperkt, wat gedeeltelijk te wijten is aan een gebrek aan wetenschappelijk bewijs; (3) Sociale mobilisatie ten behulp van kustbescherming is tot op heden nog weinig inclusief en sluit bepaalde categorieen van de bevolking uit; (4) Er heeft weliswaar een proces van leren en vergroting van aanpassingsvermogen plaatsgevonden, maar dit moet – gezien het veranderend karakter van kustrampen – wel voortgezet worden.

Bovendien blijft de afhankelijkheid van de overheid van buitenlandse financieringsbronnen met betrekking tot Eco-DRR-projecten groot. Dit schept uitdagingen in termen van legitimiteit, soevereiniteit en het bereiken van duurzaamheid (hoofdstuk 6). Het Public Private Partnership-model is onlangs via het project Building with Nature Indonesia (en in samenwerking met het Indonesische ministerie van Marine Affairs and Fisheries, Ministerie van Openbare Werken en Human Settlement en het Nederlandse Ecoshape-consortium) geïntroduceerd. Dit biedt mogelijkheden tot het ontwikkelen van een nieuwe co-governance aanpak. Dit kan ten goede komen aan de vier genoemde benaderingen. (Hoofdstuk 6).

Case study: Parangipettai Block, Tamil Nadu, India

Probleem en systeem het te besturen systeem (SG)

India heeft een kustlijn van 7.517 km. Ik heb me gericht op het administratieve subdistrict (ofwel *Block)* Parangipettai in het district Cuddalore, in de deelstaat Tamil Nadu. Ik heb dit gebied gekozen omdat het zwaar werd getroffen door de tsunami van 2014 alsook door zware stormen; bovendien maakt men in dit gebied gebruik van mangrove-ecosysteemdiensten om dergelijke risico's het hoofd te bieden. Mangroven zijn in dit gebied echter gedegradeerd als gevolg van onwetenschappelijk uitgevoerd beheer. Mangrove-dekking neemt onlangs echter opnieuw toe dankzij het Joint Mangrove Management (JMM) -programma onder leiding van de MS Swaminathan Research Foundation (MSSRF). Ondanks de hedendaags goede kwaliteit van de mangrovebossen, wordt hun voortbestaan bedreigd door industriele vervuiling en de uitbreiding van de visteeltindustrie. Zonder passend duurzaam beheer kan de ontwikkeling van toeristische activiteiten ook een bedreiging vormen voor het voortbestaan van mangroves (Hoofdstuk 7).

Ik identificeer drie factoren die de *governability* van het natuurlijke SG beïnvloeden. Ten eerste, in termen van het ramptype, wordt Parangipettai Block vooral bedreigd door plotseling opkomende rampscenario's, zoals veroorzaakt door zware stormen (*cyclone)* en tsunami's. Wat betreft de intensiteit van de ramp wordt deze regio geconfronteerd met een jaarlijkse bodemdaling van 0,34 mm en een jaarlijkse zeespiegelstijging van 0,13 - 0,32 mm. Ten derde, in termen van de kwaliteit van de mangrovebossen, geeft de fysieke conditie van het huidige bestand een hoge geschiktheid voor deze vorm van Eco-DRR aan.

In termen van sociale SG, onderzocht ik 3 van de 41 Panchayat Unions – een administratieve eenheid boven het niveau van de gemeente - in Parangipettai Block, waarbij drie factoren werden geïdentificeerd die de *governability* beïnvloeden. Ten eerste, neemt de populatie langzaam in omvang toe; de nederzettingen zijn op dusdanige wijze geclusterd, dat bescherming door de nabij gelegen mangrovebossen wordt bevorderd. Ten tweede vindt er slechts een geringe migratie uit het gebied naar de steden plaats. Tenslotte is, net als in Demak, de lokale bevolking ook direct of indirect afhankelijk van de mangroves voor de het levensonderhoud en de regulerende diensten.

Besturingssysteem (GS) in Parangipettai Block

Net als Demak zijn strategieën voor het bereiken van duurzame kustbescherming in de loop van de tijd veranderd, en vinden ze plaats in het kader van zowel de overheidswetgeving als de activiteiten van NGOs.

Ik onderzocht de manier waarop vier benaderingen de *governability* van rampen beïnvloeden. Ten eerste is het probleem van mogelijke rampen aangepakt door middel van het Joint Mangrove Management (JMM) -programma. Het JMM-programma, dat hoofdzakelijk wordt gefinancierd door buitenlandse donoren, wordt geleid door de MS Swaminathan Research Foundation (MSSRF), een lokale onderzoeks-NGO. MSSRF heeft van het Ministry of Environment and Forests (MoEF) niet alleen het vertrouwen maar ook de middelen gekregen om dit programma uit te voeren, en neemt ook de coördinatie taken op zich. Ten tweede lijken de percepties van het aanwezige probleem (d.w.z. de teloorgang van mangrovebossen) qua visie en instrumentarium te passen bij de doelstellingen (d.w.z. behoud en maximalisering van ecosysteemdiensten voor kustbescherming en verbetering van het levensonderhoud) alsook de activiteiten (d.w.z. mangroves planten en trainingen uitvoeren met gemeenschapsparticipatie). De op ecosystemen gebaseerde aanpak is ook expliciet opgenomen in de voornaamste regelgeving voor het kustgebruik, te weten het Coastal Regulation Zone Notification 2011. Dit beleidsdocument bevat verwijzingen naar het gebied van rampenbeheer, bosbeheer alsook het behoud van biodiversiteit. Ten derde heeft het geheel van bestuursmaatregelen het probleem van het herstel van mangrovebossen opgelost, en tevens – met behulp van een *co-governance* bestuursmodel - gezorgd voor een verbetering van leefomstandigheden en en kustbescherming (Hoofdstuk 8). De belangrijkste struikelblok is dat de Eco-DRR activiteiten van JMM niet volledig geïntegreerd zijn in de kustbeschermingsactiviteiten van het districtsbestuur van Cuddalore.

Besturingsinteracties (GI)

Evenals in Demak, heb ik heb GI in Parangipettai onderzocht middels de effectiviteit van het genereren, delen en distribueren van kennis. Mijn onderzoek toont ten eerste aan dat overheidsinstellingen, MSSRF, onderzoeks- en academische instellingen alsook de lokale bevolking in de loop van de tijd het probleem van kustbescherming hebben leren begrijpen, en kennis over de teloorgang maar ook het herstel van mangroves hebben verspreid. Om het mangrove-ecosysteem te herstellen, is er een gemeenschappelijk leerproces ontstaan tussen verschillende actoren. De lokale bevolking heeft geleerd over de oorzaken van degradatie, de voordelen van mangroven en innovatieve technieken om ze aan te planten. Ondertussen hebben de NGOs van de lokale bevolking geleerd over de bestaande toestand van kusterosie en overstromingen en hebben ze vastgesteld hoe de Participatory Rural Appraisal (PRA) -methoden effectief kunnen worden uitgevoerd. Ten tweede, om brede deelname van de lokale bevolking in het beheer mogelijk te maken, zijn er nieuwe Village Mangrove Councils (VMC) en Village Knowledge Centres (VKC) opgericht. Het functioneren van deze organen heeft de deelnemers veel geleerd over participatieprocessen. Hoewel MSSRF aanvankelijk moeite had het vertrouwen van de lokale gemeenschappen te winnen, heeft hun inzet geholpen om een uitgebreid en legitiem kustbeschermingsprogramma op te zetten (zie Hoofdstuk 8).

Risico en bestuurbaarheid

Wederom heb ik in Parangipettai Block nagegaan hoe genoemde factoren bijdragen aan de eerder genoemde vier benaderingen van beheer: (1) Coördinatie. Het besturingssysteem in Parangipettai is divers, maar goed gecoördineerd; dit draagt bij aan een geintegreerde aanpak van de kustbescherming; (2) Aansluiting. Er is duidelijke overeenstemming over de oorzaak van het probleem (vooral voor wat betreft de degradatie van de mangrovebossen) vanwege gedegen wetenschap in combinatie met lokale kennis. Juridische instrumenten met betrekking tot kustbeheer hebben elkaar aangevuld, waardoor de huidige poging om Eco-DRR in te voeren, is bevorderd; (3) Sociale mobilisatie. Mijn onderzoek toont aan dat de Eco-DRR-aanpak in Parangipettai Block brede deelname en participatie van de gemeenschap in dorpen in de kustbeschermingsprojecten heeft gerealiseerd. De ramp met de tsunami (2004) heeft bijgedragen aan een bereidheid tot collective actie. Door een bestuursmodel van *co-governance* te volgen, is de betrokkenheid van belanghebbenden vergroot en sociale mobilisatie redelijk geslaagd; (4) Leren en aanpassingsvermogen. De kwaliteit van GI, inclusief leerproces en aanpassingsvermogen, is in het JMM-programma verankerd. Door de oprichting van VMCs en VKCs, is dit programma bijzonder inclusief geworden. Hoewel financiering afkomstig is van internationale donoren, zijn de planning en uitvoering volledig uitgevoerd door de MSSRF waardoor de legitimiteit en soevereiniteit van het project is vergroot. Ondanks alle positieve aspecten van de gehanteerde aanpak, ondervindt het beheer in Parangipettai Block nog steeds substantiele uitdagingen, m.n. ten aanzien van de lange termijn effecten van klimaatverandering. Bovendien blijft de integratie van dit mangrove-programma in het bredere beleid van kustbeheer een aandachtspunt.

Vergelijking Demak en Parangipettai

De analyse van de **aard van het probleem** toont aan dat het niveau van *governability* in de case study van Indonesië over het algemeen lager is dan in India als gevolg van een verschil in de aard van het zich voordoende probleem, de onduidelijkheid over haar precieze oorzaken, alsook de manier waarop het programma voor kustbescherming is ontworpen (zie hoofdstuk 9). Met betrekking tot de kenmerken van het **natuurlijke SG** komen Demak en Parangipettai redelijk overeen. Wel is de status van mangroves in India gezonder dan in Indonesië, wat wijst op lagere risico's en hogere *governability* (zie hoofdstuk 9). De analyse van het te reguleren sociale SG onthult dat er meer mensen in in drie dorpen in Demak aan overstroming worden blootgesteld dan in alle 17 nederzettingen rondom Pichavaram Mangrove Forest, in Parangipettai Block, India. Er vindt in Demak een sterkere beroepsmatige transitie plaats, die mogelijk verbonden is met de hogere migratiegraad. Migratie kan wijzen op verminderde sociale cohesie, en daarmee ook verbonden zijn met mindere effectieve sociale mobilisatie. Hoewel de lokale bevolking in beide case-studies zelfstandig maatregelen heeft genomen om kustrampen te voorkomen, zijn deze op lange termijn onvoldoende (zie hoofdstuk 9).

Uit de analyse van het **GS** blijkt dat er in beide gevallen veel overheidsinstanties bij kustbescherming betrokken zijn, van nationaal tot lokaal niveau; eveneens vindt men internationale en lokale NGOs en lokale mangrovegroepen. Ten tweede, blijkt het beeld van het aanwezige probleem is duidelijk in beide case-studies. De verklaring van de oorzaken van het probleem in Demak is echter nog steeds in het geding. Bovendien zijn regelgeving en activiteitenprogramma's in Demak nog onvoldoende op elkaar afgestemd, en is het coordinatiemechanisme nog inactief Ondertussen, in Parangipettai, zijn de regelgeving en wetgeving meer coherent, ondanks dat de uitvoering van het programma nog uitdagingen kent. In Parangipettai Block wordt het scala van actoren dat deelneemt in het JMM-programma gecoördineerd door MSSRF, met ruggensteun van de Indiase overheid (zie Hoofdstuk 9).

Trajecten om de bestuurbaarheid van Eco-DRR / EbA te verbeteren

De vier geschetste benaderingen blijken alle relevant te zijn voor de *governability* van de kustbescherming op basis van Eco-DRR. In hoofdstuk 10 worden zij nogmaals onderzocht. Saillante conclusies zijn:

1. *Coördinatie*. De diversiteit van het SG (natuurlijk en sociaal) in kustgebieden gaat dikwijls samen met het bestaan van een groot aantal actoren in het GS. Dit laatste levert echter ook specifieke uitdagingen op in termen van coördinatie en het bereiken van consensus over kustbeheer. In beide case-studies is sterke coördinatie nodig, maar vanwege een complexer en breder ingebed probleem, heeft Demak meer inspanning nodig om effectief te zijn. Er kan worden verwacht dat effectieve coördinatie een positieve bijdrage zal leveren aan de effectiviteit van de overige drie benaderingen. Mijn onderzoek suggereert dat de coördinatietaak op lange termijn alleen maar door de overheid kan worden uitgevoerd. NGOs en bedrijven kunnen echter projecten initiëren en uitvoeren.

2. *Aansluiting*. Wanneer er duidelijk afstemming bestaat tussen het begrip van de aanwezige kustbeschermingsproblem, de doelstellingen van een programma en het instrumentarium, kan een Eco-DRR-benadering effectiever zijn. In Parangipettai, India, is in dit opzicht veel bereikt. Kern van het succes aldaar is dat de leiding van het programma gevestigd was in één gerespecteerde organisatie die rugdekking ontvangt van de overheid. Maar om 'aansluiting' te verkrijgen is meer nodig. Ten eerste, in termen van het probleem: hoe moeilijker en meer ingebed het probleem is, hoe uitdagender het bereiken van een goede aansluiting, omdat er een gebrek aan overeenstemming is tussen belanghebbenden. Ten aanzien van de overstromingsproblematiek in Demak kwam dit tot uiting. Daarnaast, wanneer er geen inzicht is

in welk probleem prioriteit moet krijgen, bijvoorbeeld met betrekking tot de strijd tussen de noodzaak om een waterbeschermingsinfrastructuur in de stad Semarang aan te leggen en de gevolgen van bepaalde ontwikkelingen voor het platteland van Demak, is het moeilijk om een effectieve reactie te verwachten van actoren in de GS.

Tot slot, in termen van GI, kan een adequate aanwezigheid en kwaliteit van het genereren en delen van kennis worden bereikt door middel van op wetenschap gebaseerde gegevens. De afwezigheid van voldoende wetenschappelijke inzichten, zal de inspanningen voor Eco-DRR en klimaatadaptatie belemmeren.

3. *Sociale mobilisatie*. Binnen de GS is een responsief bestuursmodel vereist, waarbij co- en zelfbestuurstijlen worden ondersteund door een wettelijke instantie op nationaal niveau. Nationale autoriteiten zullen hierbij de hoofdverantwoordelijkheid moeten blijven nemen om duurzame

De vorm en snelheid van een ramp kan van invloed zijn op sociale mobilisatie. Een plotselinge ramp (zoals de tsunami van 2004 in India) kan meer sociale mobilisatie teweeg te brengen dan een sluipende ramp (zoals in Demak). In Demak neigen lokale mensen ertoe de situatie te accepteren als het 'nieuwe normale' en zich dagelijks aan te passen aan de voortdurende erosie en overstromingen in plaats van zich te mobiliseren voor acties op lange termijn. Wat GI betreft, betoog ik dat sociale mobilisatie mogelijk zal worden gemaakt door een doorgaand en inclusief leerproces, dat betrokkenheid van belanghebbenden vergroot.

4. *Leren en aanpassen*. Het bestaan van een leerplatform voor kennisuitwisseling is cruciaal om de duurzaamheid van de Eco-DRR-inspanningen te waarborgen. Kennis moet echter telkens worden bijgewerkt en gevalideerd. Bovendien is het van belang dat informatie eerlijk tussen mensen wordt gedeeld. Het geval van Parangipettai laat zien dat de oprichting van een Village Knowledge Centre (VKC) helpt de informatie op een geïntegreerde en eerlijke manier te verspreiden. Nogmaals, coördinatie werd cruciaal om ervoor te zorgen dat het genereren van kennis en het delen en verwerken van leren en aanpassingsvermogen effectief is.

Tenslotte

Om een succesvolle Eco-DRR te garanderen, zijn strategieën op de langere termijn belangrijk. Of mangrove-gebaseerde benaderingen relevant zijn en blijven, hangt af van lokale omstandigheden en van de wijze waarop het klimaatveranderingsproces zich ontvouwt. Hoewel mangroves een rol kunnen spelen bij kustverdediging, moeten mogelijk ook andere benaderingen worden overwogen. Een combinatie van op ecosystemen gebaseerde benaderingen is daarbij mogelijk. Hierbij kan het concept van EbA (dat grotere reikwijdte en schalen voor aanpassing aan klimaatverandering omvat) een leidraad bieden. Maar ook hybride systemen – waarbij harde en zachte maatregelen worden gecombineerd – kunnen voor kustgebieden van betekenis zijn.

About the author

Annisa Triyanti obtained her bachelor degree in Geography in 2011 from the Faculty of Geography, Universitas Gadjah Mada (UGM), Indonesia. With the support from Indonesian Beasiswa Unggulan Scholarship from the Ministry of Education and Culture, the Republic of Indonesia and DAAD Germany Scholarship, she continued her study in Master Programme on Planning and Management of Coastal Area and Watershed, Faculty of Geography UGM and ITT Cologne University of Applied Science, Germany, and obtained a joint MSc degree in 2013. She was also working as a junior lecturer in Human Geography at the Faculty of Geography UGM in 2013-2017. Since 2014, she has been engaged in the UN and intergovernmental processes on DRR, Climate Change, and Sustainable Development. She is one of the initiators of the Young Scientists Platform on Disaster Risk Reduction, launched in Geneva in 2016. In 2017, she got appointed as the young scientists' representative to the Global Science and Technology Advisory Group for Disaster Risk Reduction of UNISDR. In March 2014, she began her PhD research in coastal disaster risk governance and ecosystem-based disaster risk reduction in Indonesia and India with a full scholarship from the Indonesian LPDP Beasiswa Scholarship from the Ministry of Finance, Republic of Indonesia. This book, titled "Governing ecosystem-based disaster risk reduction: Mangroves in Indonesia and India" is the outcome of her five years of PhD research.