RISC-KIT

Resilience-Increasing Strategies for Coasts – Toolkit

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D4.1 Potential prevention, mitigation and preparedness measures for each case study site

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Executive Publishable Summary

This report describes the potential prevention, mitigation, and preparedness measures for each of the eleven case studies included in RISC-KIT (Resilience-Increasing Strategies for Coasts – toolKIT) (RISC-KIT deliverable 4.1). Based on data collected in Task 1.2, a discussion with case study owners about potential measures, as well as written material the measures were identified and are presented according to what Disaster Risk Management (DRM) phase (prevention, mitigation, preparedness, response, or recovery) and dimension of disasters (hazard, exposure, or vulnerability) they address as well as the nature of the measure (technical, policy/planning, investigation/research, capacity building/information, and ecosystem-based).

In addition to the potential measures, this deliverable presents measures that are planned, in construction/ongoing, or implemented in the case study areas for an improved understanding of the issues that are already covered and what the remaining gaps are. Each of the eleven case studies also elaborate on what plans and processes already exists in the area and what RISC-KITs specific contribution could be in the individual case.

The case studies display multiple hazards, although coastal storm impact with associated flooding and erosion dominate. All phases of the DRM cycle are represented in most case studies, but prevention/mitigation and preparedness often dominate. All types of measures are represented, although technical measures dominate and investigation/research measures are least represented. Most case studies have some ecosystem-based measures.

Although there is a diversity of contexts and situations in the case studies, some commonalities can be observed where RISC-KIT can contribute:

While the type of measures differ very much from case to case, it is evident that DRR plans need to consider both long-term hazards such as erosion, annual hazards like river or flash flooding, and rare high impact storm events.

Bringing different stakeholders views and knowledge together, including the coordination between different government bodies, would contribute to more integrated approaches. It could also clarify to stakeholders how their views have been incorporated in existing plans.

There is an important role for the project to point to the economic benefits of ecosystem services and how to assess and fund them supported by political priorities. How to define boundaries to inland systems will be a future concern for some cases in an effort to achieve Integrated Coastal Zone Management, which could be aided by the combined Early Warning /Decision Support System.

RISC-KIT is seen as a good complement to existing plans through its tools to address coastal hazards. For example, the Flood Early Warning System is seen as an effective means of highlighting the locally specific aspects and the need for improvements. As such it provides a concrete input into the communication with local populations for coastal DRR planning and to justify and attract funding for such measures.

1 Introduction

Recent and historic low-frequency, high-impact events such as Xynthia (affecting France in 2010), the 2011 Liguria (Italy) Flash Floods, the torrential rain and heavy floods killing a dozen people in Varna (Bulgaria, June 2014), and the 1953 North Sea storm surge which inundated parts of the Netherlands, Belgium and the UK have demonstrated the flood risks faced by exposed coastal areas in Europe. Typhoons in Asia (such as Typhoon Haiyan in the Philippines in November 2013), hurricanes in the Caribbean and Gulf of Mexico, and Superstorm Sandy, affecting the northeastern USA in October 2012, have demonstrated how even larger flooding events pose a significant risk and can devastate and immobilize large cities and countries.

These coastal zone risks are likely to increase in the future (IPCC, 2014) which requires a re-evaluation of coastal disaster risk reduction (DRR) strategies and a new mix of prevention (e.g. dike protection), mitigation (e.g. limiting construction in flood-prone areas; ecosystem-based solutions) and preparedness (e.g. Early Warning Systems, EWS) (PMP) measures. Even without a change in risk due to climate or socio-economic changes, a re-evaluation is necessary in the light of a growing appreciation of ecological and natural values which drive ecosystem-based or nature-based flood defense approaches. In addition, as free space is becoming sparse, coastal DRR plans need to be spatially efficient, allowing for multi-functionality. Nevertheless, societal and cultural perceptions, but also the events themselves, significantly shape preferences, drivers and acceptance towards such approaches.

This report addresses some of these issues by presenting the findings from the eleven case studies included in RISC-KIT (Resilience-Increasing Strategies for Coasts–Toolkit) with regard to what the current measures are and what measures could be proposed to help prevent, mitigate, and prepare for coastal hazards occurring within as well as outside Europe.

1.1 Project objectives

In response to these challenges, the RISC-KIT project aims to deliver a set of open-source and open-access methods, tools, and management approaches to reduce risk and increase resilience to low-frequency, high-impact hydro-meteorological events in the coastal zone. These products will enhance forecasting, prediction and early warning capabilities, improve the assessment of long-term coastal risk and optimize the mix of PMP-measures. Specific objectives are:

1. Review and analysis of current-practice coastal risk management plans and lessons-learned of historical large-scale events;
2. Collection of local socio-cultural-economic and physical data at case study sites through end-user and stakeholder consultation to be stored in an impact-oriented coastal risk database;
3. Development of a regional-scale coastal risk assessment framework (CRAF) to assess present and future risk due to multi-hazards (Figure 1.1, top panel);
4. Development of an impact-oriented Early Warning and Decision Support System (EWS/DSS) for hot spot areas consisting of: i) a free-ware system to predict hazard intensities using coupled hydro-meteorological and morphological models

and ii) a Bayesian-based Decision Support System which integrates hazards and socio-economic, cultural and environmental consequences (Figure 1.1, center and bottom panel);

5. Development of potential DRR measures and the design of ecosystem-based and cost-effective, (non-)technological DRR plans in close cooperation with end-users for a diverse set of case study sites on all European regional seas and on one tropical coast (Figure 1.1, bottom panel);
6. Application of CRAF and EWS/DSS tools at the case study sites to test the DRR plans for a combination of scenarios of climate-related hazard and socio-economic vulnerability change and demonstration of the operational mode;
7. Development of a web-based management guide for developing integrated DRR plans along Europe's coasts and beyond and provide a synthesis of lessons learned in RISC-KIT in the form of policy guidance and recommendations at the national and EU level.

The tools are to be demonstrated on case study sites on a range of EU coasts in the North- and Baltic Sea Region, Atlantic Ocean, Black Sea and Mediterranean Sea, and one site in Bangladesh, see Figure 1.2. These sites constitute diverse geomorphic settings, land use, forcing, hazard types and socio-economic, cultural, and environmental characteristics. All selected regions are most frequently affected by storm surges and coastal erosion. A management guide of PMP measures and management approaches will be developed. The toolkit will benefit forecasting and civil protection agencies, coastal managers, local government, community members, NGOs, the general public, and scientists.

1.2 Project structure

The project is structured into seven Work Packages (WP) starting with WP1 on 'Data collection, review and historical analysis'. WP2–4 will create the components of the RISC-toolKIT containing an 'Improved method for regional scale vulnerability and risk assessment' (WP2), 'Enhanced early warning and scenario evaluation capabilities for hot spots' (WP3) as well as 'New management and policy approaches to increase coastal resilience' (WP4). The toolkit will be tested through 'Application at case study sites' (WP5). WP6 will be responsible for 'Dissemination, knowledge transfer and exploitation' and 'Coordination and Management' are handled in WP7.

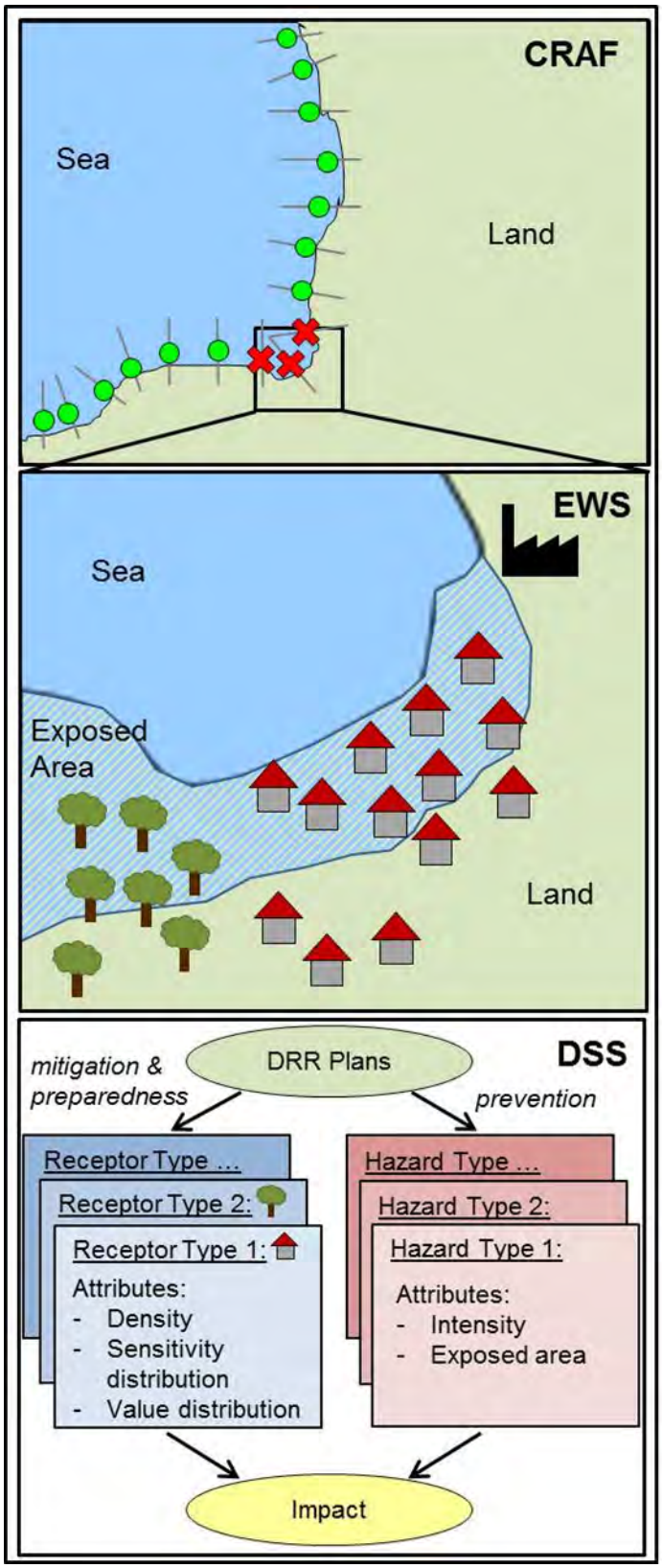

Figure 1.1: Conceptual drawing of the CRAF, the EWS, and the DSS

Figure 1.2: Case study sites, RISC-KIT case study site partners, and non-case study site partners*

* Stars – Case study site; blue solid dots – RISC-KIT case study site partners; red open circles – non-case study site partners

1.3 Deliverable context and objective

The current deliverable 4.1 is part of WP 4. The objectives of WP 4 are to:

- Develop potential DRR measures
- Design site-specific DRR plans and evaluate their effectiveness and feasibility after their application and scenario testing at case study sites in WP5
- Create a web-based management guide for developing integrated risk-reduction plans in other locations
- Synthesize findings and provide recommendations for management and policy guidance

This deliverable addresses the first of the WP4 objectives and Project Objective 5 (Development of potential DRR measures and the design of ecosystem-based and cost-effective, (non-)technological DRR plans in close cooperation with end-users for a diverse set of case study sites on all European regional seas and on one tropical coast in Bangladesh) by providing the potential prevention, mitigation, and preparedness measures that will feed into the DRR plans for each of the eleven case study areas.

The Description of Work (DoW: 16) states that:

> In the first phase, potential prevention, mitigation and preparedness measures (D4.1 [this deliverable]) will be developed based on the data collected in Task 1.2 and the indicators developed in Task 2.2. An integrated approach that takes socio-economic, cultural and environmental issues and policies into account will be followed. Design criteria will also be drawn from the phase 1 report of Task 1.1 (which reviews the current-practice coastal DRR management plans at the EU level, at the national level for member states with case study sites and at the supra-national level) to ensure that the proposed DRR measures are in line with existing policy and further, to promote policy coherence (…).

The current deliverable 4.1 only diverts from the DoW in that the indicators from Task 2.2 have not been used to any great extent, because we found that these indicators by nature were less relevant as input to the development of measures as originally foreseen. The reference to Task 2.2 was included in the DoW to make sure there would be appropriate cross-referencing and synergies between related tasks if need be, and this has been achieved through the use in Task 2.2 of the measures coming out of the interviews. This is described further below in Chapter 2.

In addition to the potential measures, this deliverable presents measures that are planned, in construction/ongoing, or implemented in the case study areas for an improved understanding of the issues that are already covered and what the remaining gaps are. This is an important input to the objective 2 of WP4 – the design of site-specific DRR plans, to be developed in a collaborative way in the next phase of WP 4 and built on the contents of this report.

1.4 Outline of the report

This report is structured as follows. In Chapter 2, the approach and methods used in identifying the potential prevention, mitigation, and preparedness in each case study are presented. First, the theories and practices concerning collaborative learning are

explained. This is followed by an introduction to ecosystem-based approaches for DRR – something that the RISC-KIT has included as a central element to integrate if feasible in its different working areas. The actual steps taken by the task leader and participants in developing the measures are described in the section that follows. The outcomes of these steps are presented in Chapter 3, case per case. The final chapter, Chapter 4, pulls the findings together and reflects upon them. Finally, the next steps – the development of DRR plans for each specific case, including a suggested basic template for such a plan – are presented.

2 Approach and methods

We have followed the DoW where potential prevention, mitigation, and preparedness measures were developed for each case study site based on the data collected in Task 1.2, complemented with written material in several of the cases. The potential measures were compiled and compared and complemented with the existing measures that were identified in the interviews with local stakeholders. The case study owners (CSOs) furthermore added additional suggested prevention, mitigation and preparedness measures for the case study sites. The purpose of this exercise is to prepare for a second phase (Milestone 8), where the set of locally appropriate measures will be compiled into DRR and resilience plans specific to each case study site. The results of Task 4.1 will feed into WP5, Task 5.3, where the site-specific DRR plans will be tested against various hydro-meteorological event scenarios.

The indicators developed in Task 2.2 were originally thought to be informing this work, but this turned out not to be necessary. Task 2.2 is by its nature more depending on input from Task 4.1 as indicators can be derived from the measures/hazards but the indicators are less relevant as input in the development of measures. The reference to Task 2.2 was included in the DoW to make sure there would be appropriate cross-referencing and synergies between related tasks if need be, and this has been achieved through the use of the measures coming out of the interviews in Task 2.2.

The measures in the case studies have been developed and designed in the context of the current policy frameworks at supra-national and national level. This has been done to ensure that the proposed DRR measures are in line with existing policy and further, to promote policy coherence. These policies are sometimes referred to in relation to the case study descriptions, and described more in detail in the deliverable of Task 1.1. This report reviewed the current practice of coastal DRR management plans at the EU level, at the national level for member states with case study sites, and at the supra-national level, which was available as Milestone 5, the text of which will be published as the first section of D1.1. This deliverable is available on the website Riskit.eu.

An integrated approach that takes socio-economic, cultural, and environmental issues and policies into account was followed using information from extensive stakeholder consultations and a collaborative learning approach, which is described in more detail below. The collaborative learning approach provides steps for a planning process where measures and governance mechanisms are to be implemented for integrated coastal zone planning and management. This includes knowledge and consensus building, communication, and involvement of stakeholders. Existing guidelines on collaborative learning were used and adapted to fit coastal planning, informed by the experience of ten case studies in Europe and one in Bangladesh. We have added a specific section on ecosystem-based approaches in this report to highlight this area in particular as an important potential outcome of the collaborative learning approach.

2.1 Collaborative learning

The theory underpinning the work on DRR measures and their integration in planning and implementation in WP4 is part of the field of collaborative learning which stems from social learning, which basically means “learning together by doing together” (Craps,

2003: 5). This type of learning is an essential part of adaptive management which is more generally defined as a systematic process for improving management policies and practices by learning from the outcomes of management strategies that have already been implemented (Pahl-Wostl et al., 2007). Adaptive management stems from the recognition that interactions between people and ecosystems are inherently unpredictable, that current knowledge will never be sufficient for future management and, thus, management needs to be adaptable to new information and changing circumstances (Raadgever et al., 2008). Learning is a foundation for good decision making in adaptive processes, both prior to the decisions but also in the process that follows.

Participatory processes are necessary to allow for a constant exchange of information and knowledge, and co-operation among actors and societal levels (Huitema et al., 2009). By using information from scientific research and applying that research to inform policy and management in a collaborative learning process the gaps among actors involved in DRR can be bridged, thus creating a "Collaborative Learning Bridge" (Feurt, 2008: 4). Techniques of learning support the development of strategies that reconcile conflict in order to focus on the design and implementation of solutions to environmental problems.

There are different tools and mechanisms to apply and research exists about models for facilitating learning and participation among stakeholders in co-management arrangements (Pinkerton, 1989), small groups or learning alliances (Butterworth and Morris, 2007, Moriarty et al., 2007, Van Koppen et al., 2009), and river basins (Tippett et al., 2005, Blackmore et al., 2007, Mostert et al., 2007) or in ecosystem approaches as part of land use planning (Pirot et al., 2000, Janssen, 2002).

In spite of past research and experience, there are challenges in taking the last step in applying such models for the integration of risk and safety concerns with sustainable land and water management (Johannessen and Granit, 2015). Achieving good adaptive processes to achieve equitable risk reduction is not easy. Public policy faces an enormous challenge that must make progress by crafting technically competent decisions through processes that create and involve an informed citizenry (Daniels and Walker, 2001). Risk management and the reduction of risks can also become a debate about different measures, but less about the quality of the process of establishing consensus and evaluating appropriate alternatives of such measures with the affected stakeholders. Without an adequate, broad participation, it may become an inadequate top down and non-transparent process, favoring business as usual and dominant coalitions. The challenge is also the process of integrating the views of a multitude of different actors who views the environment and their role in managing it through an individual lens affected by their education, training, work experience and the requirements of their job (Daniels and Walker, 2001). Potentially, each person therefore has a unique perspective of the system and its dynamics co-existing in a system.

Through a collaborative learning platform a wider circle of expertise and knowledge can be brought in. Bringing together stakeholders with e.g. ecological, governance, land use, educational practices, science, technology, and local knowledge – perhaps persons who have never met before – can generate substantial learning outcomes (Smits et al., 2007). In RISC-KIT it is therefore also interesting to note who the persons are that get involved in particular issues and what their histories are in a place-based context (Martinez et al.,

2014). One of the roles of WP4 is to widen that circle to include, or plan to include, the relevant stakeholders (see Table 2.1 for the stakeholder groups at the coast whose knowledge RISC-KIT taps into and the knowledge domains they are present in). The role of RISC-KIT would be to act as a trigger, to show the benefit of including different types of knowledge, an approach that could become permanent and continue after the project. However, for each case study the work in WP4 needs to assess whether this is relevant and possible, and provide insights about its relative benefits, insights that will feed into the guideline (D4.3).

Table 2.1: Knowledge domains and users of the knowledge

Knowledge domains	**Knowledge within the domain**	**People who use this knowledge**
Ecological knowledge	Understanding the structure and function of the coastal environment, the hydrologic cycle, connections between groundwater and marine waters, and the value of ecosystem services provided by a coastal area.	Ecologists, farmers, hydrologists, coastal managers, marine ecologists, consultants, local residents
Governance knowledge	Understanding the interrelationships among policy, regulations, government hierarchy, planning documents, ordinances, and the structures and processes in place to execute them.	Coastal planners, code enforcement officers, elected officials, regulators, local authority
Land use knowledge	Understanding the ways land management and conservation and the design of infrastructure and development can influence risk related issues and the ways that safety issues, socio-economic value, and ecological value of land can be balanced.	Land use planners, coastal planners, farmers, developers, public works directors, water district managers
Educational practices knowledge	Understanding how risk knowledge is generated and transferred among the knowledge domains. Designing and evaluating the effectiveness of education and outreach strategies.	Education and outreach specialists, trainers, science translators, town planners
Risk & safety knowledge	Understanding of risk, exposure, vulnerability, and hazard and the actions for prevention, mitigation, preparedness, response and recovery.	Civil protection officer, disaster management officers, local residents
Science knowledge	Understanding the factors influencing climate, environment, culture and socio-economic development for the purpose of documenting conditions, monitoring change, understanding cause and effects, and evaluating the effectiveness of management practices and policies	Natural and social scientists, environmental and climate monitoring professionals, regulators, local residents (e.g. citizen scientists)
Technology knowledge	Understanding the use and application of engineering and computer technologies for safety and risk reduction measures, mitigate impacts, best management practices.	Engineers, public works directors, technical planners, consultants

Local knowledge	Understanding connections between the people and places in the community, including familiarity with town history, values, decision making, conflicts and past hazard events	Town planners, public works directors, elected officials, farmers, developers, local residents, chairpersons of local citizen groups

Source: adapted from Feurt (2008: 6)

In each of these stakeholder groups there might be one or more champions who are driving one or several local issues. It will be important to identify these persons and to understand how their knowledge and enthusiasm play a role in the implementation of DRR measures. Several bodies of literature have highlighted the significant role emergent leaders can play in triggering and driving change in response to complex environmental challenges (Taylor et al., 2012). Such leaders have been variously described as champions (Andersson and Bateman, 2000, Taylor, 2009), policy entrepreneurs (Brouwer et al., 2009, Meijerink and Huitema, 2010) and change agents (Benn et al., 2006, Dunphy et al., 2007). A growing body of research has focused on emergent leaders (champions), albeit in different contexts (e.g. Andersson and Bateman, 2000, Brown and Clarke, 2007, Meijerink and Huitema, 2010)

Planning and implementation of DRR measures takes time. Learning and understanding the full complexity of the coastal issues may take years to develop into a comprehensive and integrated action. In this way it is the enabling environment for day-to-day learning which is important, not single learning events or trainings. A democratic structure and good interpersonal communication can be central to success, characterized by a dialogue without prestige, positioning, or dominance. Focusing on the common problem, cooperation through open communication, unrestrained thinking, and constructive conflict resolution can contribute to the building of knowledge sustainably over time (Schusler et al., 2003, Johannessen and Hahn, 2013).

2.2 Ecosystem-based approaches for Disaster Risk Reduction

The development of potential DRR measures in RISC-KIT and design of plans should be done by exploring and considering ecosystem-based and cost effective approaches. At this moment, ecosystem-based approaches are not always included in the current focus of the local case studies. However, the collaborative learning approach is a means for an increased inclusion of ecosystem-based approaches through a widening of what types of knowledge gets involved in DRR. According to Sudmeier-Rieux (2009: 9):

> Ecosystem-based disaster management refers to decision-making activities that take into consideration current and future human livelihood needs and biophysical requirements of ecosystems, and recognizes the role of ecosystems in supporting communities to prepare for, cope with, and recover from disaster situations.

Benefits of including an ecosystem-based approach are well documented (Emerton and Bos, 2004, Sudmeier-Rieux and Ash, 2009). Adaptation measures based on the

protection and restoration of relevant coastal natural systems such as mangroves (Schmitt et al., 2013), oyster reefs (Beck et al., 2011) and salt marshes (Barbier et al., 2010) are seen as no- or low-regret options irrespective of the future of climate change (Cheong et al., 2013).

Through ecosystem-based measures, it is often possible to create synergies with sustainable development, for example between flood control and wastewater treatment (Emerton and Bos, 2004) and therefore also potentially meet multiple policy targets. However, in reality the domains of disaster risk reduction and environmental sustainability are found separated in governance arrangements and communities of practice (Johannessen and Granit, 2015). To integrate these domains is part of what WP4 in RISC-KIT aims to contribute towards. The goal of the collaborative learning is not to change the focus of attention of RISC-KITs activities, but rather acknowledge the linkages to these elements as integral part of the planning and decision-making.

Several groups and organizations work collectively to put a value to ecosystem services and to facilitate the integration of ecosystem services approaches into DRR (Emerton and Bos, 2004, PEDRR, 2010, TEEB, 2010), and a few work to address European policy makers on this matter (Sudmeier-Rieux, 2012). Some practical steps and recommendations have been given to promote the use of ecosystem-based approaches in DRR (Sudmeier-Rieux, 2012: 36-37):

#1. Recognize and promote the multiple functions and services provided by ecosystems at multiple spatial scales.

#2. Analyze and promote the cost-effectiveness of ecosystem-based DRR and climate change adaptation.

#3. Combine investments in ecosystems with other effective DRR strategies as part of a diversified 'DRR portfolio'.

#4. Address both long-term and short-term climate risks with [the help of] ecosystem management.

#5. Enhance governance capacities for ecosystem-based DRR through multi-sector, multi-disciplinary platforms and especially in spatial planning.

#6. Create financial and legal incentives for ecosystem-based DRR and climate change adaptation.

#7. Involve local stakeholders in decision-making to ensure more sustainable solutions.

#8. Utilize existing instruments and tools in ecosystem management and enhance their DRR value.

#9. Link ecosystems-based risk reduction with sustainable livelihoods and development.

#10. Foster more science–policy–practitioner dialogues.

2.3 Analysis

In short, the collaborative learning approach consists of four steps:

1. Assessment (covered by Task 4.1)
2. Designing the process (covered by Task 4.2)

3. Implementing collaborative learning (covered by Task 4.2)
4. Evaluation & adaptive management (covered by Task 4.2)

Only the first **Assessment step** is covered by this report where its outcomes are described. The other steps will follow and their outcomes will be presented under Task 4.2 in another report. For this deliverable the assessment step entailed to (adapted from Feurt, 2008):

1. **Understand and clarify the nature of the problem** by collecting different stakeholder perspectives and knowledge. This was mostly covered by Task 1.2, which included identifying relevant stakeholder groups and persons representing those groups as well as interviewing them according to an established interview protocol (see Annex 1).

   The following stakeholder groups were identified for RISC-KIT:

   - Stakeholder 1 (SHI): Coastal manager
   - Stakeholder 2 (SH2): Land use planners
   - Stakeholder 3 (SH3): Civil protection agency/disaster management agency
   - Stakeholder 4 (SH4): Academic working in coastal zone
   - Stakeholder 5 (SH5): Consultant previously engaged in managing the coastal environment
   - Stakeholder 6 (SH6): Local resident previously affected by the hazard
   - Stakeholder 7 (SH7): Chairperson of local active citizen groups
   - Stakeholder 8 (SH8): Local authorities (e.g. port, tourism board, fishing, housing)

   Except for Sandwip (BD) where the interviews were not voice-recorded, the interviews were voice-recorded, transcribed, and translated into English for all case studies. For all case studies the goal was to obtain at least one interview per stakeholder group. This was not achieved in all cases for Task 1.2 but many times complementary interviews were made as part of Task 4.1. For the Zeebrugge case study no interviews were possible with stakeholders of the focus area (outer harbor) due to a request from a key end-user. Instead interviews from the surrounding coastal area were used as well as expert knowledge from the CSO about the outer harbor.

   The interviews were coded using the qualitative data analysis programs MAXQDA (http://www.maxqda.com/) and Atlas.ti (http://atlasti.com/) (see Figure 2.1 for a screenshot of MAXQDA and the codes used). The identified measures were categorized according to three 'dimensions':

   - What phase of disaster risk reduction the measures address: Prevention/mitigation, Preparedness, Response, or Recovery;
   - What part of the chain of events the measure address: Hazard, Exposure, or Vulnerability; and
   - What type of measure it is: Technical, Policy/planning, Investigations/research, or Capacity building/information.

   Finally those measures that were proposed were separated from those that were either planned, in construction/ongoing, or implemented already. The results were used as the basis for step 2 and 3 (see below).

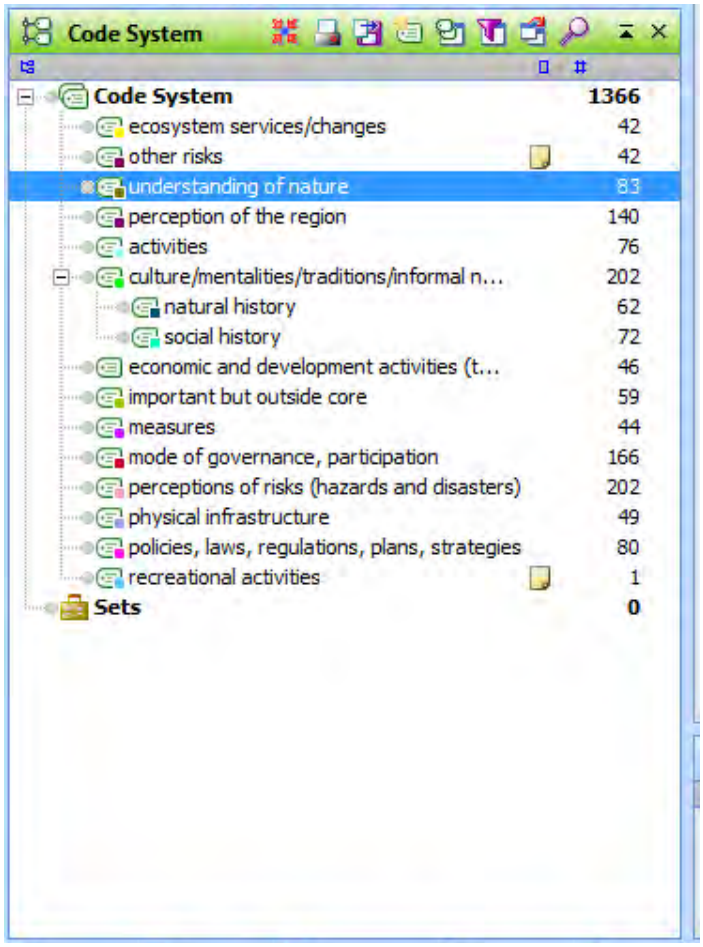

Figure 2.1: Screenshot of code system in MAXQDA

2. The nature of the problem was then illustrated by drawing **situation maps** that synthesize and capture the diversity of perspectives. These were focusing on the different hazards as problem areas and the main planned, in construction/ongoing, and implemented measures to address those were put in relation to them. Figure 2.2 depicts the template used by the case studies in drawing their situation maps.
3. An **assessment matrix** was set up to organize knowledge about the different measures and to provide a summary for overview of who is involved in realizing the different measures. The matrices include proposed measures in addition to those depicted in the situation maps. Apart from the coded interviews the case studies have used various sources for the identification of measures. A list of potential measures, drawn together from literature on coastal DRR and presented according to the three 'dimensions' mentioned above, was also offered as a source that the CSOs could select from (the list can be accessed on the RISC-KIT web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1).

All CSOs were asked to comment and complement the situation maps and assessment matrices, especially with proposed measures in the case they had not been captured by the interviews or in other ways in Task 1.2.

In addition to being a way to capture the stakeholders' perceptions and knowledge on coastal risks and actions that either have already been implemented or that need to be

undertaken along with their limitations and benefits, the situation maps and assessment matrices were constructed to be a tool to feed into the next steps of the collaborative learning process.

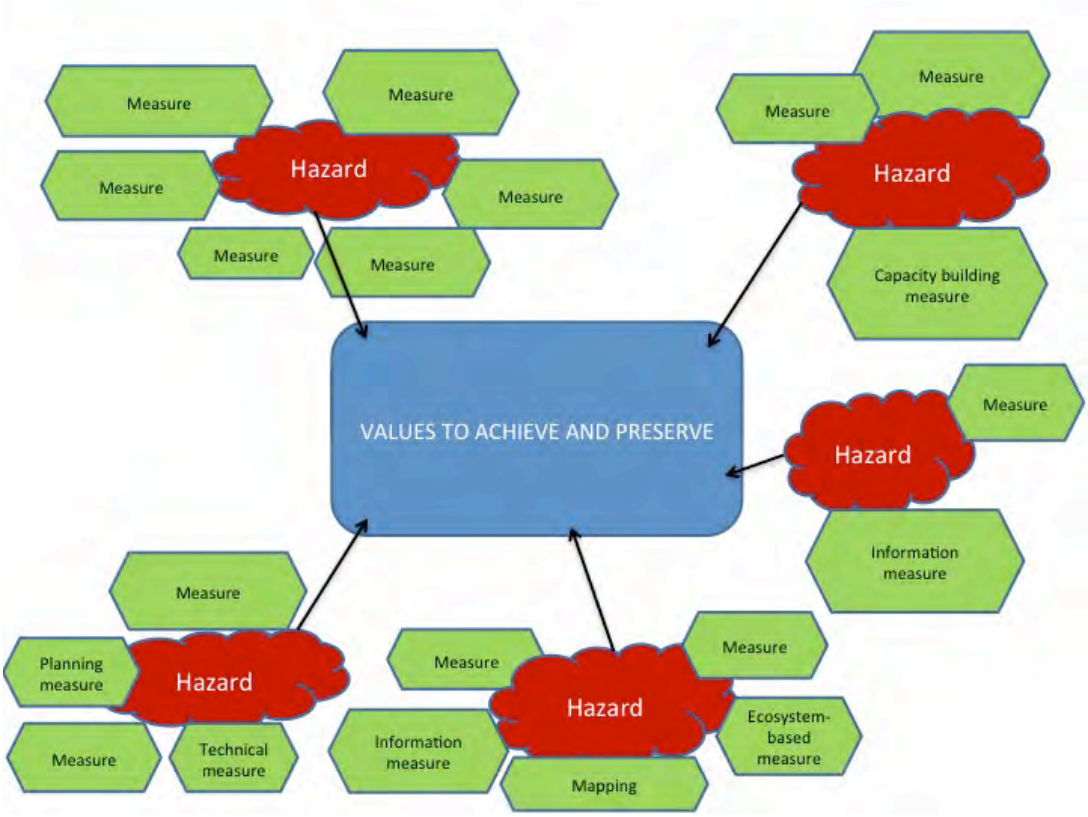

Figure 2.2: A simple template for a situation map

Source: adapted after Feurt (2008)

3 Results

In this chapter the results for each of the eleven case studies is presented. After a brief description of the geographical location of the case study (for more detailed descriptions see RISC-KIT's web site (http://www.risckit.eu/), the sources used are presented (see Chapter 2 of this report for what the stakeholder categories stand for). Then follow two sections. The firsts presents the contents of the situation map and assessment matrix (the assessment matrices can be accessed on the RISC-KIT web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1). The second elaborates on existing plans and processes and what the contribution of RISC-KIT could be in the individual case.

3.1 Bocca Di Magra (IT)

The geographical focus of the case study is the last part of the Magra river and the related coastal zone in the municipalities of Sarzana and Ameglia, which are located in the floodplain close to the estuarine part of the river (Figure 3.1).

Figure 3.1: Map of Bocca di Magra case study area

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) are mainly based on the outputs from Task 1.2 including eight face-to-face interviews and a discussion with 40 participants of a public debate held in Sarzana (the biggest municipality in the Bocca di Magra area). The interviewees and participants of the public debate were representatives of all the stakeholder categories identified in the project, with the exception of stakeholder group 1 (Coastal manager).

3.1.1 Current and proposed measures in Bocca di Magra

The situation map (Figure 3.2) gives an overview of the main values at stake, which focus on the safety of the local settlements as well as preservation of natural values. The planned, in construction/ongoing, and implemented measures are mainly addressing the consequences of a river flood and landslides, but a few measures exist that are more general. Below follow two statements from the stakeholders that well describe the perception of flood risk in the Bocca di Magra area:

> The territory of Ameglia is lying along the final stretches of the river Magra and is a land characterized by several different environments. You can find fluvial areas (the course of the river Magra and its mouth) and coastal areas (sandy beaches on the east side of the mouth river and steep rock on the west). You can find small historical centers spread on the surrounding hills and the green natural environment of the promontory of Caprione. Ameglia is also included in the "Montemarcello – Magra" Regional Park. It is the borderland between Liguria and Tuscany region. (Interview 2, SH 8, translation from Italian and emphasis by CSO).

> Certainly since the last flood of 2011 there was **much more awareness of the fact that the area needs to be protected**; there is the need for the agencies and institutions to implement instruments and structures to **be able to cope with these problems, not only in an emergency that is absolutely important, but also at the stage of prevention**. Almost every year we have some events. In 2012 Marinella was flooded twice within fifteen days when residents and traders had just finished repairing the damage and putting everything in place. **The situation is causing great distress and the population believes that these things have to be accepted and they are aware that they are living in an area at risk.** (Interview 5, SH 3, translation from Italian and emphasis by CSO).

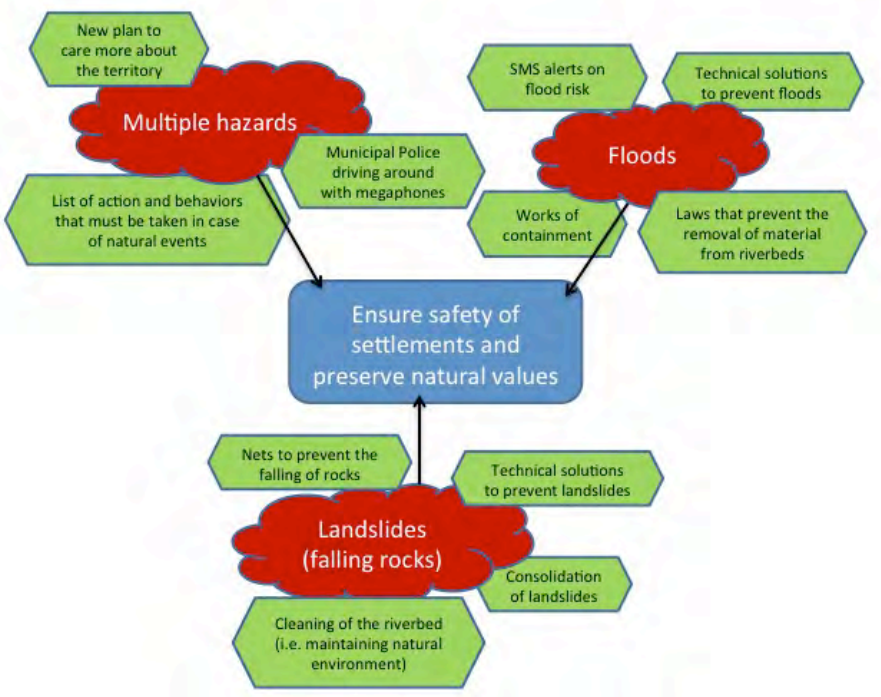

Figure 3.2: Situation map, Bocca di Magra (IT)

Among the implemented measures, technical measures focusing on preparedness for and prevention of the hazard itself are the most common (Figure 3.2 and Table 3.1). However, some policy/planning and capacity building/information measures also exist. Such measures are addressing vulnerability to a greater extent. Ecosystem-based measures have not been implemented to any greater extent.

The assessment matrix (Table 3.1) provides more detail about the measures that aim to address the main challenges of flooding. Most of the measures are for the phases of prevention/mitigation and response. Some are technical. There are also a substantial number of measures focusing on policy/planning and on capacity building/information. The prevention measures are both technical and non-technical solutions. The measures that have been proposed, and that are not yet implemented focus to a large extent on flood risk awareness including in educational programs in schools, training and exercises with the citizens, new plans for caring more about the territory, and proper implementation of existing measure. To investigate and evaluate the options for investments and measures, with a strong participatory element of local residents will be central for the next steps.

Table 3.1**:** Assessment Matrix, Bocca Di Magra (IT)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

3.1.2 Existing plans and processes and the contribution of RISC-KIT in the case of Bocca di Magra

The Bocca di Magra area already planned an improvement of risk reduction measures with a particular focus on a participatory approach. The participatory element in this process is the main element of novelty. There is an involvement of a diversity of stakeholders, mainly local residents. RISC-KIT could help in highlighting the exposure to floods through the EWS/DSS. RISC-KIT could furthermore contribute to the implementation of suitable and by local stakeholders accepted measures by designing a few strategy workshops mainly concerning the floods.

3.2 Kiel Fjord (DE)

Kiel is located on the Baltic Sea (Kiel Fjord) and is the terminal of the Kiel Canal, the busiest artificial waterway in the world (Figure 3.3). Even though storm surges are less frequent on the Baltic Sea, storms "can be a dangerous surprise during proper wind from the right direction" (MELUR, 2008: 9, trans. by CSO). A generally well-organized rescue system and a protection system against risks from the seaside have been established in Germany, so interviewees felt secure in the area of Kiel. Coastal defense lies within the responsibility of authorities, but there are exceptions when it comes to areas that are located outside of the defended zones. Beaches and also the marinas are to some extent covered by the responsibility of authorities. These areas are outside of the direct responsibility of the coastal defense authorities because this is not of concern for the general public, but an aspect of 'leisure'. Hence, individuals are responsible for the implementation of preparedness and prevention measures. The case study will therefore focus on marinas and beaches used for camping grounds.

Figure 3.3: Map of Kiel Fjord case study area

The situation map and assessment matrix is mainly based on eight interviews conducted in February 2014 and input from the CSO. Interviews were undertaken with experts from coastal defense agencies, academia, and persons responsible in the marinas.

3.2.1 Current and proposed measures in Kiel Fjord

The situation map (Figure 3.4) focuses on the Safety of a Marina in the case of a storm surge and coastal erosion. Four different stakeholder groups were identified that could be affected by a storm surge: The City of Kiel, administrative bodies in Schleswig-Holstein, the Marina itself, and Sailors as 'end-users' of the Marina (except from scientists these groups include all Stakeholder groups identified as part of Task 1.2).

Figure 3.4**:** Situation map, Kiel Fjord (DE)

From the assessment matrix (Table 3.2) it is clear that in the interviews the focus was more about the Kiel area and not directly focused on the marina, therefore measures mentioned are relevant mostly to city or regional administrations. While these areas already have a rather high standard of DRR plans and measures, the marinas lack this. Almost all of the measures can be categorized as prevention or preparedness measures. For the marina the task is twofold: 1. persons responsible in the marina can improve the safety, and 2. the users of the marina, the sailors, can prepare better for the case of an emergency.

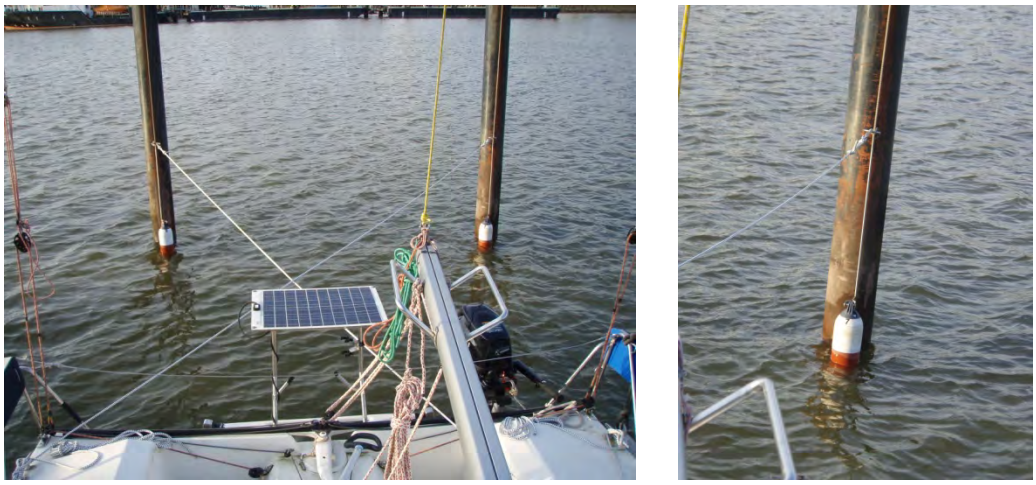

Figure 3.5: Flexible fastening of sailboat

Photos by G. Seiß

The identified measures can be clustered in four areas:

1. Acknowledgement of a minimum of prevention measures (technical measures)
2. Implementation of a local chain of actions in the case of an emergency. Concrete identified roles must be addressed to individual persons.
3. Implementation of a flexible rescue structure so that different emergency situations can be addressed in an effective way.
4. Training of the sailors using the marina.

As a concrete example, a simple measure can be presented in more detail. Figure 3.5 shows a flexible fastening of a sailboat that could be transferred to the marinas in the Baltic. This would allow a vertical movement of the fastening in case of a flood. These are easily installed and not overly expensive and would avoid damage to sailboats.

Table 3.2: Assessment Matrix, Kiel Fjord (DE)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

3.2.2 The contribution of RISC-KIT in the case of Kiel Fjord

There are other ideas mentioned in the matrix that show that there is a lot of potential for the marinas to increase their resilience. For further work within RISC-KIT a close cooperation with specific marinas in the Bay of Kiel area is envisioned. If possible, testing of easily adapted measures can be made. It is also possible to have public events for the sailors to talk about 'good seamanship'. The results from this 'bottom-up' approach can be transferred to other areas in Europe.

3.3 Kristianstad Municipality (SE)

The geographical focus of the case study is the coastal zone of the municipality of Kristianstad, which is consisting of a sandy beach and dune landscape, following the Hanö Bay, where Helge River discharges (Figure 3.6). Some areas of the inland river basin of Helge River are also included where relevant (mainly in relation to the environment, agriculture, and security).

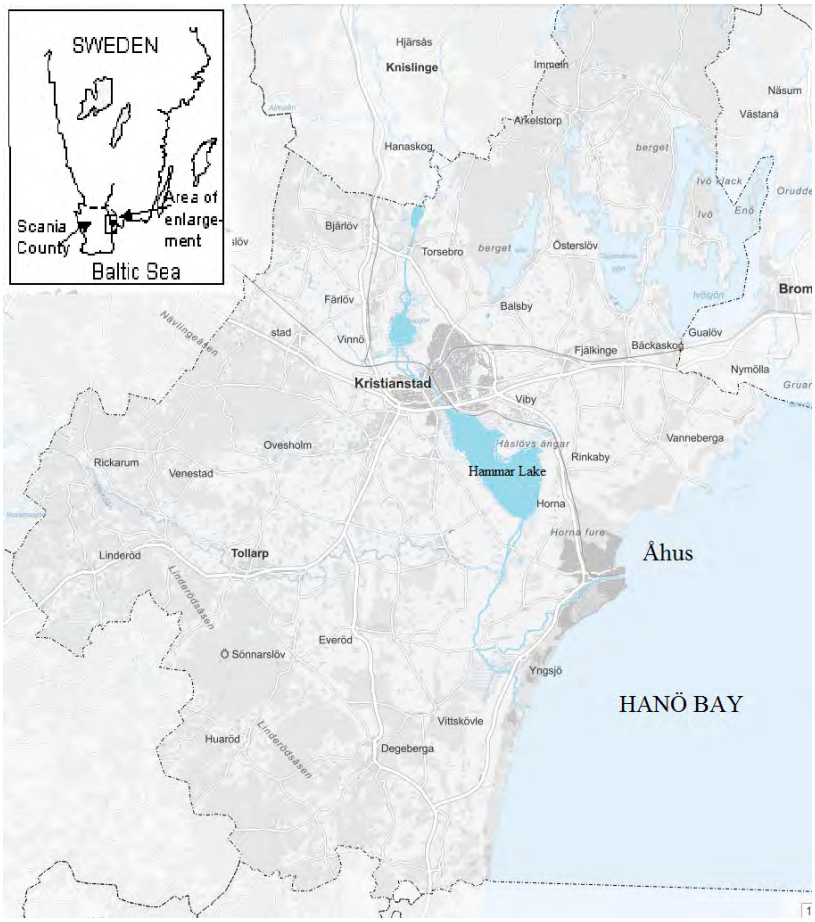

Figure 3.6: Map of Kristianstad Municipality case study area

Source: adapted from Municipality of Kristianstad (n.d.)

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) is mainly based on the outputs from task 1.2 including ten face to face interviews and one interview that was submitted in written form. The interviewees were all representatives of the stakeholder categories identified in the project, with the exception of stakeholder group 5 (consultants previously engaged in managing the coastal environment). The information was also derived from a focus group discussion with representatives from the municipality, the regional water authority, local interest groups, academia, and consultants working with coastal processes in the area that took place in the city of Kristianstad on the February 26, 2014.

3.3.1 Current and proposed measures in Kristianstad Municipality

The situation map (Figure 3.7) gives an overview of the main values at stake in the case study area – a living coast including a clean healthy sea and support to other natural values (e.g. biodiversity), different industries like tourism and fisheries, and recreational values. The planned, in construction/ongoing, and implemented measures are addressing the consequences of a river flood combined with a coastal high tide or storm, although sea level rise and the subsequent erosion are also addressed.

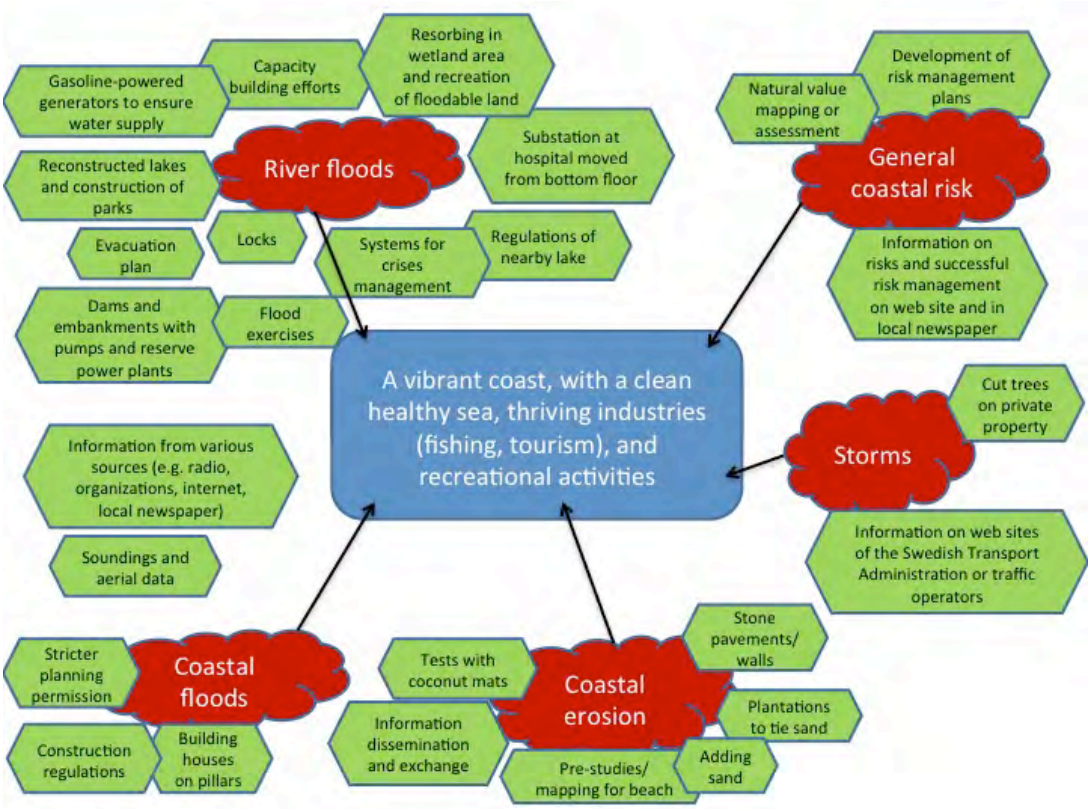

Figure 3.7**:** Situation map, Kristianstad Municipality (SE)

The assessment matrix (Table 3.3) provides more detail about the measures that aim to address the main challenges of flooding and erosion, both of which will become worse with more storms and sea level rise. In the matrix, proposed measures are included in addition to those in the situation map. It becomes clear that the measures mainly focus on the prevention phase. Most are technical, some of which are ecosystem based, but there is also a substantial number of measures focusing on capacity building/information. While the prevention measures to protect the city of Kristianstad are structural embankments, the solutions at the coast itself are focusing on non-structural solutions like sand feeding. No decision has been taken yet regarding what measure to implement, however, and the next steps are about investigating and evaluating options for investments and measures, with a strong participatory element of local residents.

The stakeholders repeatedly mentioned that erosion was the hazard that needed more attention than what it received thus far. To identify the best coping strategy, such as to retreat, carry out sand feeding, or stabilize the dunes by planting vegetation in the case of erosion, one can examine what the values at stake are through e.g. scenario planning and economic valuation of tourism and consultation with local stakeholders. The process of identifying the values at stake can also be used as a rationale for investing and preserving the coastline given that the municipality has an interest in ensuring that the fishing, tourism, and other socio-economic activities are not declining. Again, this is most likely best dealt with by involving different types of knowledge in consultations on potential solutions as well as in the planning, which the development of strategies for the different sectors, such as tourism, can be based on. Linked to this is the work with achieving a healthy environment of the Baltic Sea (and coastal waters) including

mitigating biodiversity loss, fish death, and bathing water deterioration. Measures to achieve this could be to increase the awareness about the ecological values at the coast and working with payments of ecosystem services. To be successful in this, the lack of political priorities related to long-term goals such as preservation of ecological values need to be dealt with. Ways forward here could be to increase the awareness of ecosystem approaches and cross-sectoral governance and ensure that this is reflected in planning and implementation.

Table 3.3**:** Assessment Matrix, Kristianstad Municipality (SE)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

3.3.2 Existing plans and processes and the contribution of RISC-KIT in the case of Kristianstad

Kristianstad already has an extensive planning process for the coast, which is part of the comprehensive planning of the municipality. RISC-KIT is feeding into this planning and working in close collaboration with the person coordinating this work, located in the municipality, who is working with an integrated approach that includes environmental and cultural values to a large extent. In that sense, although the measures in focus in RISC-KIT may not be ecosystem based per se (e.g. sand feeding), they are planned to provide synergies with other goals in the integrated planning for the coast, including between tourism and eco-recreation, the protection of sensitive coastal biodiversity, and the support of a healthy water environment.

The main gap in this planning process is the participatory element. There is a lack of involvement of a diversity of stakeholders, mainly local residents, which could be done through coastal councils – a measure which has been proposed and evaluated by the municipality, but where funding is lacking. In addition, there is no element of exposure modeling or early warning system development in the municipal planning process. Here, RISC-KIT could make a difference in highlighting the exposure to storms through the EWS/DSS.

RISC-KIT could furthermore contribute to the implementation of suitable and by local stakeholders accepted measures by designing a few strategy workshops mainly concerning the erosion threat. The workshops could focus on what investments are justified, including what industries (e.g. tourism, local fisheries) or values (biodiversity, recreational, cultural) could provide the base for measures such as sand feeding. The alternative could be to retreat, if the base for coastal values would not be sufficient to justify investing in e.g. sand feeding. Such investments would need to be based on a willingness among politicians and other stakeholders to develop the area in a certain direction, which the workshops could also contribute towards. In addition, how to arrive at certain measures such as sand feeding or retreat may need additional knowledge of coastal erosion, which require processes RISC-KIT could also contribute to shaping.

3.4 La Faute-sur-Mer (FR)

The town of La Faute-sur-Mer is built on a sand spit that forms a peninsula surrounded by water – the Atlantic Ocean on the west and the river Le Lay on the east (Figure 3.8). The peninsula is connected to the mainland in the North and by a bridge over the river Lay. The town is thus highly vulnerable to floods that mainly come from the riverside.

The side of the peninsula exposed to the ocean is naturally protected by a dune with a rear back dune lagoon that acts as a buffer in case of a storm surge.

Figure 3.8: Map of La Faute-sur-Mer case study area

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) is mainly based on the outputs from task 1.2 including five face-to-face interviews, and the knowledge of the CSO. The interviewees were representatives of the stakeholder categories: local residents, local authorities, and rescue service.

3.4.1 Current and proposed measures in La Faute-sur-Mer

The situation map (Figure 3.9) gives an overview of the main values at stake in the case study area – to provide a safe living area and an unspoiled environment. There are three types of planned, in construction/ongoing, and implemented measures which aim to meet these goals:

- Measures aimed at protection of persons and assets that is made by protection structures such as dikes, levees, and sea walls.
- Safety measures which include all measures in the Communal Safety plan (PCS) and also the Disaster Risk Reduction plan (PPR) (dark green boxes).
- Measures in the local urbanization plan which is an extension of the PPR plan.

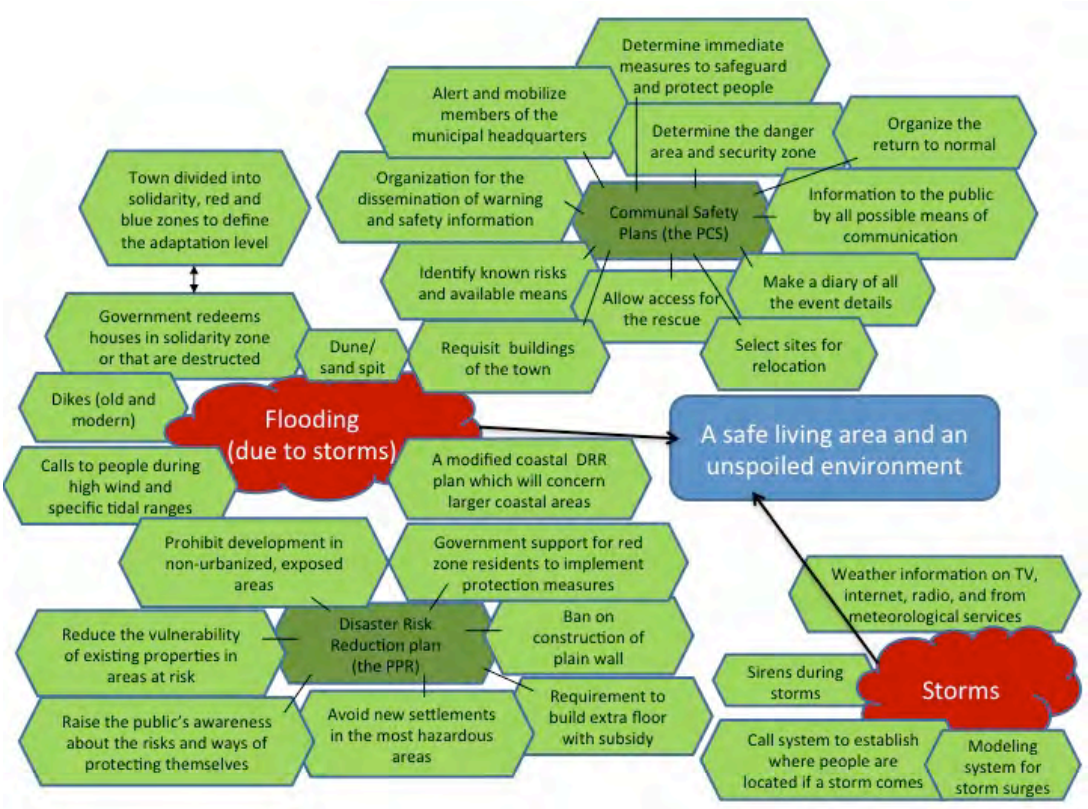

Figure 3.9: Situation map, La Faute-sur-Mer (FR)

The assessment matrix (Table 3.4) provides more detail about planned, in construction/ongoing, implemented, and proposed measures that aim to address the main challenges of storms and their associated flooding. Most measures fall under the preventive and mitigation phase and the response phase, while there is less for the preparedness and recovery phases. In terms of type of measure, policy/planning measures dominate, followed closely by capacity building/information, technical measures and investigation and research. Of the measures that are ecosystem-based most of them are technical (e.g. expand the pine forest in order to reduce the erosion of dunes).

Table 3.4**:** Assessment Matrix, La Faute-sur-Mer (FR)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

Existing plans and measures

Since the Xynthia storm event in 2010, DRR measures have been undertaken under two main plans that are relevant for this study: the PCS (Community Safety Plan) and the PPRL (Prevention Plan for Coastal Risks). The first plan concerns the emergency measures and actions in case of floods. It is based on the Hazard Study Document (Étude de Dangers) for La Faute-sur-Mer which was ordered by the municipality. The second (PPRL) concerns the adaptive measures of the town regarding its hazardous location. It is a new version of the PPR based on new risk maps that case out in 2014, but will concern several towns along the coast, rather than focus solely on La Faute-sur-Mer as the PPR did.

Both plans are imposed by state services to the local community. Recently, the PPR has been cancelled in the administrative court and thus a new plan is under development. This new plan will be slightly different since it will be drawn at regional scale and thus will include several towns on the coast. It will also take new hazard maps into consideration.

To answer the need of DRR measures imposed by state services, many public discussions have been conducted. Although, interviewees did not agree with the fact they have been consulted, the CSO for La Faute-sur-Mer can see that many of their ideas are actually parts of the PCS measures and have already been implemented.

The DRR measures concern mostly the urban developed part of the town with a strong emphasis on the low lying residences. Economic activities located in the town center have been the focus of a special attention that will be discussed in the new plan. Regarding campsites in lower areas, there was no other choice than closing them.

Proposed measures

The proposed measures can be divided into three categories:

1. Protection of persons and assets

The need to raise protective dikes on the riverside was expressed in all interviews and confirmed by local authority as well as end users. This measure is part of the PCS (Immediate measures to safeguard and protect people). These measures aim to mitigate the flood impact. Parts of these measures have already been undertaken. The dikes have been raised according to the referenced level (4.70 m NGF, Nivellement Général de la France or French Ordnance Datum) which is 20 cm above the maximum level reached during Xynthia according to one of the interviewed stakeholders. But this level may be subjected to change since the new hazard maps are studied for the new PPRL that is being developed.

On the other hand, there is a consensus on the fact that raising the dikes makes the risk increase since the water level would be higher on the seaside, and would thus threaten more properties inland. It has been suggested that low lying fields could be flooded first to act as a buffer avoiding the water level to rise too high, but this is precisely what the farmer group does not want. It is extremely difficult to reach a consensus on raising the dikes higher on the right river bank than on the left bank, although there are houses in La Faute-sur-Mer (right bank) and fields that should serve as buffer on the Aiguillon-sur-Mer side of Le Lay (left bank).

2. Safety measures

Protection measures are accompanied by warning and safety information measures. The main goal of these measures is to ensure the safety of people, especially relevant since the Xynthia event ended up in 29 fatalities in the town. PCS measures are the early warning system and event's management set by the town council and it is described in the PCS. The communication of these measures is planned within the program LITTORALIS which is going to be a place dedicated to Xynthia and coastal flooding issues in general. The construction of a building, which will receive the public, is planned. The site will present several activities around flooding issues but also how to live in such environment, communication about the rules and regulation.

The alert system has been set and is operated by the town council, who can send text messages in case of hazardous situations. A neighborhood network has also been set up in order to make people aware of persons who need help in case of emergency measures.

Evacuation exercises were proposed by the interviewed firemen. Such exercises are not planned yet but could provide interesting insights into the event management plan of the PCS.

3. Local urban plan and adaptive measures

The configuration of the town is such that it will not be possible to avoid flooding again. The point is not to avoid the hazard but it is more about learning how to live with it.

The dikes are structures that allow mitigating the flood hazard, limiting the strength and the speed of the overflow. But a flood cannot be avoided since the sea level rise will lead to higher and more frequent floods. However, these structures will allow the territory to be flooded in a safer way. Once the built up area has been flooded, the critical issue is to get back to normal as fast as possible.

The PPR measures are mainly prescriptions to adapt houses to the flood risk, in order to be able to recover as fast as possible after a flood event. Many prescriptions are included in the PPR plan such as building houses on stilts. So far these prescriptions are not met, mainly because of financial issues. These adaptations have a cost that in general is too high to be supported by the local population. The State funding and help is not enough to get the prescriptions realized and 93% of the houses do not meet the recommendations.

Ecosystem preservation

There is a specific feature of the La Faute-sur-Mer in that there is no long-term erosion. Naturally, during storm conditions, the sand barrier and the beach experience erosion, but the sand dune has a great naturally protective effect. The sandspit is growing and the territory of La Faute-sur-Mer is extending toward the south and the sea. The beach is extending, illustrated by the fact that 240 m of dune have been gained over the sea over the last 50 years. The strong southerly long shore current is extending the sand spit in a southern direction. The south of the territory that is the sand spit is a protected area under the supervision of the National Office of Forestry. This part of the territory is not really threatened by flooding, nor is it subject to any other specific threat. Thus there are no DRR measures undertaken or planned to preserve the natural part of the territory.

The seaside northern part is called Lagune-de-la-belle-Henriette, which is small lagoon connected to the sea during the combination of high spring tides and storm conditions. For several years, State services that are in charge of this protected area (formally DREAL - Regional Department of the Environment, Planning and Housing) resolved to let the site evolve naturally and prevent human intervention as much as possible. The same position is taken regarding the pine forest in the south of the territory. This forest is managed like any other state forest by the National Office of Forestry. The deconstruction site is also in a protected area. Raising the dikes was considered as a change in the protected areas and thus negotiations have been held with the National Council for Nature Protection (CNPN for its name in French). It has been approving some changes in dikes in exchange of a full rehabilitation of the deconstruction areas to get them back as natural spaces.

Following the exchanges that the CSO had with state services DREAL, it is clear that there are no plans yet, but any proposal that could help in the preservation of these protected sites will be studied with great interest.

3.4.2 The contribution of RISC-KIT in the case of La Faute-sur-Mer

Completing the very detailed work done for both the PPR and the PCS, RISC-KIT may provide some help in measures testing through the EWS/DSS.

The measures that will be assessed with EWS/DSS are:

- The efficiency of the rise of dike levels
- The efficiency of deconstruction sites
- The efficiency of buffer zones.

In addition, to answer the concern of some of the stakeholders regarding the lack of communication, RISC-KIT is in good position to propose workshops between the different stakeholders to share knowledge and experiences. This has been planned in the PCS but has not been implemented yet. There are members of RISC-KIT that have a good experience for identifying and proposing a program for a workshop/training session about storm surges and flood management. The program will be defined in close cooperation with end users and will aim at providing to stakeholders the state of the art in terms of knowledge, assessment of risk, prevention, management, and rescue and disaster risk reduction measures.

3.5 North Norfolk (GB)

This case study focuses on the North Norfolk coast, a 45 km north-facing stretch of coast within East Anglia, on the east coast of the UK (Figure 3.10). This stretch of coast includes saltmarshes and dunes, with low levels of economic development. The main town is Wells-next-the-Sea.

Figure 3.10: Map of North Norfolk case study area

The data and material in the situation map and assessment matrix of risk reduction measures is based on the outputs from task 1.2, including 14 interviews with 19 stakeholders. All stakeholder groups were represented except stakeholder group 2 (land use planners).

3.5.1 Current and proposed measures in North Norfolk

Figure 3.11 shows some of the risk reduction measures in place in this area (the measures shown are representatives of all the risk reduction measures mentioned by stakeholders). Based on the interviews, 127 individual measures were identified that aim to reduce risk from coastal flooding. These range from policy measures, technical measures, preparedness, response during the event, recovery activities, and prevention and mitigation measures (Figure 3.11 and Table 3.5).

The assessment matrix (Table 3.5) provides more detail about the measures that aim to reduce risk from coastal flooding, which is likely to become more frequent as climate changes, and flood depths will certainly increase as sea level rises. The table demonstrates that while the majority of measures are aimed at prevention, a significant proportion also address preparedness. Activities both during and after the event (response and recovery) are also important for reducing risk. There is also a need to consider longer term prevention and mitigation, e.g. reducing risk by removing people and property from the risk zone, and this requires a long process of awareness raising to make this an acceptable option, and a significant change in funding priorities.

Figure 3.11: Situation map, North Norfolk (GB)

The current measures address the risk from flooding well, as demonstrated during the 2013 storm surge where there was no loss of life, although there was some damage to property. Issues that were raised post-2013 included the loss of mobile phone coverage during the event, which hampered efforts to coordinate the event response, and the lack of compliance by some local residents. This resulted in an increased level of damage to property.

Table 3.5: Assessment Matrix, North Norfolk (GB)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

3.5.2 Existing plans and processes and the contribution of RISC-KIT in the case of North Norfolk

Under the current management plan (East Anglia Coastal Group, 2010), this stretch of coast is divided into 29 policy development zones, each of which has a defined management policy for three epochs (up to 2025, 2025 to 2055 and 2055 to 2105). The management policy consists of one of three possible management actions: hold the line; managed realignment; or no active intervention. While the Shoreline Management Plan considers the effect of sea level rise, providing a transition to progressively higher sea levels over the different epochs, a major gap exists in its lack of consideration of responses to sudden, major coastal flooding events (e.g. after the 2013 event, decisions needed to be made about the repairs of breaches in the flood embankments, and the SMP did not provide guidance on this issue).

There is no planned revision of the latest SMP. This is where the RISC-KIT project could make a difference, by demonstrating the likely efficacy of the current risk reduction measures against changes in flood hazards due both to sea level rise and changing storm intensity/frequency, and providing a tool to explore the benefits of alternative risk reduction measures in the future. This could be a useful communication tool for planning by the Environment Agency, for communication with local communities about the need for further measures, and for attracting funding to enact those measures.

3.6 Porto Garibaldi (IT)

The case study area is located in the Ferrara province in the Emilia-Romagna Region, northern Italy, and is part of the Comacchio municipality (Figure 3.12). The geographical focus points are the built-up area of Porto Garibaldi, Lido degli Estensi and Spina, the navigation channel of Porto Garibaldi, the boundary between the urbanized coast and the park (the "Jamaica" bathing establishment), and the natural area that is part of the Po Delta park (Bellocchio marshes and Comacchio lagoon).

Figure 3.12: Map of Porto Garibaldi case study area

The analysis below is based on eight face-to-face interviews (with SH1, SH2, SH5, and SH8) performed in 2014 and six recent face-to-face interviews with local residents, owners of economic businesses, and representatives of the Fire Brigade of the Comacchio area (SH6 and SH8) carried out after the large storm in February 2015. The written material used includes both scientific papers published in international journals, and regional guidelines for integrated coastal zone management (the ICZM guidelines) (Regione Emilia-Romagna, 2004).

3.6.1 Current and proposed measures in Porto Garibaldi

The situation map (Figure 3.13) presents a series of planned, ongoing/in construction, and implemented measures that were derived from the material. It is clear from the map that most of the measures are long-term and yearly prevention and mitigation actions that deal with the protection of the beach and tourist activities. They address threats such as beach erosion, sediment shortage, and flooding. There are several actions identified in the map that include the maintenance of hard protection structures (earth embankment and breakwaters) and others that are ecosystem-based solutions such as beach nourishments that are carried out regularly at the case study site (back-pass from Lido degli Estensi to Lido di Spina south and “Jamaica” bathing establishment). Beach scraping is an implemented measure at regional level that is planned also for the case study site. It is useful to prevent inundation and damages to structures. Regular dredging of the channels that connect the lagoons to the sea is carried out to favor water exchange. This benefits the aquaculture, which is an important activity carried out into the Comacchio lagoon and in the brackish wetlands of the Bellocchio area. The monitoring activities carried out at regional level are useful to collect and analyze data that are necessary to understand what the main coastal risks are, where the most vulnerable

areas are located, and where hotspots of erosion or flooding can be found. The collected data are all included into a large regional database that is continuously updated with new information and with the outcomes of data processing. The early warning procedure, through the operational coastal EWS, is a key tool. It is used to issue alerts for coastal areas when storms are forecasted. The interviewed stakeholders mentioned the improvement of the EWS as a major issue.

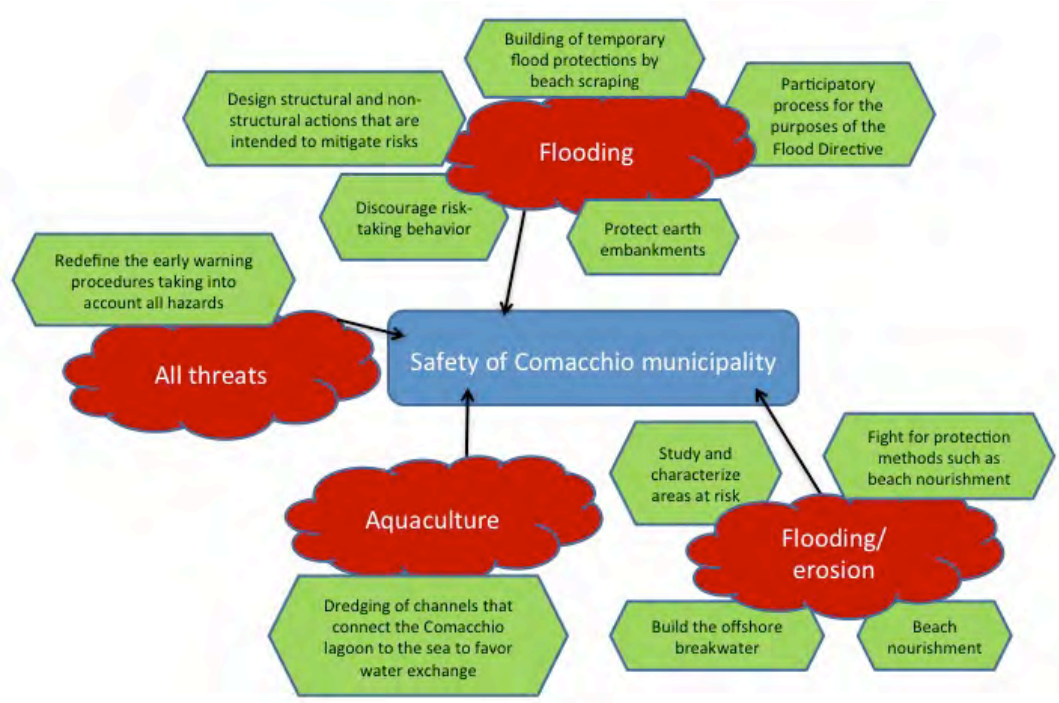

Figure 3.13: Situation map, Porto Garibaldi (IT)

From the assessment matrix (Table 3.6) it is evident that most of the proposed measures identified in the assessment matrix for the Porto Garibaldi case study area are prevention and mitigation actions. The actions can be improved through a better management of existing measures, improving prevention strategies and EWS, through the political consciousness of the importance of natural habitats, a better sharing of information between all stakeholders (from the higher level down to the population, local residents and entrepreneurs), and cooperation among regional actors dealing with coastal issues.

As a general aim, the measures presented in the assessment matrix should include the reduction of coastal vulnerability and exposure, in order to reduce coastal risk. Vulnerability and exposure reduction is still a major issue along with hazards prevention. The majority of the measures should be carried out by regional and local authorities. Local communities play an important role especially for what concerns self-protection and the improvement of risk consciousness. Local communities should furthermore be more involved into the decision-making process and need to acknowledge new ways of prevention and mitigation. Therefore, a better sharing of information between local and regional authorities and the local community is proposed.

Managed retreat is proposed by coastal managers and scientists (Nordstrom et al., 2015) but it is not put into practice. This measure goes along with the conversion of bathing

establishments (*Bagni*) into more resilient structures (build structures on poles, move the electric cables to the upper part of the building, remove goods that can be damaged by flooding, e.g. refrigerators, before the winter season). The proposed measure is fundamental to reduce the vulnerability of the structures located on the beach or immediately at its back and should be implemented by local and regional authorities through the compilation of binding regulations. The managed retreat option can lead also to coastal regeneration, because, where possible, existing structures can be moved further inland and old buildings will not be renovated nor converted into tourist activities, but possibly demolished, to reduce the density of urban areas along the coastal corridor. Consequently, there is also the proposed action to obliterate the urban expansion along the coastal corridor even if the urbanization rate has decreased since the ICZM guidelines were issued as a result of lack of space (there is no more room for urbanization on the sea front and it is forbidden to build in natural parks, Sekovski et al., 2015).

Table 3.6**:** Assessment Matrix, Porto Garibaldi (IT)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

Natural areas are identified by stakeholders as important ecosystem services in the case study area. It is proposed to protect the few remaining natural dune ridges along the coast. With only a few exceptions, these are not being protected with wind barriers or similar structures and not even the extensive construction of boardwalks along the coast is planned. This measure should be carried out by local and regional authorities. In fact, dune trampling is a major issue in natural areas (e.g. the case study site, Lido di Dante and Lido di Classe, Ravenna province). Natural areas are basically not managed and no interventions are carried out to achieve their long-term survival. Parks are an important tourist attraction but are not sufficiently valued. It is also proposed to use ecosystem-based solutions to protect the Bellocchio beach and wetlands. They should be carried out together with long-term management plans and include beach nourishments, to maintain the necessary sediment supply to the natural area. The necessary sediment supply can derive from nourishments, but also through the construction of dunes, stabilized through planting of endemic species. The construction of dunes is an ecosystem-based solution that is proposed to favor and maintain the biodiversity (flora and fauna) of the case study area. Biodiversity can be supported also through the creation of new wetlands where possible, to favor migrating species. Additionally, the increase of natural areas can be effective to prevent and mitigate risks, because wetlands are able to dissipate the energy of storms.

With regard to hard defense structures, the interviewed stakeholders proposed to maintain the existing earth embankment that is located at the boundary between the urbanized area and the natural park. This would prevent the flooding of inland areas (where a large campsite is located together with buildings that belong to the southern part of the Spina village). Another proposal was to protect the "Jamaica" bathing establishment with new structures and to keep the existing wood groins in place. This measure is already implemented, because the local authorities financed the repair of the wood groins and the embankment, and the owner of the "Jamaica" bathing establishment paid the construction of a rock groin and of a rubble mound slope at his *Bagno* out of his own pocket. Another proposed measure is to protect the mouth of the navigation

channel of Porto Garibaldi to act against hazards and to reduce the exposure of the economic activities located along the channel. The protection of the mouth would help dissipate the wave energy to prevent the overflow of the channel during storms when waves enter the channel.

Another proposed measure is to use temporary protections, such as the beach scraping to construct the locally called "winter dunes" (Harley and Ciavola, 2013), as early prevention systems and to regulate their construction with the help of scientifically based guidelines. Today the winter dunes are built seasonally and without any scientific knowledge. Instead their construction is only based on the personal experience of *Bagni* owners handed down trough time. Furthermore, the winter dunes are built non-continuously along the coast and have different elevations, width and slope.

Other important issues are: the lack of cooperation between different regional services dealing with the coastal area; the scarce dissemination to the population and local owners of useful information on the large number of interventions, monitoring activities and plans carried out by the regional and local authorities to improve coastal management practices; inadequate dissemination of the scientific results to the population and insufficient translation of scientific results into clear and useful information for decision-makers. Furthermore, the early warning procedure includes the hazard evaluation and the translation of hazards into specific indicators (see Harley et al., 2015 for more details) but coast-specific DRR measures for prevention are not yet implemented. It is planned to improve the early warning procedure to produce coast-specific prevention and mitigation strategies.

The interviewed stakeholders, regional reports, and scientific papers properly identify the main coastal threats. It is clear that what is done nowadays to protect the coast is important but not sufficient to avoid damages and flooding. Hence, the current measures should be improved. Furthermore, it is stated that the main storm-related threats (erosion, flooding, damage to structures) are managed with post-storm response actions and that more effective proactive measures, including EWS, are required.

3.6.2 Existing plans and processes and the contribution of RISC-KIT in the case of Porto Garibaldi

The Integrated Coastal Zone Management Plan

Regional policies and strategies for management of water, coastal zones, natural resources and land use are listed in the regional guidelines named *Guidelines for the Integrated Coastal Zone Management (ICZM)* (Regione Emilia-Romagna, 2004), that were approved by the Regional Council in 2005 following European recommendations issued in 2000 and 2002 regarding Integrated Coastal Zone Management (V European Action Program).

The guidelines cover nine macro-topics: 1) Physical coastal system, risk factors and defense strategies; 2) Pollutant loads, water resources management and monitoring; 3) Harbors, waste from boats, and risks from maritime transport; 4) Enhancement of habitats, biodiversity, and landscape; 5) Tourism; 6) Fisheries and aquaculture; 7) Agriculture; 8) Energy resources; and 9) Urbanization and infrastructure (services and mobility).

Long-term mitigation actions for coastal areas included in the regional ICZM plan are:

1. Subsidence reduction through a better control of water extraction (from household and agricultural/livestock consumption) and use especially during the summer season when the coastal population increases significantly. For this purpose two artificial canals were built between the 80s and 90s – Diga di Ridracoli (Ridracoli dam, Forlì-Cesena province) and Canale Emiliano Romagnolo – to take fresh water to the coast and reduce water extraction from groundwater aquifers. Moreover, ENI (the Italian National Oil Company) and the Regione Emilia-Romagna agreed on a protocol to monitor the effects of gas extraction on subsidence rates;
2. Actions related to rivers (dam removal, avoid to take sand out of riverbeds, change the land use from abandoned lands and forests to cultivated areas that produce more sediments);
3. Favoring the set back of bathing establishments;
4. Reducing or almost stopping the expansion of coastal urban areas;
5. Increasing the good practice of reutilization of dredged sands (from ports and channels) for nourishments (after the approval of ARPA (the Regional Environmental Protection Agency) and ISPRA (the Institute for Environmental Protection and Research) that certify the absence of pollutants); and
6. Favoring the good practice of reutilizing the sand when beach cleaning is performed (in the past the sand was brought to waste disposal areas and thus lost).

Other long term measures include: (i) beach nourishments using offshore sands, alongshore deposits (back-pass and by-pass practices), sands extracted from quarries, re-utilization of dredged sands; (ii) updating of land-use mapping and coastal characteristics (e.g. shoreline evolution) information in order to define risk change through time; (iii) dune reconstruction; and (iv) hard defense structure restoration and maintenance.

In the last ten years since the ICZM plan release an important improvement of mitigation measures was achieved. For example, the reutilization of the sand derived from beach cleaning is a normal practice nowadays. Furthermore, there are important research projects aiming at reutilizing the sand dredged from ports (e.g. LIFE Sediportsil-http://www.lifesediportsil.eu). The sand derived from dredging activities carried out inside natural channels and at river mouths is already used for nourishments. With respect to nourishments, the Emilia-Romagna Region Geological, Seismic and Soil Survey (SGSS) is completing a large database with all the information on relict offshore sand deposits, in order to understand which the amount of available sand is and where it is possible to take it. Subsidence rates have decreased in the last 10 years, due to a better control of water extraction. Many scientific studies were carried out on coastal issues (e.g. short- and long-term monitoring, and risk evaluation) and there is a strong cooperation between regional stakeholders and scientists, as a result of the participation of regional and local services in EU projects.

Early Warning

The Region has also set-up a real time EWS for coastal hazards that is able to translate predicted hazardous conditions (i.e. storm) into clear indicators (Haerens et al., 2012). Warnings are issued by the EWS when pre-defined thresholds (using Storm Impact Indicators, see www.micore.eu and Ciavola et al., 2011, Haerens et al., 2012) are

exceeded (Harley et al., 2015). These are then discussed within the so-called Functional Centre, which is composed of personnel from three different regional agencies – the Hydro-Meteo-Climate Service of the Environmental Agency of Emilia-Romagna (ARPA-SIMC), SGSS, and Civil Protection. ARPA-SIMC provides hydro-meteorological forecasts and sea state forecasts (wave height and water levels). When a forecast is generated the professionals discuss whether or not to activate emergency measures based on several criteria, such as, for coastal areas, the expected water level, the foreseen duration of the storm, and the state of the coastal area (if it was already affected by antecedent storms of not). Once an alert is issued all the information on what is probably going to happen are sent to local coastal Councils, Technical River Basin Services, Local Civil Protection agencies, volunteers working with Civil Protection, law-enforcement agencies (e.g. Police and Port Authorities), and to all regional offices involved in coastal risk management.

There are emergency measures that are carried out when a storm hits the coast. The Civil Protection, Fire Brigade, Coast Guard and Police are involved in the emergency response through a number of actions: sand bags are used to close gaps (water breakthrough of dunes and channel banks), to protect buildings and to raise embankments; emergency closure of ports and opening/closure of flood gates to avoid the overflow of lagoons and canals; water pumps are installed to remove the overflowed water from roads and lower parts of buildings; Police control of flooded or damaged roads; urgent nourishments carried out to reinforce the beach and winter dunes to avoid flooding. After the storm: replenishments; restoration of damaged defense structures; restoration of damaged buildings; dredging of channels and ports due to having been silted up.

Main shortcomings

Despite having long-term coastal management strategies (prevention and mitigation) that are well underway, a greater effort should be made to improve the existing plans and to complete the real time early warning procedure with specific measures. The main shortcomings, along with their explanation, of the existing plans are:

1. The managed retreat option is proposed both into official regional reports, scientific papers, and by the interviewed stakeholders (SH1), but it is not put into practice.

The proposed measure can be carried out along the case study area at the “Jamaica” bathing establishment. The measure is extensively described, along with its positive consequences, in the paper by Nordstrom et al. (2015). The main issue is that the proposed measures are contradictory because on the one hand it is said that the managed retreat should be carried out, but, on the other hand, it is stated that the “Jamaica” bathing establishment represents the “last defence” (Perini, 2014) against marine water to flow landward and has to be protected to avoid flooding of the Spina Lake, the camping site and the Spina village, southern area. In the abstract of the paper by Nordstrom et al. (2015) it is said that:

> Shore protection projects have maintained the concession and the integrity of a dike protecting the lake. Allowing retreat to occur would cause (1) loss of the concession in its present location; (2) erosion of the dike, converting the lake to brackish habitat; and (3) migration of the shoreline to a pine forest, campground and residences that are now 500 m from the shoreline. Freshwater and pine forest habitat would be lost, but salt water wetland and pioneer coastal species would be restored. The beach and campground could still be used as the shoreline migrates

inland, but with less fixed infrastructure. Landward facilities could be protected by a ring dike. At issue is whether normally dynamic and short-term landforms and habitats should be protected as static features in perpetuity and whether human actions should be taken to protect human-created nature (lake, pine forest) against natural evolutionary processes. Stakeholders indicated that managed retreat should occur eventually but existing features should be protected now. The retreat option is compatible with Regional ICZM plans, but differs from the standard engineering designs actually suggested for implementation. The benefits of managed retreat on exposed sandy shores can only be presented in conceptual terms until demonstration projects provide concrete answers, so it is not surprising that the undocumented benefits of a more dynamic shoreline have little appeal relative to maintaining the status quo.

The managed retreat option goes along with convert bathing establishments (*Bagni*) into more resilient structures that is proposed but not put into practice.

2. Specific measures for prevention are not available. DRR solutions are mainly emergency responses and post-storm solutions.

Even if the Region has set up a real time EWS, a specific decision support (DS) module, which includes tools and results to help decision making, is not available once the alerts are issues for coastal areas. Therefore, no actions are taken to prevent damage to structures, flooding, or to evacuate the population when a coastal storm is forecasted. In the paper of Harley et al. (2015) the construction of winter dunes, designed with a specific tool (e.g. DuneMaker, Harley and Ciavola, 2013) that is able to design their dimension (width, height, location along the beach) according to weather forecasts, is described as an effective solution to prevent storm impacts. Binding regulations, scientifically based, for the construction of winter dunes (location, width, slope, height) should be implemented at regional level.

The DRR measures also need to include a training process, to inform the population, and owners of activities located in exposed areas how to behave in case of an emergency. The training process ought to include the Fire Brigade personnel as well, who mentioned during the recent interviews that they would benefit from a coastal warning system and of specific measures to be activated along coastal areas to prevent damages when a storm is forecasted.

3. Protect and value the natural area with ecosystem-based solutions. It is proposed in the ICZM regional guidelines to cleverly manage and protect natural areas and by the interviewed stakeholders to build wetlands where there is still room to convert abandoned and cultivate fields into natural sites (SH5, the forest ranger, *…accepting the possibility that … you could create some similar wetland-type areas in the agricultural areas between Casal Borsetti and the Reno…*).

This measure was proposed by several stakeholders during the interviews. There is a drawback that has to be taken into account when dealing with the natural area that was mentioned by SH1 (*…At the same time however he notes that this area is inhabited by trees and animals that "don't vote or pay taxes")* and SH5 (the forest ranger, *…the weak point is that the maximum preservation effort is reserved for stretches of coastline where there is infrastructure*). The lack of funding and the importance given to economic activities rather than natural habitats is, at the political level, the main obstacle for the activation

of specific interventions to protect the ecosystem services represented by the Bellocchio wetlands.

3.7 Ria Formosa (PT)

The geographical focus of the case study is the coastal area of Ria Formosa at the southernmost part of the Portuguese coast (Figure 3.14). The Ria Formosa is a coastal lagoon protected from the direct action of the open ocean by five barrier islands and two peninsulas spatially distributed to produce a cuspate shoreline that extends over 55 km. The Ria Formosa has many natural values with a natural reserve created in 1987. The hotspot area, which the RISC-KIT project will be focusing on, is Praia de Faro, located within the Ancão Peninsula, on the western side shoreline.

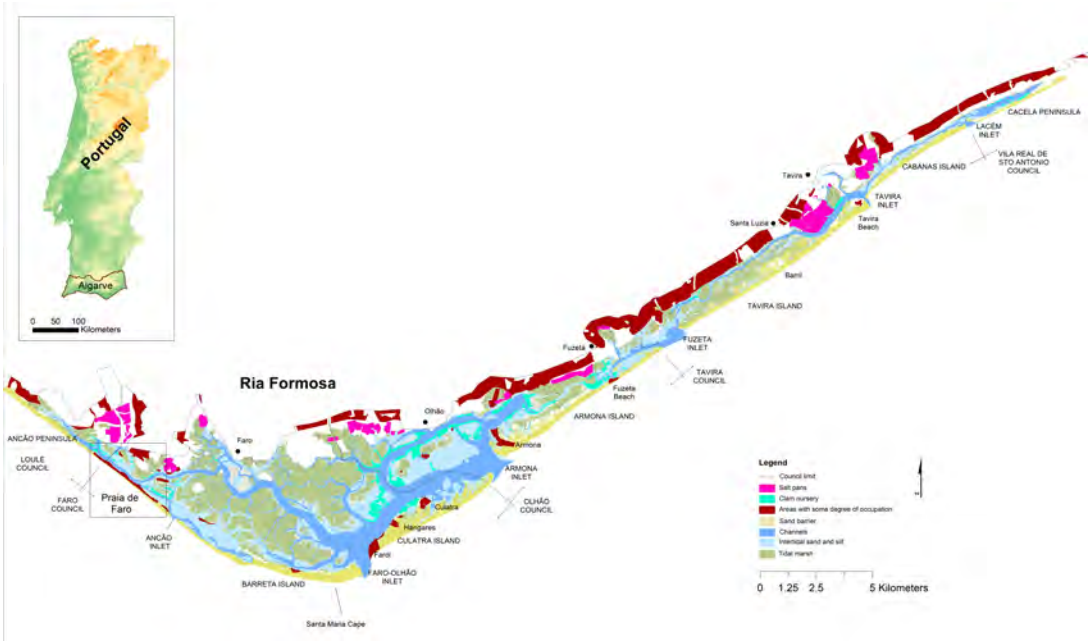

Figure 3.14: Map of Ria Formosa case study area

Source: adapted from land use shape file provided by the Natural Park of Ria Formosa

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) were compiled from the twelve face-to-face interviews with stakeholder groups 1 and 3-6. These were conducted within Task 1.2. In addition, scientific publications, grey literature, media articles, and the collective knowledge of the group of CSOs have been used. The different types of measures proposed in the interviews were summarized and compared with the measures included in the existing local plan.

3.7.1 Current and proposed measures in Ria Formosa

The situation map (Figure 3.15) gives an overview of the main goals that the measures aim to achieve, the different types of measures and types of threats addressed and not addressed.

The main goal(s) can be summarized as:

- Ensuring public safety mainly against storms and erosion through measures such as risk alert, and improving population awareness, including preparedness of the people living at risk about how to act if evacuation alerts are activated. Public safety is also ensured through technical measures such as the removal of houses from areas at risk and the construction of seawalls.
- Preserving natural values through measures such as replenishment of sand in the beach and dune recovery.

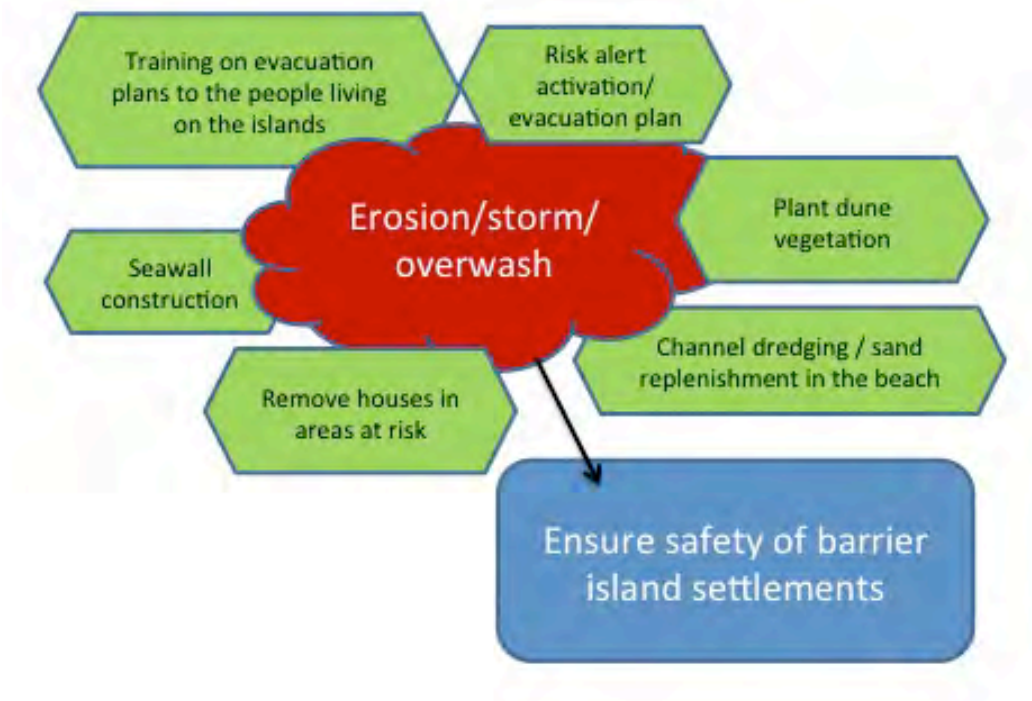

Figure 3.15: Situation map, Ria Formosa (PT)

A variety of measures were mentioned by the stakeholders (Table 3.7). The most popular were the prevention measures, followed by the measures of recovery, preparedness, and response. Regarding the actual nature of the measures, technical measures, several of which are ecosystem based, were the most popular, followed by policy/planning, investigations/research, and capacity building/information measures. Overall, three categories of actions are included in the assessment matrix for Ria Formosa: (1) technical measures ensuring natural conservation and risk reduction through the removal of hard structures and populations at risk; (2) technical measures to ensure the protection of the population, including the increase of size/volume of the beach, measures to stop shoreline retreat and an increase in beach protection through ensuring barrier growth and dune stabilization. Dunes are understood by the stakeholders as very effective natural barriers; and (3) processes for how to work with the populations at risk through learning how to improve risk awareness.

Table 3.7**:** Assessment Matrix, Ria Formosa (PT)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

Proposed measures were mentioned mostly by local citizens as alternatives to the planned measures that they do not agree with. The most popular proposed measures in

this regard are the ones that concern coastal armoring. Local residents are convinced that hard structures (e.g. houses) are an effective way to fixate the shoreline position and prevent further shoreline retreat. In addition, alternative measures, such as beach nourishment, are proposed in order to promote beach growth and prevent shoreline retreat and the consequential impact on adjacent infrastructures.

Furthermore, proposed measures included the preservation of coastal communities and the cultural aspects associated. Also, there are a series of measures that imply a process of learning and active discussion and preparedness of local communities, as well as information transference between different groups of stakeholders, that can turn very effective but are not contemplated in the planned measures but proposed by different groups.

The type of measure the stakeholders preferred mostly depended on what stakeholder group they belonged to. Local citizens advocated for measures that implied beach maintenance through beach nourishment and dune protection, or through coastal armoring and reef construction. Conversely, coastal managers (in alignment with the national government and the existing coastal management plan for the Natural Park) advocated for measures that ensure nature conservation and the total removal of risk to the population or infrastructure by removing them from the sand barriers. In addition, citizens and civil protection stakeholders suggested the implementation of measures that ensure the preparation of the populations at risk through processes of learning and information transfer among the different groups of stakeholders.

In general, the proposed measures address the most relevant threats such as storm impact (storm surge, wave action, and beach erosion), or coastal water quality. The most frequently mentioned threats were storms that affect the coast in terms of wave action, coastal erosion and shoreline retreat, and severe winds. Coastal inundations were not mentioned as a threat, though coastal managers are aware of its eventual importance under exceptional circumstances when the water inside the lagoon may reach unusual levels. However, the risks associated to this were not brought up as being of great importance.

3.7.2 Existing plans and processes and the contribution of RISC-KIT in the case of Ria Formosa

Existing plans and planning processes include the Strategic Polis Littoral Plan for the Requalification and Valuation of the Coast (Parque EXPO, 2010) implemented by the Sociedade Polis Litoral Ria Formosa S.A. The plan is based on the main principle: “Ria Formosa — singular coastal zone — reference for sustainability”, it is based on the POOC (Plano de Ordenamento da Orla Costeira – Littoral Land Use Management Plan) in action, and includes three major projects:

1. Reduce coastal erosion to ensure the conservation of the lagoon system and reduce risk to life and goods. Re-qualify and re-naturalize degraded areas important for the biophysical equilibrium of the Ria Formosa;
2. Improve the interface between the Ria and the adjacent cities; and
3. Improve the competitiveness of the natural resources of the Ria.

All the actions included in the existing plan aiming to reduce disaster risks would be included within the first part of the plan:

1. Corrective measures for erosion and coastal defense, re-naturalization of the islands within the lagoon and the barrier islands (this refers to the removal of buildings);
2. Inlet relocation, beach and dune nourishment; and
3. Improving the hydrographic network adjacent to the lagoon system.

For the specific case of the Ancão Peninsula, and in particular for Praia de Faro, the plan includes the removal of the residence buildings located within the risk zones previously identified by the POOC and within the primary dunes. This plan involves:

1. Relocation of the families/individuals whose first residence is in Praia de Faro. The buildings used as second residence should be removed from the coastal barrier; and
2. Recovery of the beach and dune.

For that, there are two plans of which one, the Intervention Plan for the Faro Island (RIOplano/A.T93, 2011), addresses the maritime public domain area within the Natural Park and includes the fishermen settlements and the actions to take place in such communities settled in Praia de Faro. So far, the plan has only been partly executed, including the removal of second residence buildings within the public domain area, not only for the areas where the risk zones are located but for the entire settlements. The other plan, the Detailed Plan for Praia de Faro (NEMUS, 2013), addresses the actions in the area managed by the council that is excluded from the maritime public domain and is mostly used for second residence houses. As opposed to the Intervention Plan for the Faro Island, this plan has not been implemented.

In conclusion, by comparing the existing and the proposed measures, some major shortcomings of the existing plan can be identified:

- It does not reflect the needs and claims of local communities. For example, there is a lack of measures reflecting the active discussion/participation of the stakeholder groups representing local citizens and of measures for population preparedness for evacuation or local warning systems.
- It does not consider the possibility of cultural preservation. This is likely due to the lack of active discussion between different stakeholder groups with different interests.
- It does not include any measures related to preparedness or early warning. This is partially derived from the fact that it only considers the total removal of the communities at risk, but also because working with communities is not a traditional approach (i.e. has never been fully implemented). In addition, there is no EWS implemented or planned at local, regional, or national level.
- At a certain level of implementation (mostly related to the Water Directive and the Flood Directive), risk assessment and mapping of coastal areas do not seem to encompass the complexity of the problem as they only focuses on the threats related to flooding, which, as mentioned above, does not apply to the case study area. A more detailed and proper risk assessment is thus needed.

Due to social and political circumstances, the existing plan is not fully implemented and at present only second residence buildings in areas located within the maritime public domain are being removed. As a result of actions from the local government's side, the livelihoods of local fishermen have been negatively affected causing great controversy

and the communication between stakeholders and coastal managers is non-existent or extremely reduced at the moment. At present (May 2015) a large set of demonstrations and protests against house demolitions on the islands are taking place. Hence, a fruitful communication between coastal managers and end-users does not seem to be viable in the near future. The CSOs of Ria Formosa have decided that a process of discussion would, under such circumstances, not be useful. Instead, the measures proposed in RISC-KIT should try to reflect the concerns of the major groups under the main goal of risk reduction.

3.8 Tordera Delta (ES)

The geographical focus of the case study is the area located at the Tordera river's mouth (Figure 3.16). It is a low-lying coastal plain with a sandy coastal fringe composed by coarse sediment delivered by the river, which forms a cuspate wave dominated delta.

Figure 3.16: Map of Tordera Delta case study area

The data and material in the situation map and assessment matrix (of existing, planned, and proposed measures) is mainly based on the outputs from Task 1.2 including four face-to-face interviews with representatives from SH1-3 plus direct knowledge acquired during different projects already executed and under execution by the CSO (Universitat Politècnica de Catalunya · BarcelonaTech, UPC) for different government bodies in the study area. In addition, the UPC has maintained continuous interaction with the Government at three levels (Municipalities of Blanes and Malgrat, the Regional Government, and the Central Government) and with the stakeholders having the main economic interests in the area (campsite owners).

3.8.1 Current and proposed measures in Tordera Delta

The situation map (Figure 3.17) gives an overview of the main values at stake, which focus on a coast supporting present activities and use (recreation/tourism), maintaining its natural values (which are mainly related to the landscape and the proper existence of

long and relatively wide beaches), and providing protection to existing values in the hinterland.

The main hazard identified in the area is coastline erosion, which subsequently increases the magnitude of coastal floods and the direct exposure to wave action. However, the area has also been described as being at risk from river flooding. Despite this stakeholders in the area prioritize coastal risks. This is obvious from the types of planned, in construction/ongoing, and implemented measures which mainly address the consequences of coastal erosion and flooding. Still, river-induced flooding is also considered.

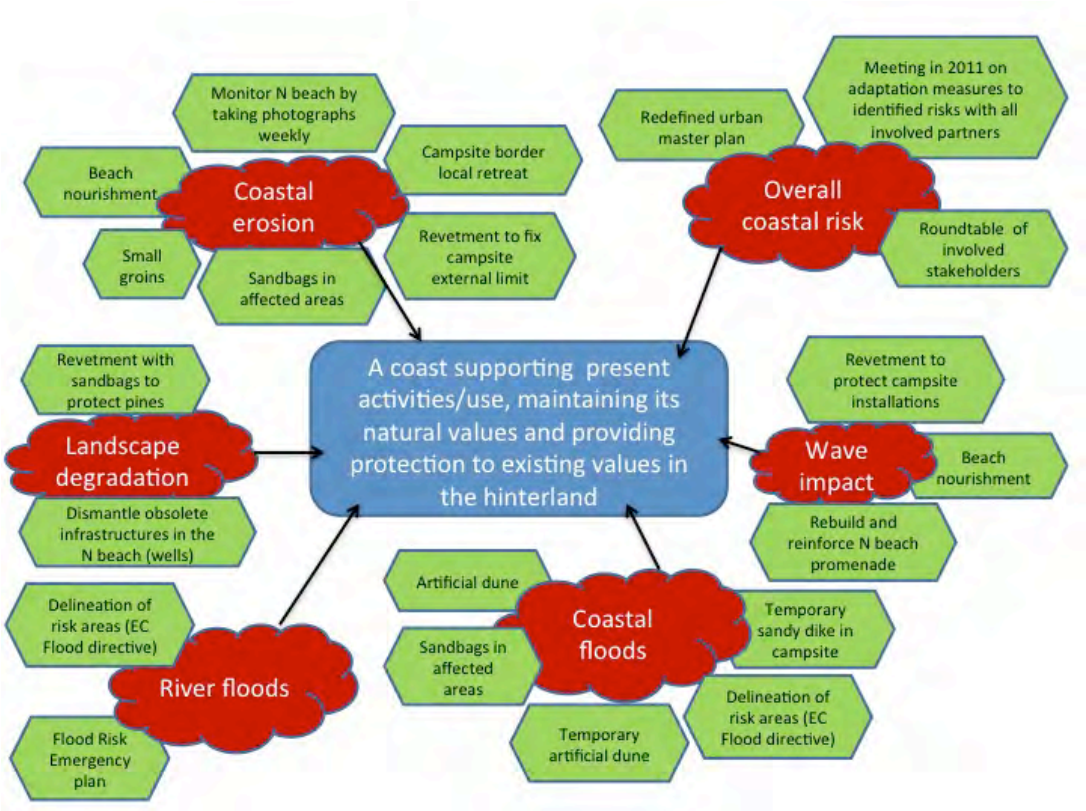

Figure 3.17**:** Situation map, Tordera Delta (ES)*

* *N beach*: s'Abanell beach (Blanes, North of the Tordera river mouth)

The assessment matrix (Table 3.8) provides more detail about the measures that aim to address the main challenges of erosion and flooding under current conditions. It has to be considered that due to the magnitude of the identified hazards, in particular coastline erosion, it is expected that the situation will rapidly deteriorate if no proper action is taken. Moreover, in the long-term, it is expected that the situation will be aggravated by impacts of sea level rise (shoreline retreat and relative submergence).

It becomes clear that most of the implemented measures can be classified as prevention/mitigation and/or recovery. This is especially true for measures implemented by campsite owners, which are of the technical type. One of the main characteristics of these measurements is that they have been "designed" and implemented by campsite owners without the direct involvement of the Government. In fact, they could be classified as 'illegal' (done without permission). Thus, some of the campsite owners on the north (Blanes) and south (Malgrat) beaches have protected their

external limits with a rock seawall/revetment. As a result, although shoreline retreat has locally been stopped, the beach in front of these structures has fully disappeared. Other campsite owners have placed sandbags to reduce wave action and to force the sand deposition to the front of their sites to reduce the direct wave impact. Finally, one of the campsite owners at the s'Abanell beach just north of the river mouth did a 'managed retreat' by abandoning the most external fringe of the campsite. It has to be considered that although this implied a loss in part of their surface (the most valuable one which is the first row), the advantage was that they maintained a beach in front of the campsite. Among these 'reactive-oriented' measures, the (repeated) reconstruction and reinforcement of the promenade along the north beach can be included. This has collapsed several times due to the direct impact of waves during storms in those areas where the beach has been eroded.

In addition to this, there are prevention measures of technical and policy/planning nature. In the technical category there are measures that increase the height of the beach (by building artificial dunes and/or revetments) to decrease the probability of being flooded due to storms. Also, beach nourishment can be considered as a prevention measure since it not only prevents coastline erosion, the widening of the beach by artificial nourishment is also decreasing the risk and magnitude of storm-induced damage in the hinterland. Regarding the policy/planning measures, they are essentially related to the delineation of new setback lines, which will implicitly be accompanied by a future relocation of values at risk. It has to be outlined that this last measure is promoted by the Government but is strongly opposed by the campsite owners.

Table 3.8**:** Assessment Matrix, Tordera Delta (ES)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

3.8.2 Existing plans and processes and the contribution of RISC-KIT in the case of Tordera Delta

Territorial planning in the case study area is the responsibility of the Central Government in the coastal public domain area and of the Regional Government in the hinterland. In this respect, the land development plans in the hinterland (the Master Urban Development Plan for the Coastal System, PDUSC for its name in Spanish) have recently been re-evaluated by the Regional Government with a special emphasis on campsites located in areas close to the shoreline that could be affected by the impact of coastal processes. The new regulation permits the sites to be moved further inland. With respect to the coastal public domain, the Central Government is launching a process of redefining the setback line that officially delineates this area since it is obsolete due to the coastline evolution during the last decades (at present the line delineating the public domain is, in some parts, at the sea).

In addition to this, a new process has been launched recently in the area to solve some of the problems of the decrease of the recreation and protection functions provided by beaches that is caused by the coastline erosion. This process, which is managed by the Central Government (since it is the main stakeholder regarding coastal protection), began with a claim by the stakeholders that were primarily affected – the campsite owners. As a result of this, a group was formed composed of representatives of: the Government (Central, Regional, and Municipalities of Blanes and Malgrat), affected stakeholders (representatives of campsite owners at the north and south of the Tordera

river), and the UPC as the technical/scientific partner. The objective of this group is to identify a series of short- and medium-term measures to be implemented to increase the capacity of the area to provide the previously mentioned functions. The idea is to look for a transient measure able to solve/mitigate identified problems without affecting long-term planning (which needs to be defined). RISC-KIT is feeding into this short-/medium-term solution through quantifying the existing hazards and designing potential prevention, mitigation, and preparedness measures to be implemented in the area.

An advantage of this process is that, for the first time, most of the involved stakeholders are represented, and, particularly, the different responsible governmental bodies. In this sense, it should be highlighted that one of the problems detected through the interviews performed in RISC-KIT was the lack of coordination among the different government bodies and also the apparent lack of interest from their side to face the problem.

3.9 Varna (BG)

The Varna case study area is located on the western Black Sea coast (Figure 3.18). At a regional level it stretches from cape Ekrene (north) to cape Cherni Nos (south) and inland it covers a strip of about 2 km, while at a local level it runs from cape St. George to Cape Galata, including Varna bay and the coastal area of the city of Varna.

Figure 3.18: Map of Varna case study area

Source: Google Earth (2015)

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) are mainly based on the 26 face-to-face interviews conducted within Task 1.2 in addition to other sources, including scientific publications, grey literature, and media articles. All stakeholder groups were covered. Consultants previously engaged in managing the coastal environment make up the largest group, followed by academics, representatives of civil protection agencies, and chairpersons of local active citizen groups. In addition, other

sources were used, including scientific publications, grey literature, and media articles. After having included information in the assessment matrix (Table **3.9**), it was translated into Bulgarian and sent out to the stakeholders interviewed under Task 1.2 for feedback. Moreover, targets mentioned during the interviews were summarized and the stakeholders were asked to formulate them as concrete measures. Unfortunately, only two of the stakeholders provided feedback.

3.9.1 Current and proposed measures in Varna

The situation map (Figure 3.19) gives an overview of the main values at stake in the case study area focusing on the safety of Varna city. These are centered on risk reduction goals through measures to protect the shore, adjacent critical infrastructure and public/private property from natural threats such as storm surge, wave action and beach erosion. It also includes protection against landslides due to anthropogenic activities, improvement of Early Warning Systems, and adoption of disaster and risk maps.

Other relevant goals not listed in the situation map are:

- Adaptation to climate change
- Achievement of higher living standards and increase of touristic value; and
- Environmental goals: adoption of innovative and environmental friendly shore protection solutions, forest protection and ecosystem conservation.

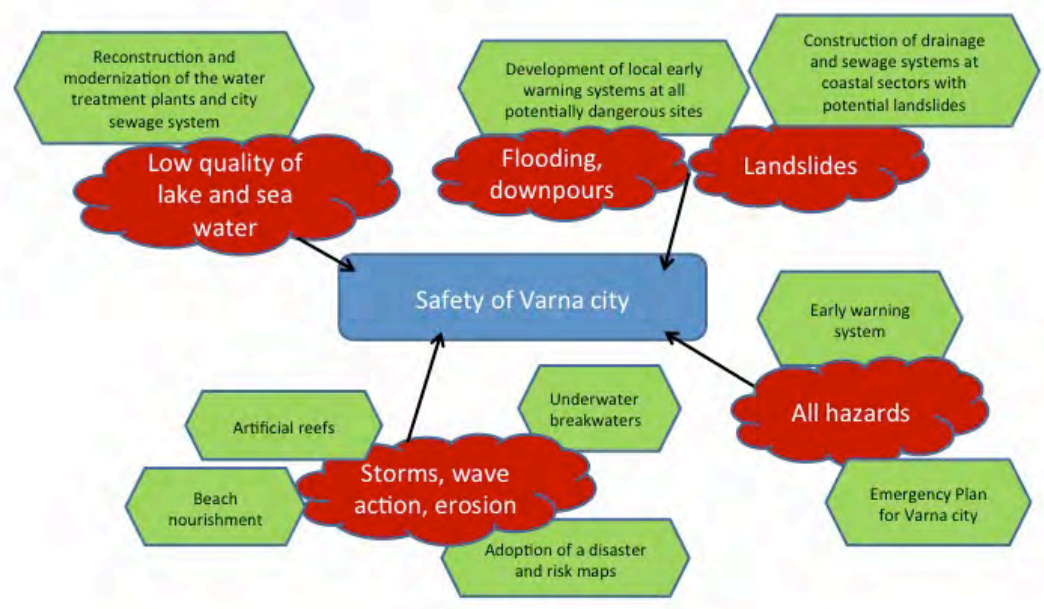

Figure 3.19**:** Situation map, Varna (BG)

The assessment matrix (Table **3.9**) provides more detail about the planned, in construction/ongoing, and implemented measures included in the situation map. In addition to these, the matrix presents measures proposed by the interviewed stakeholders and that are found in the literature. These range from prevention to recovery and include technical, as well as other types of measures, some of which are ecosystem-based. Most of the proposed measures focus on prevention and preparedness against storms, while a lot fewer of the proposed measures cover response and recovery. This reflects to a certain extent the gaps in the present state of the prevention-preparedness-response-recovery chain in case of emergency for the study site. There is also a predominance of measures such as policy/planning and investigation/research

measures as opposed to technical. Ecosystem-based measures can be found among the technical, policy/planning, and investigations/research measures.

Concerning shore protection most stakeholders highlighted the importance of technical measures and maintenance of the existing protection facilities (e.g. refurbishment of the existing coastal infrastructure, armoring of vulnerable coastal stretches, beach nourishment) rather than building new structures. Adoption of innovative shore protection solutions, including environmentally friendly, was also widely mentioned. However, measures are also proposed that require prevention activities like regular maintenance and monitoring, preservation of ecosystems that act as natural buffers preventing coastal erosion and adoption of disaster and risk maps.

Table 3.9: Assessment Matrix, Varna (BG)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

Retreat from endangered coastal areas was mentioned as well as the role of ecosystems as natural buffer to coastal flooding. Concerning landslides, alongside options like construction of effective sewage/drainage systems and landslide stabilization, a more environmentally friendly solution such as afforestation was also proposed. In order to protect waters of Varna Lake and the Black Sea from polluting discharges of untreated sewage and industrial wastewater rather technical solutions were proposed, but it also would require more strict control of the quality of discharged outflows and close following of environmental regulations. Measures related to early warning capacity would require complementing the existing Unified Response System with monitoring and forecasting activities at vulnerable coastal areas, while for floods and landslides development of specialized local early warning systems was proposed. As for potential 'policy/coastal management and planning' measures answering to all case study related threats priority was given to Varna Emergency Plan update and capacity building of responsible authorities to organize/apply wider spectrum of prevention activities and cope with disaster consequences. Although a variety of measures were proposed, little weight was given to capacity building measures.

In general, the proposed measures address the most relevant threats such as storm impact (storm surge, wave action, and beach erosion), landslides, flash floods, coastal water quality, and effectiveness of sewage system. Seemingly, sea flooding was not recognized as a major threat, while river/flash floods were highlighted only in connection with outdated drainage systems and cliff/beach erosion due to landslides. Meanwhile, several flash flood events occurred and revealed the insufficient governmental capacity to cope with such types of disaster.

3.9.2 Existing plans and processes and the contribution of RISC-KIT in the case of Varna

At national level the *Flood Directive 2007/60/EU* was adopted for Bulgaria by means of legislation changes made into the Water Act in August 2010. At regional level the Black Sea Basin Directorate – Varna is the responsible party working on the development of flood risk management plans for river basins and coastal areas with potential significant flood risks that are under its jurisdiction. The plans are to be completed by the end of 2015.

Varna already has an Emergency Plan implemented in case of disaster, which has been updated in 2013. Nevertheless, coastal storms as a phenomenon triggering the coastal degradation are not considered as a major threat and therefore no adequate measures are envisaged in the existing Emergency Plan.

As reflected in the NATO analysis (NATO CMDR COE, 2014) one of the main reasons for the devastating consequences of the flash flood that took place in Asparuhovo district in Varna in June 2014 was the illegal deforestation of hills above the district. Nevertheless, the illegal tree cutting continues even today and because of this, ecologists and residents of Asparuhovo district organized a peaceful protest in March 2015 and started a petition aiming to prohibit tree cutting in the district for ten years (Mediapool.bg, 2015).

In 2007 HOLDING VARNA PLC started a project named "Alley first" (HOLDING VARNA PLC, n.d.). Its main purpose is to increase the tourist value of Varna promenade encompassing the coastal territory behind the Varna jetties. The investments include cliff stabilization (accomplished in 2012), afforestation of landslide prone areas, construction of water pipe, sewage and power systems, biking and walking paths, parking lots, and facilities for water sports, spa, and entertainment.

According to the NATO analysis (NATO CMDR COE, 2014) the main reasons that have led to the flash flood event in Asparuhovo district in Varna in June 2014 are:

- Illegal construction and improper urban planning (also mentioned in the interviews carried out within Task 1.2).
- The pollution of the gullies with household and construction waste, as well as poorly maintained drainage channel (also mentioned in the interviews).
- The inaccuracy of weather forecasts and dangerous meteorological phenomena
- Lack of effective communication between the local authorities and the regional division of the National Meteorological Institute.
- The early warning system was not used properly.
- Illegal tree cutting (also mentioned in the interviews)
- Lack of coordination between central and local authorities (also mentioned in the interviews)
- The regional Emergency plan does not consider climate change and the recent infrastructural development, which implies an urgent need for update.

All stakeholders interviewed under Task 1.2 share a common concern for lack of political support and poor governance. Among the most critical and problematic aspects related to the governance practices in Bulgaria are: lack of financial support, lack of power among Bulgarian NGOs, low interest of central authorities for local problems, lack of long-term vision for coastal development on behalf of beach concessionaires, coastal managers and decision-makers, lack of administrative capacity, and insufficient public participation.

Although formally under their jurisdiction, municipalities do not have the power to take decisions regarding the coastal issues due to legislative ambiguity, e.g. beaches are exclusively state property while the responsibility for maintenance of coastal protection facilities is within the central Government. At the same time, the Government appears to show little sensitivity to the problems of the coastal regions.

Another set of problems that hampers the adequate governance measures can be summarized as follows:

- Lack of experience with participation and integrated planning processes (Dieperink et al., 2012);
- Mistrust in the Government, general feeling of corruption and lack of transparency;
- Unclear division of competences between ministries and municipalities after recent decentralization process (incomplete decentralization of spatial planning);
- Lack of coordination between different administrative levels.

Hence, despite the region's rich cultural history and heritage, people living in Varna do not feel and act as a community. The lack of "collective action" might be reflected in the low participation in the decision making process and in the indifference of the people struggling to meet their everyday needs.

Comparing the existing plans with the proposed measures the main gaps are the lack of a balanced and up-to-date portfolio of prevention, preparedness, and recovery aspects. The technical measures that are in place, were originally aimed to have high prevention capacity, but they are no longer considered effective. Therefore, a reassessment of their functionality would be in order in view of present and future conditions. In addition, an introduction of contemporary and environmentally friendly technical solutions, such as underwater breakwaters combined with regular beach nourishment and taking into consideration of available ecosystem services is proposed. Although a certain level of risk assessment and mapping of coastal areas exists (mostly related to the Water Directive and the Flood Directive), it does not seem to encompass the complexity of the problem. A more detailed and proper risk assessment is therefore needed.

Among the preparedness measures that are not widely put into practice are the early warning systems. There is only one warning system in place (a siren). Its effectiveness is questionable since most activities of the Operational Center at the Regional Administration "Fire safety and civil protection" - Varna are focused on response and recovery rather than prevention and preparedness. The main gap is considered the lack of regional flood early warning system based on storm impact thresholds as well as local early warning system for landslide prone terrains.

In view of problems identified, RISC-KIT could contribute to filling the gaps and shortcomings related to coastal risk assessment through the implementation of the combined EWS/DSS. RISC-KIT could also contribute to finding a suitable solution with respect to flash floods in terms of decision support. Problems related to landslides are likely to have to be addressed more in a different context, however.

3.10 Zeebrugge (BE)

The harbor of Zeebrugge consists of three parts: (i) the outer port, (ii) the inner port, and (iii) the seaport of Bruges (Figure 3.20). The outer port has been constructed on land reclaimed by the sea and is protected by two breakwaters. The direct access to the sea and the available water depth makes this part of the port appropriate for roll-on/roll-off and container traffic. Also Liquefied Natural Gas (LNG) vessels moor in the outer port. Via the Pierre Vandamme lock and the Visart lock vessels sail towards the inner port. Around the docks of the inner port, logistic centers are located for the handling, storage, and distribution of mobile vehicles, break-bulk cargoes or food products. The connection

with the seaport of Bruges is made through the Baudouin canal. The activities in this part of the port mainly consist of bulk and conventional cargoes.

The residential area of Zeebrugge is located in between the harbor locks. The Belgian Master plan for Coastal Safety studied measures for protecting this residential area and it was agreed to construct a storm wall (see Figure 3.21). In order to avoid massive flooding of the hinterland, separate detailed studies on the functioning of the two locks in the harbor are performed.

The outer harbor of Zeebrugge was not included in the studies for the Master plan, however. This means that the risk for negative impacts on economical activities in the outer harbor and the possible consequences on a larger scale are not taken into account in the studies. Therefore, RISC-KIT specifically focuses on studying the effects on the outer harbor.

Figure 3.20: Map of Zeebrugge case study area

Figure 3.21: Zeebrugge planned measures for residential areas*

* Storm wall (blue yellow line) and scour protection of the landside of the talud (orange line)

Source: www.kustveiligheid.be

The data and material in the situation map and assessment matrix is mainly based on the outputs from Task 1.2 including three face-to-face interviews. Since the focus of the interviews was not specifically on Zeebrugge harbor, several of the measures mentioned do not apply for the case study site (i.e. the outer harbor of Zeebrugge. Several meetings with the end-user and expert knowledge of IMDC (International Marine And Dredging Consultants) have therefore also been used in as input to the proposed measures.

3.10.1 Current and proposed measures in Zeebrugge

The situation map (Figure 3.22) gives an overview of the main values at stake, which focus on preserving the current economic activities and some nature values (e.g. the stern island in the north east of the outer harbor). It shows that the focus of existing measures is on the safety of people while the economic activities in the outer harbor are not addressed.

Figure 3.22: Situation map, Zeebrugge (BE)

The assessment matrix (Table 3.10) provides more detail about the current and proposed measures that aim to address the main challenges of flooding and overtopping, both of which can become more severe with climate change. Existing measures focus more on the whole coast (and a possible massive flooding of the hinterland) and less or not on the actual case study. Because of the Master Plan for Coastal Safety, which was approved by the Flemish government on 10 June 2011, many of the measures aiming at the protection of people and residential areas have already been implemented (see www.kustveiligheid.be for the measures' current status).

Table 3.10**:** Assessment Matrix, Zeebrugge (BE)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

Proposed measures listed in the assessment matrix are focusing on the outer harbor and mainly in the area of prevention and mitigation and preparedness, and less or not in the response or recovery areas. The main reason for this is that response and recovery measures are already quite well defined in the ordinary disaster management procedures.

For most of the proposed measures several stakeholders are included as responsible. This is a potential complication and threat to the implementation. At this stage it is not clear who will decide which measures to build nor who will pay for them.

3.10.2 The contribution of RISC-KIT in the case of Zeebrugge

A better insight in the possible threats and their consequences will allow for a better quantification and valuation of the risk the different stakeholders are facing. It will also determine the budget they are willing to spend in order to limit these risks. Depending on these outcomes, stakeholders can make an informed choice of the type and number of measures to be taken to reduce the risk within acceptable limits. RISC-KIT will provide some basic information for this. The full operational implementation of an early warning system specific to the site and process (as developed within the RISC-KIT project) might just be one of the options to allow for timely information and preparation of the different stakeholders.

3.11 Sandwip (BD)

The geographical focus of RISC-KIT's case study site outside Europe is Sandwip Island, an erosion prone offshore island of the northern Bay of Bengal of Indian Ocean which is consisting of silty clay sediments following the lower Meghna Estuarine System where the Ganges, Bruhmputra and Meghna (GBM) delta system discharges the highest sediment loads and third highest water volume to the Bay of Bengal (Figure 3.23). The Island, located at the confluence of the Lower Meghna River Estuary (LMRE), shaped and characterized by both the tidal actions of the Bay of Bengal and the river streams of the Meghna, was chosen as the only case study site outside Europe in the RISC-KIT project. Bangladesh ranks fifth among the countries most at risk in the world in terms of disasters in the World Risk Report 2012 with a WorldRiskIndex[1] of 20.22% (Beck et al., 2012: 9). Coastal and island flooding induced by extreme storms and cyclones born in the northern Indian Ocean passing through the funnel shaped shallow northern Bay of Bengal, are the most dangerous natural hazards in the area. Additionally, a remarkable geomorphological change of the lower GBM active delta and the relative sea level rise have made the environmental scientists and relevant managers pay special attention to the alarmingly more intense and increasing climate change vulnerabilities. The LMRE is an extremely dynamic estuarine system with dramatic geomorphological changes of the offshore islands.

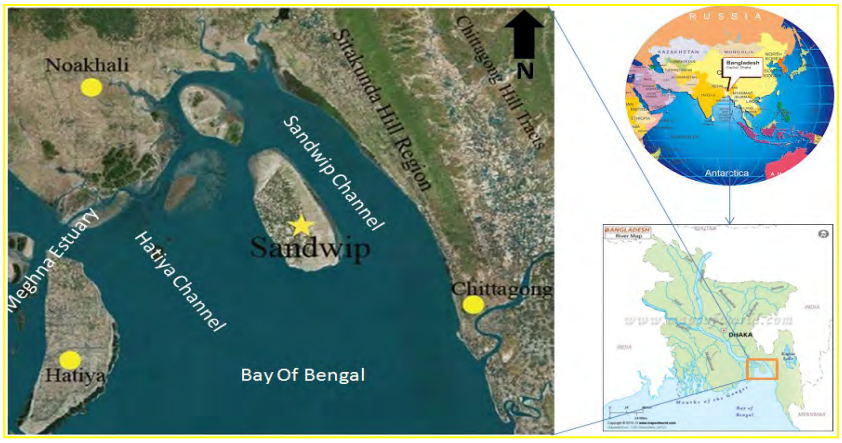

Figure 3.23: Map of Sandwip case study area

The data and material in the situation map and assessment matrix (of planned, in construction/ongoing, implemented, and proposed measures) is mainly based on the outputs from task 1.2 including 43 face-to-face interviews and a focus group discussion. The 43 interviewees were locals with experience, relevant government officials from different societal levels, NGO and social club representatives, coastal policy makers and managers, local people, and researchers. The information was also derived from a focus group discussion meeting of the Coastal Inundation Forecasting Demonstration Project for Bangladesh (CIFDP-B) on 16-18 February 2014 in Dhaka, Bangladesh, in association

[1] Based on four components – Exposure to natural hazards; Susceptibility; Coping capacities; and Adaptive Capacities – and 28 indicators. For further details, see Beck et al. 2012.

with RISC-KIT organized by the Bangladesh Meteorological Department. In addition to this, the data and material comes from the research outcomes of Dr. Mohammad Muslem Uddin (Uddin, 2015). This included interviews from 150 randomly selected island dwellers from three of the most effected unions located in the southwest, midwest and northwest of the island. The socio-economical results of the research were also based on information collected from publications, official documents and offices, expert's comments, and interpretation of the collected data and field study.

3.11.1 Current and proposed measures in Sandwip

The situation map (Figure 3.24) gives an overview of the main values, which focus on a safe living area including an unspoiled environment. The types of planned, in construction/ongoing, implemented measures are addressing the consequences of extreme coastal erosion combined with tropical cyclones and storm surges, flooding and tidal inundations, sea level rise, and general coastal risks including poor transportation, salinity intrusions, and limited access to health and education. These are also the threats that, according to historical background studies, people's perceptions, ranking, and interpretation of the collected data about the risks, make the island one of the most risky places to live in.

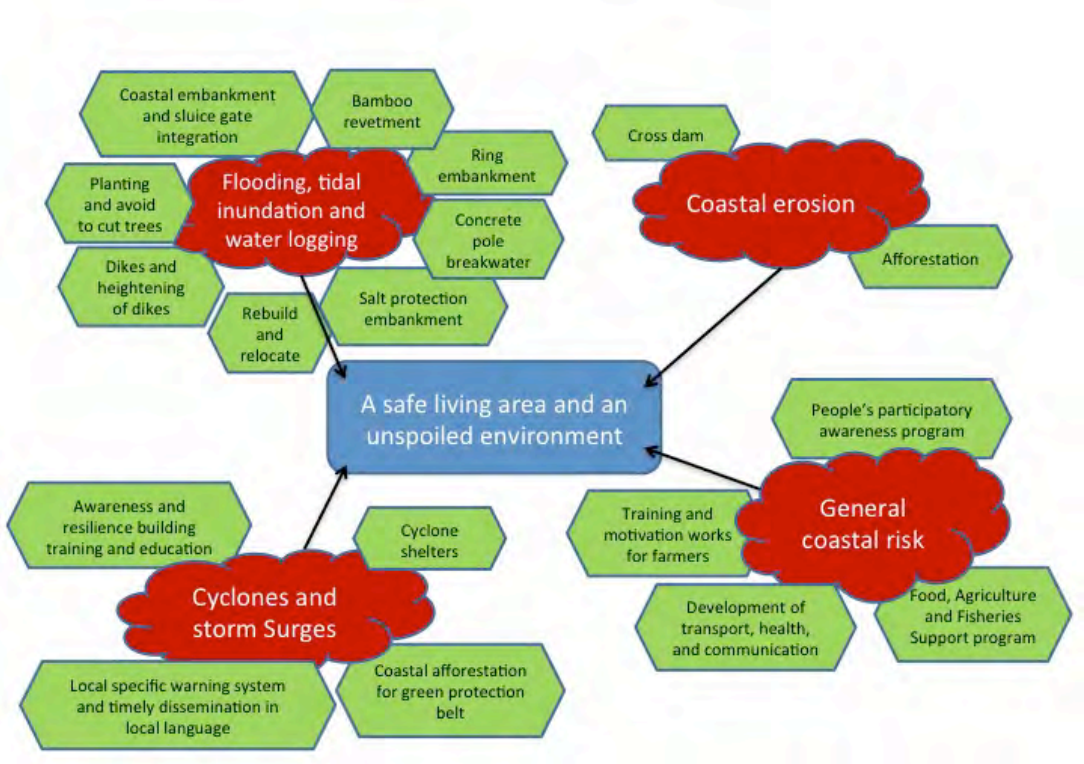

Figure 3.24**:** Situation map, Sandwip (BD)

The assessment matrix (Table 3.11) provides more detail about the measures that aim to address the main challenges of erosion and cyclone induced storm surge flooding, both of which will become worse with more storms and sea level rise following the upcoming climate change consequences. It becomes clear that the measures already implemented are not well organized, integrated, and planned for the long-term. Most of the ongoing measures or those already implemented were initiated immediately after extreme events

and not in continuation. Nor are any further actions made to advance the measures and make them more effective. Most of the ongoing measures (mostly partially ongoing) or those that are to be implemented are technical and national policy measures and involve a high to medium level of financial investments. Many furthermore focus on capacity building of the inhabitants regarding their livelihood mechanisms as well as awareness building and information dissemination relevant for a resilient community development in the face of future threats. In addition, some ecosystem-based measures were proposed to be initiated for a sustainable approach.

Table 3.11**:** Assessment Matrix, Sandwip (BD)

[See RISC-KIT's web site: http://www.risckit.eu/np4/public_deliverables.html, Deliverable 4.1]

The stakeholders repeatedly mentioned that erosion has been the hazard that needed more attention. Only a couple measures exist already, both technical although one is afforestation – an ecosystem based measure. Among the proposed, all can be categorized as prevention and mitigation measures, and a couple as preparedness measures in addition to that. All focus, furthermore, on the reducing the threat itself. Finally, a majority are technical measures with an ecosystem-based approach to them, but several are also focusing on the policy/planning, investigations/research, and capacity building/information.

For the second most threatening hazard, tropical cyclones and associated storm surges, a larger share of the measures have been implemented with a focus mainly on preparedness (although the other phases – prevention and mitigation, response, and recovery – are also represented). Another difference is their target – to reduce the exposure and vulnerability rather than the hazard itself. Finally, there is a majority aimed at capacity building/information rather than being technical measures.

Among the measures found as necessary to be taken to face the flooding and tidal inundation are, similar to erosion, one finds a majority of technical measures independently of whether they are implemented, planned, on going/in construction, or proposed. However, only a few are ecosystem based. Still, among the proposed measures there are a few that would complement the technical measures with policy/planning, investigations/research, and capacity building/information. The majority can also be categorized as prevention and mitigation measures with some also focusing on preparedness and recovery. Finally, also similar to the measures against erosion, those for flooding and tidal inundation are mostly aimed at reducing the hazard itself. It should be mentioned that most of the measures have been in practice at some point time, but in limited numbers or attempts and most part of the Island Protection Ring Embankment has eroded especially on the southern, western, and northern sides which were built immediately after the 1991 super cyclones and great devastations.

As an offshore densely populated island, the case study area has already been facing some coastal hazards other than the above hydro-meteorological and geomorphological hazards, including a low access to transport, education, communication, and health services along with salinity intrusion and limited local food availability. Development of all these aforesaid sectors and their easy accessibility for local inhabitants is not only required for the population to be able to cope with the general coastal risks but also a prerequisite for the successful implementation of the measures to be taken against the

extreme events discussed earlier. Coastal risk relevant education and adaptation training for the whole population can save a lot and build a resilient community to those hazard according to the overall findings.

3.11.2 The contribution of RISC-KIT in the case of Sandwip

Representatives of RISC-KIT have in the case study worked in close collaboration with a Bangladesh government agency as end user and a university faculty in Bangladesh as local representatives using an integrated approach that includes environmental and cultural values to a large extent. Thus, although the measures in focus in RISC-KIT may not be implemented directly the output can substitute the integrated planning for the island as well as further studies. In addition, there is no element of locally based exposure modeling or early warning system development in the local or national planning process. Here, RISC-KIT could make a difference in highlighting the locally specific exposures to storms through the EWS/DSS.

RISC-KIT could furthermore contribute to the implementation of suitable and by local stakeholders accepted measures by designing a few strategy workshops mainly concerning the extreme erosion threat, cyclone induced storm surge flooding, and consequent sea level rise, induced by climate change. The workshops could focus on what investments are justified, including what values (land and natural opportunities associated with coastal environment and geographical location, biodiversity, culture, and tradition) could provide the base for measures such as cross dam construction or bio-geo-engineering and further research for models. Such investments would need to be based on a political will to develop the area in a certain direction, which the workshops could also contribute towards. In addition, to justify structural developments like the Cross dam and the IPRE, or ecosystem-based alternatives may need additional knowledge of coastal geomorphological changes and processes with hydro dynamical phenomena. Further studies within RISC-KIT can contribute to this.

4 Summary and next steps

To summarize, the case studies display multiple hazards, although coastal storm impact with associated flooding and erosion dominate (see Table 4.1 for an overview). Other hazards include river flooding, landslides, high tide, sea level rise, wave action, water quality, and in the case of Bangladesh salinity intrusions, and limited access to health and education.

All phases of the Disaster Risk Management (DRM) cycle are represented in most case studies, but prevention/mitigation and preparedness often dominate. Measures are mostly technical in nature, of which some may be ecosystem-based. All other types are represented, although measures of investigation and research are least represented. Most case studies have some ecosystem-based measures. The exceptions are Kiel Fjord (DE) and Zeebrugge (BE), which can be explained by the fact that these case studies focus on a very small area.

Table 4.1: Overview of hazards and measures in the case studies

Case study	Type of hazards	Phase in DRM cycle	Type of measures	Ecosystem-based measures
Bocca Di Magra (IT)	Landslides (falling rocks), floods, multiple hazards	All phases except recovery well represented	Mostly technical and capacity building/ information measures	One ecosystem-based measure
Kiel Fjord (DE)	Storm flood	Almost all prevention/ mitigation or preparedness	Mainly technical and capacity building	None
Kristianstad Municipality (SE)	River flood, coastal high tide or storm, sea level rise, erosion, water quality	Mostly prevention/ mitigation measures	Most technical, but there is also a substantial number of measures focusing on capacity building/ information	Some of the technical measures are ecosystem-based. Many ecosystem considerations in planning
La Faute-sur-Mer (FR)	Storms and their associated flooding	Most in the prevention/ mitigation and response phases	Policy/planning measures dominate, followed closely by capacity building/ information, technical measures and investigation and research	Mostly technical measures are ecosystem-based

North Norfolk (GB)	Coastal flooding, sea level rise	All phases but majority prevention/ mitigation and preparedness	Mainly policy and technical measures but also some research and capacity building/ information measures	Some of the measures (mainly technical and policy/ planning) are ecosystem based
Porto Garibaldi (IT)	Beach erosion, sediment shortage, and flooding	Mostly prevention and mitigation	Mostly technical but also other measures	Mostly technical measures are ecosystem-based; natural areas not sufficiently valued or managed
Ria Formosa (PT)	Storm impact and coastal water quality	Prevention/ mitigation most popular, followed by recovery, preparedness, and response.	Technical measures were the most popular, followed by policy/planning, investigations/ research, and capacity building/ information	Several technical measures are ecosystem based
Tordera Delta (ES)	Coastline erosion, coastal flooding, river flooding, sea level rise	Mostly prevention/ mitigation and recovery	Mostly technical and policy/planning measures	Some technical measures are ecosystem based
Varna (BG)	Storm surges, wave action and beach erosion, landslides	Mostly prevention/ mitigation and preparedness against storms	Mostly technical, policy/planning, and investigation/ research measures	Some of the measures are ecosystem based
Zeebrugge (BE)	Flooding and overtopping from storms, which can become more severe with climate change	Mostly prevention/ mitigation and preparedness	Mostly technical and policy/planning measures	None
Sandwip (BD)	Coastal erosion, tropical cyclones, storm surges, flooding, tidal inundations, sea level rise, salinity intrusions,	Mostly prevention/ mitigation and preparedness	Mostly technical and national policy measures, but also capacity building regarding livelihoods, awareness building and information dissemination.	Some ecosystem based measures

	limited access to health and education			

Although there is a diversity of contexts and situations in the case studies, some commonalities can be observed where RISC-KIT can contribute. Firstly, while the measures differ quite a lot from case to case, it is evident that DRR plans need to consider both long-term hazards such as erosion, annual hazards like river or flash flooding, and rare high impact storm events.

Secondly, the need for local stakeholder dialogues for a 'bottom up' approach to discuss options for decision-making is evident in many cases. Stakeholder values often underpin the justification to invest in certain DRR and resilience measures. Bringing different stakeholders views and knowledge together, including the coordination between different government bodies, contributes to more integrated approaches. It could also clarify to stakeholders how their views have been incorporated in existing plans.

Thirdly, not all case studies have adopted ecosystem approaches as the areas in focus were too small (e.g. marinas and harbors) for this to be relevant. However, in many cases these linkages could be further defined and strengthened. There is an important role for the project to point to the economic benefits of ecosystem services and how to assess and fund them supported by political priorities. In some cases the links to inland ecosystem threats (such as deforestation) was linked to urban safety at the coast and the risk for flash flooding which could interact with hazards from e.g. coastal storm. How to define boundaries to inland systems will be a future concern for some cases in an effort to achieve Integrated Coastal Zone Management (ICZM), which could be aided by the combined EWS/DSS.

Finally, RISC-KIT is in many ways seen as a good complement to existing plans through its tools to address sudden, major coastal flooding events. For example, the EWS/DSS is seen as an effective means for highlighting the locally specific aspects, for example exposure, assessing existing dikes, and buffer zones as well as the need for improvements. As such it provides a concrete input into the communication with local populations for coastal DRR planning and to justify and attract funding for the measures.

4.1 DRR plans – the next step

In the next stage the CSOs will be asked to, based on what the case studies' end-users and stakeholders have said, select one or a few issues which are outstanding and where RISC-KIT can make a difference. They will be asked to also identify (or confirm if they have already been identified) the relevant stakeholders involved in planning and implementation of potential measures to address these issues, and the ways in which this needs to go about. These action points will make out the main part of the DRR plans. These will have to be drafted in such a way that they clearly also refer to the existing political and planning processes which the DRR plan feeds into or links to. An overview is provided in Table 4.2.

Table 4.2: Relation between case studies and existing plans

Case study	
Bocca Di Magra (IT)	Address gaps in coastal risk assessment and early warning /decision support. Address decision support in terms of (riverine) flood/flash floods
Kiel Fjord (DE)	Address the safety of the marina which is lacking although city and regional DRR plans are of high standard
Kristianstad Municipality (SE)	Part of existing municipal coastal planning in close coordination with local planner supporting decisions on DRR options
La Faute-sur-Mer (FR)	Complement existing plans and processes
North Norfolk (GB)	Complement existing plans by addressing sudden, major coastal flooding events
Porto Garibaldi (IT)	Help improve existing plans and complement the real time Early Warning System with specific measures
Ria Formosa (PT)	Complement existing plans in terms of alternatives to retreat options (such as preparedness and early warning)
Tordera Delta (ES)	Contribute to integrated long-term planning through stakeholder dialogues and decision support on coastal and riverine flood risk
Varna (BG)	Complement existing emergency plan with coastal storm risk measures such as improvement of the existing early warning system and also flash flood decision support
Zeebrugge (BE)	Complement existing coastal plan with a more detailed plan for the outer harbor of Zeebrugge which currently does not exist
Sandwip Island (BD)	Provide an integrated plan for the island, highlighting exposure and contribute to implementation of measures

The contents of this report will function directly as input to the DRR and resilience plans (see Annex 2 for a draft template for the DRR plans). The plans will also outline more

specific actions for RISC-KIT to contribute to. These actions will in general represent the perceived gaps in existing measures and where the project is perceived to make a difference. This is in accordance with the DoW in which this step is described as Milestone 8. The remaining steps of the collaborative learning process will guide the prioritization and selection of the measures taken up in these plans as this requires close interaction with study site partners and local end-users. To engage in the most strategic way with end-users so as to facilitate an action process forward for successful implementation will be especially important. The results from the first assessment step have to be confirmed by local stakeholders, also including new stakeholder groups and persons who have previously not been involved in the project. The collection of information is thus an iterative process. Hence, the situation maps and assessment matrices are not written in stone. It will be important to assess if all stakeholders have been invited to give their perspective on the key issues which RISC-KIT will be focusing on, and come with proposals for how to solve them. This process will require a considerable amount of facilitation skills. With each engagement the problem statement of the issues in focus will have to be confirmed. This can be done through convening local workshops or organize a similarly relevant action to address the key issues. For this process a protocol for assessment will be developed early on in the Task 4.2 to be able to continuously evaluate the proposed measures from the viewpoint of e.g. local acceptability, cost effectiveness, and policy coherence. During the engagement process, indicators of such attributes will have to be documented and in the end provide the input data for a performance matrix, which can be used to score the plans according to the multi criteria analysis.

The plans aim to holistically focus on site specific hazards and appropriate measures which take technical and non-technical measures and specific societal perspectives and needs into account. The multi criteria analysis aims to measure this as much as possible.

In many cases we can see that the system under planning and investigation is limited to the DRR area and not intersecting with other areas (e.g. environmental, social, cultural). In many cases it is also clear that the boundary of the issues is limited to the coastal zone. If a broader set of considerations are to be integrated under more holistic planning and be part of ICZM then the future DRR plans, which will be formulated in the next step of WP4, will have to address the issue of coordination with these areas and geographical areas (i.e. river basin) to really achieve ICZM. On the other hand, this may not be justified and to strive for ICZM may not be relevant in all cases.

When the plans are finalized by the end of Task 4.2 they will also include an action plan for continued social learning in the case study and a strategy for monitoring and evaluation. The objective of such a strategy will be to track the improvement towards risk and resilience management goals, documenting learning, conflicts and ideas, and solicit feedback through Participant Surveys and Dialogue. The evaluation will also include an aspect of accountability.

Finally, the results of this Task 4.1 will feed into WP5, Task 5.3 where the site-specific DRR plans will be tested against various hydro-meteorological event scenarios.

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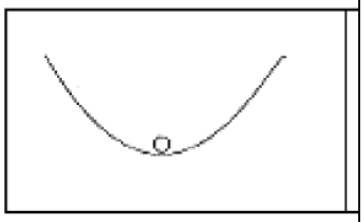
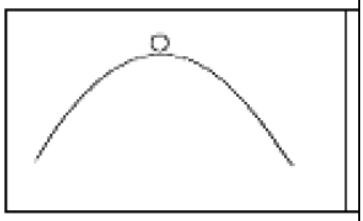
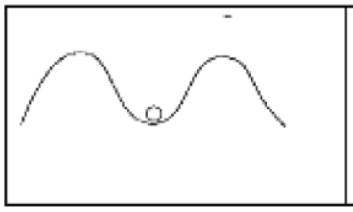
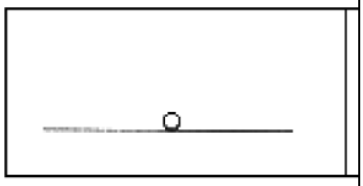
Annex 1. Interview protocol

Socio-cultural information – to be (1) used as overall frame in which investigations are embedded and (2) to identify DRR solutions that are acceptable to local perceptions and social, political and economic circumstances especially for task 4.1. and 4.2.

A) Information on values and, traditions in the municipality/community in relation to risk reduction planning

1. How long have you lived in XXX?
2. Is there any particular reason why you decided to move here/stay here?
3. How would you describe xxx to someone who has never been here?
4. What do you think is truly special about XXX, and what do you treasure most of all about living here?
5. Are there any physical or non-physical heritage sites in your region? (e.g. buildings, artifacts, monuments –at the coast, in the water or soil). If yes, what meanings do they represent to the local people?
6. Please take a look at the following sketches and read the accompanying descriptions. Then select the description that is closest to your understanding of nature and circle the corresponding number. Could you also explain what you mean by the image of your choice.

1		**"Nature is benign"** Basically, nature will always regain its balance. No matter what man does, the ball will always return to the original position.
2		**"Nature is ephemeral"** Nature is very sensitive to any type of intervention. Even very small interventions can make the ball get out of control.
3		**"Nature is tolerant"** Nature is tolerant to a certain degree of intervention. Only when a certain threshold is crossed does the ball get out of control.
4		**"Nature is capricious"** When intervening in nature, one can never be sure whether this will have positive or negative consequences. There is no way of knowing how the ball will move.

7. Are there any aspects of local culture (such as traditions, local rituals) which are only found in XXX and which are meaningful to the peoples live with the coast and the ocean here? Why are these important?

8. What values (personal, social, cultural) would you say are particularly important in XXX? Do you identify with these values?

9. Do you think that historical events or past change have altered xxx? What changes have taken place? Did these changes influence the attitudes or values of the people living here? Do you think these changes were positive or negative?

10. What do you think the future holds for xxx? What aspects about life in xxx should definitely not change, and what aspects should change or will change anyway in your view?

11. Do the people living here engage with environmental issues? Do they take an active role in preserving the environment? Do you think that the people living here spend more time thinking about the environment than people living elsewhere, and if so, why?

B) Information on perceived levels of threat with relevance to risk reduction planning

12. In your view, what are the biggest problems xxx is facing right now?

13. Just thinking about the coastal environment, which issues should be given priority in XXX and why?

14. Do you think that the people in this region should be concerned about storms, flooding, inundation and coastal erosion, and if so, why?

15. How have past environmental hazards and disasters affected your thinking about your region?

16. Would you say you live in a region which is
    a. at risk
       You stated that there is a considerable risk of flooding in your area. Do you use the lower stories of your house accordingly?
       Do you have technical measures at home in case your area is affected by a flood (e.g. a pump or an power generator)?
    b. Somewhat at risk
    c. Not at risk at all

17. How often do you experience hazards and disasters? (If the interviewee thinks that the region in 'at risk' or 'somewhat at risk' the next question is applicable):

18. What types of actions have been taken/are planned to prepare/ adapt to this risks (e.g. ecosystem based approaches, technical solutions, social solutions)?

19. Is any type preferred, and why? Please explain.

20. How successful was the approach?

21. Was there a participatory process in your community and who was involved?

22. Who should take responsibility for formulating and implementing risk reduction measures?

23. Should further risk reduction measures/ management plans be implemented?

24. How realistic is such implementation (e.g. finances, cooperation, political dynamics amongst decision makers and interest etc.)?

C) Risk reduction knowledge / transfer of knowledge

25. Do you think that other communities have had similar risk experiences? Have similar strategies been developed to cope with change? Are there similar cultures of participation and dialogue, and are there similar perspectives for the future?

26. What sources of information do you use to inform yourself about coastal risk in your region?

27. What do you consider the best examples of successful risk management here in your region?

28. How could information on this be shared between similar communities/towns/regions?

29. What factors/circumstances have so far prevented cooperation?

Is there anything else you would like to tell us?

For statistical purposes, we would like to know some basic information about you: Please tell us your age, profession, education and family status. We will treat this information confidentially.

Annex 2. Draft template for a DRR plan

1. Introduction

1.1 Case study specific issues

1.2 Existing plans

1.3 Goals and gaps within existing plans

1.4 Main objective for plan

2. Target audience for plan

2.1 End-users and stakeholders

3. Rationale for/Objective of the plan

4. Methodology

4.1 Basic inputs to the plan

4.2 Process behind the development of the plan

5. Relevant issues to address with a plan

5.1 Issues identified in Task 1.2, possibly complemented with more recent sources

5.2 Information from Task 1.1 as well as Task 2.2

6. Learning/planning/implementation process

6.1 Learning/planning/implementation process to date

6.2 Gaps in the process up to date

7. Implementation strategy and action plan

7.1 Long-term goals the plan needs to relate to

7.2 DRR measures in focus of the plan (preferably as many ecosystem based measures as possible)

7.3 Stakeholders to plan and implement the measures

7.4 Collaborative learning processes and action plan for involving stakeholders

7.5 Identified capacity development, research, and other needs

7.6 Different roles and responsibilities

8. Monitoring and evaluation strategy

8.1 Objectives, attributes, and indicators to measure progress

8.2 Cost-effective mechanism to detect and address problems in planning and implementation

8.3 Mechanisms for communication and feedback with end-user and stakeholders

9. References