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RISC-KIT

RESILIENCE-INCREASING STRATEGIES FOR COASTS - TOOLKIT

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Preparing for Extreme And Rare events in coastaL regions

DISASTER RISK REDUCTION STRATEGIES IN EU COASTAL AREAS

KEY MESSAGES

• Climate-induced coastal storms and on-going coastal development necessitate a re-assessment of Disaster Risk Reduction strategies. Strategies which depend on preparedness and some risk mitigation measures will need to adopt more mitigation or preventive measures.

• Both technical and ecosystem-based solutions are feasible options to build long-term Disaster Risk Reduction strategies. Ecosystem-based solutions can support win-win solutions, although to date their implementation is limited due to a disconnection between disaster risk management, adaptation, and nature conservation goals.

• Targeting local values and adapting national Disaster Risk Reduction strategies to local historical and socio-cultural characteristics and priorities through multi-level communication and stakeholder inclusion can lead to greater adoption and more effective implementation of policies.

• The European Union is in a unique position to support and coordinate Member State efforts to develop Disaster Risk Reduction strategies, as well as support collaboration on the development and sharing of knowledge, standards and cost-effective tools.

BACKGROUND

One third of the EU's population lives within 50 km of the coast

Coastal storms, sea level rise and flooding have caused and will continue to cause significant impacts across Europe and endanger the security of people and their livelihoods. Presently, one third of the European Union's (EU) population lives within 50 km of the coast and generates an estimated 30% of the total EU Gross Domestic Product (GDP). The economic value of coastal areas within 500 meters of European seas is estimated to be between €500 - 1000 billion alone (EC 2014a).

Population growth and climate change lead to increased risk in coastal areas.

Due to population and economic growth and the increased likelihood of hazards due to climate change, risks (the probability of occurrence of a hazard multiplied by the consequences) are expected to increase in the near future (IPCC Fourth Assessment Report 2007). The costs of inaction are estimated to be €6 billion by 2020, which is higher than the annual costs of taking precautionary and adaptation measures. Conversely, up to €4.2 billion in net benefits could be created if action is taken (EC 2014a). Thus, a re-evaluation of current coastal Disaster Risk Reduction (DRR) strategies is needed and a new mix of prevention, mitigation, preparedness and early response measures should be considered.

DRR measures:
- **Prevention**
- **Preparedness**
- **Mitigation**

DRR measures can be separated into three categories: prevention, mitigation and preparedness measures. The first category is used to prevent the hazard from occurring through measures such as dikes and dunes. These measures are applied in highly-developed coastal areas. Mitigation measures are used to reduce the impacts of a hazard and are often applied in less urbanised areas. These include structural (e.g. low dunes, beach nourishments, marshlands) and non-structural measures (e.g. limiting construction or flood-resistant buildings) (Veraart et al. 2009; Walker et al. 2004). Preparedness measures such as Early Warning Systems (EWS) and evacuation plans are used in combination with prevention and mitigation measures for cases when storms exceed the level of protection (Ciavola et al. 2011a and b) or as stand-alone measures in areas with minimal assets and low population in the coastal zone.

Because the investment level in coastal areas plays an important role in the selection and effectiveness of DRR measures, coastal development necessitates that DRR strategies are adjusted to adapt to these changes. The expectation is that DRR strategies which depend heavily on preparedness and some mitigation measures will shift to more preventive measures as the level of coastal development increases.

Increases in coastal development will require adjusting DRR strategies to include more mitigation or prevention measures

The IPCC AR5 expresses confidence in the technical feasibility of adaptation measures but indicates that these measures need to be ecosystem-based to incorporate existing ecological and natural values, as well as maximise spatial efficiency to allow for multiple uses. At the same time, adaptation to coastal hazards is influenced to a large degree by national, regional, historical, cultural, socio-economic, institutional, political and geographical factors (Martinez et al. 2014a). Therefore, a DRR strategy is a socio-technical process that cannot be studied in isolation. This presents a challenge which requires a more dynamic representation of the evolution of risk as well as approaches and metrics (Vojinovic et al. 2014).

The EU Strategy on adaptation to climate change aims to make Europe more climate-resilient through improved coordination, preparedness and capacity of governments to respond to climate change impacts (EC 2014b). The Strategy places particular emphasis on the issues faced in coastal areas where a higher portion of the population may be at risk, because coasts are often densely populated, and this is expected to increase in the future (EC 2014c). The strategy promotes greater coordination and information-sharing between Member States, and by ensuring that adaptation considerations are addressed in all relevant EU policies. The EU has also developed risk management guidelines, focussing on risk assessment, in an effort to improve coherency and consistency of risk planning among the Member States (EC 2010). The European Flood Risk Management Directive (2007) requires Member States to prepare flood risk management plans (EC 2014d). The Directive is based on the principle of the safety chain - pro-action – prevention – preparation – response – recovery – (Ten Brinke et al. 2008) to reduce the probability of flooding and resulting consequences and thus recommends a common strategy of risk management to all Member States.

The Hyogo Framework for Action offers the EU and opportunity to review its disaster management and policies

At the international level, the Hyogo Framework for Action is a collaborative effort to reduce disaster losses and increase disaster resilience of nations and communities. The goals for the Hyogo Framework for Action will be re-formulated in 2015, presenting an opportunity for the EU to also review its policies and progress made in building resilience and developing risk management (UNISDR 2013a).

BACKGROUND

ABOUT THIS BRIEF:

This policy brief is an output of RISC-KIT (Resilience-Increasing Strategies for Coasts- Toolkit) and PEARL (Preparing for Extreme And Rare events in coastaL regions). RISC-KIT aims to deliver a set of open-source and open-access methods, tools and management approaches to improve DRR strategies and measures within European coastal areas. The toolkit will benefit forecasting and civil protection agencies, coastal managers, local government, community members, NGOs, the general public and scientists. PEARL will develop adaptive, sociotechnical risk management measures and strategies for coastal communities against extreme hydro-meteorological events to minimise social, economic and environmental impacts and increase the resilience of coastal regions in Europe. A key input for this brief are the results of an international case study analysis of DRR strategies. RISC-KIT assessed eleven case study sites, including both local and national DRR strategies of nine European countries (Belgium, Bulgaria, France, Germany, Italy, Portugal, Spain, Sweden and the UK) and one international case in Bangladesh. PEARL reviewed case studies in Norway and Greece as well as Thailand, New York, St Maarten and Taiwan.

NATIONAL AND LOCAL DRR STRATEGIES

Implementation of national DRR strategies and policies varies at the local level despite these areas sharing similar risks

Risk management and planning at the local as well as at the national level is the result of physical, socio-political, institutional, historical and socio-economic factors. This suggests that each region and nation have developed their own culture of management, leading to different solutions to similar problems.

Many countries have a national DRR strategy or plan to reduce the effects of coastal hazards and build resilience (defined as the ability of a system to recover from impacts through the restoration of its essential basic structures and functions) (UNISDR 2013b). Strategies and plans entail a systematic process using administrative directives, organizations and operational capacities to implement policies.

There is often considerable variation in how national DRR management approaches are interpreted or implemented at the local level. Indeed, a mix of technical, socio-cultural and ecosystem-based measures to respond to coastal storms is implemented in the case study sites and is achieving varying levels of success.

The results from the RISC-KIT and PEARL case studies suggest that geo-morphological characteristics and physical impacts are not the only forces shaping risk perceptions and responses. Socio-economic, cultural, historical and political diversity have a strong influence on the actions taken to reduce risks, hazards and subsequent disasters. Although technical measures do form and will form a major part of the solution now and in the future, participation, dialogue, coordination, political will and transparency are necessary to build effective, long-term disaster risk reduction solutions.

LEARNING FROM PAST EVENTS IN THE EASTERN UK (RISC-KIT CASE STUDY)

The east coast of the UK is subject to storm surge flooding from the North Sea. In 1953 a major storm surge resulted in over 300 deaths along England's east coast. This disaster prompted a review of coastal Disaster Risk Reduction and response strategies. Over the following decades, sea defences were rebuilt and strengthened and area-specific Shoreline Management Plans were created; flood forecasting models were developed, allowing accurate predictions of flood levels, and linked to early warning systems including SMS-based text-messaging to local residents. There was a strong focus on engaging local communities in flood risk management and preparation. Emergency management plans were created and tested by local resilience forums and flood warden teams. Along the North Norfolk coast, ecosystem based approaches were also implemented in the form of managed realignment schemes. These improvements were put to the test in December 2013 when a surge of similar magnitude again hit the east coast. This time no lives were lost, although some areas still suffered extensive damage. Community engagement continues as decisions are made about the rebuilding and future development of flood defences along the North Norfolk coast, which makes up the UK case study site of the RISC-KIT project.

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NATIONAL AND LOCAL DRR STRATEGIES

Local implementation of national DRR strategies needs clarity and definition of roles and responsibilities

Some countries, such as Belgium, France, Germany, Sweden, and the UK, illustrate direct implementation of national DRR strategies at the local level. Conversely, other countries such as Portugal, Spain, Bulgaria, Italy and Bangladesh implemented DRR measures through ad-hoc decisions at the local level. This ad-hoc approach was attributed to the lack of full implementation of national DRR plans, the overlap of such plans with other policies and measures, as well as blurred responsibilities of local authorities. This is especially true with regard to cross boundary impacts affecting multiple regions or Member States. For example, in Italy, the Magra River, in the region of Liguria, feeds sand to the coast of the neighbouring region of Tuscany. Thus, any building of dams or changes made to the Magra River by the region of Liguria affects the coastal state and resilience of Tuscany.

When looking at the wider political and administrative context, case study sites where political actions such as Integrated Coastal Zone Management (ICZM) and nature and landscape protection are implemented correlate with sites where national DRR planning is consistently pursued at the local level.

MANAGING RISK IN RIA FORMOSA, PORTUGAL (RISC-KIT CASE STUDY)

Ria Formosa (Algarve, Portugal) is affected by the passage of south-western storm tracks. Those storms constitute the major source of threat to the area as they contribute to substantial beach erosion and overwash (which are waves running over dry land). In 1941 a large-scale storm came over the barrier islands system and significantly impacted the economy of the Algarve with around €250 thousand of damage costs (€10 million at present day value). During autumn 1989 and winter 1989/1990, severe storms hit the barrier islands with important consequences for infrastructure (i.e. destruction of seawalls, roads and houses), while the damaged infrastructure was rebuilt exactly at the same spots. During winter 2009/2010 highly destructive storms partially or totally destroyed 44 of the 71 houses in Fuzeta (Armona Island) and opened a new inlet. The main management plan and DRR strategy consists of the destruction of illegal houses and relocation of legal ones. That plan has not been implemented consistently due to social contestation, political issues and financial problems. The exception was Fuzeta, where APA - Algarve (the local coastal manager) decided to implement the management plan after the 2009/2010 storms, demolishing all existing houses (all illegal and touristic) and performing dune/beach reinforcement (nourishment).

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Ecosystem based approaches can contribute to coastal risk reduction and also promote ecological goals

Ecosystem-based approaches are risk mitigation measures, which can be combined with preventive hard structures. While the implementation of hard structures usually comes at an ecological expense (e.g. physical loss of coastal areas), integrating natural protection capacities into prevention strategies can achieve flood protection goals while promoting ecological values, and reducing the load on hard structures. Ecosystem-based solutions can thus provide 'win-win' or 'no-regret' solutions to meet disaster reduction as well as nature conservation and climate adaptation goals. However, the current implementation of such solutions in DRR strategies remains limited. This is because ecosystem management is often considered independently from DRR strategies, ecosystem solutions are undervalued compared to other solutions, or there is a lack of interaction between science and policy on the use and application of such options.

Socio-economic, cultural and political diversity strongly influence local risk perceptions and responses

It was found that socio-cultural as well as historical perspectives play a critical role in the design and implementation of DRR strategies, especially on the regional level. By effectively taking socio-cultural and historical considerations into account, it is expected that DRR strategies could be significantly improved by adapting to local perceptions of risk and helping to increase understanding and acceptance of DRR measures (Martinez et al. 2014b). This can be done by communicating in ways that are oriented towards local and personal values and priorities, as well as through multi-level communication and focusing on inclusiveness of all stakeholders, to enable people to make decisions that are well informed and thus leading to outcomes that are agreeable to broad group of stakeholders. Including local stakeholders as well as end users in the decision making process also provides an opportunity to influence the risk perception (the subjective judgement that people make about the characteristics and severity of a risk (Rohrmann 2008)) of inhabitants of an area at risk as well as enable more locally responsible DRR planning and acting.

NATIONAL AND LOCAL DRR STRATEGIES

FLOODING IN THE COASTAL CITY OF RETHYMNO, GREECE (PEARL CASE STUDY)

Multiple stressors have always posed flood threats for the city of Rethymno in Crete. The flow of storm water through the city, the large number of streams that cross it and the rapid transition from the steep slopes at the upstream rural areas to the flat urban zone imposed significant pressure to flood defences. The coastal zone is also historically exposed to strong northern and north-western winds resulting in the development of waves, which often overtop the harbour infrastructure and erode recreational beaches. Historic floods (1969-1991) led to adverse human, material, economic and environmental effects and eventually to the selection of prevention and mitigation measures e.g. arrangement and diversion of streams and torrents, construction of circular storm water drainage collectors, internal-primary drainage network and flood control dams. Nevertheless, the multiple forces from the urban and coastal area still result in flood problems e.g. extensive damages to windward breakwaters of the harbour and backwater effects at drainage network outfalls as experienced during recent flood events (2010-2013). The need for flood risk management goes hand in hand with an interest in local community engagement and providing tools that will support a more interactive, inclusive and forward looking decision making against extreme events, taking into consideration future changes in urban planning as well local stakeholders' perspectives, needs and ambitions.

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OPPORTUNITIES FOR THE EU

EU support and coordination is essential to improving Member State DRR strategies

EU support and coordination is essential to provide a platform and framework to improve DRR strategies across Member States and regional authorities (EC 2014e). RISC-KIT and PEARL identified several areas which offer significant potential and opportunities for improving European risk management.

• Although a large variation of historical, socio-cultural, socio-economic and physical characteristics within the EU exists, a platform to share knowledge and experiences on technical and governance issues is needed to support Member States. This is particularly relevant in the case of cross-border impacts and inter-regional cooperation activities.

• Synergies between disaster risk management, nature conservation and adaptation to climate change should be exploited. This is especially evident in the potential that ecosystem-based solutions provide to meet climate adaptation and nature conservation objectives.

• Scientific findings enable policy makers and disaster risk managers to make more informed, knowledge-based decisions. In particular, new knowledge is needed regarding ecosystem-based solutions for DRR management, the inclusion of socio-cultural and historical perspectives into DRR strategies, and how to best address cross-boundary effects.

• A common set of tools for risk assessment and analysis need to be developed to support Member States and contribute to a shared knowledge base to inform DRR decision making.

• European data standards and protocols for recording disaster losses should be designed and implemented to enable comparison and assessment of disasters.

• Enhancing preparedness should be achieved by improving response capacities, planning and training networks, reinforcing cooperation among authorities and strengthening Early Warning Systems.

CONCLUSION

Projected increases in hazards intensified by climate change and combined with ongoing coastal economic development means that European coastal zones are facing growing risks. Thus, the need for carefully planned and implemented adaptive and flexible DRR measures is clear: it is an essential way of reducing risk within European coastal areas while protecting vital socio-economic and environmental assets.

Long-term planning and clear responsibilities facilitate successful DRR management and implementation of measures. Therefore a re-evaluation of coastal DRR strategies is needed and a new mix of prevention, mitigation, preparedness and early response measures must be developed and new partnerships with authorities must be built to adopt and embrace them.

DRR strategies show significant differences between both national and local cultures of risk planning and implementation of measures. The formulation and implementation of DRR strategies and policies are significantly influenced by political will and economic means, and that national strategies are often implemented to varying degrees at local levels. DRR responsibilities (i.e. governance level or institution) are often blurred and depend on the level of strategy formulation and implementation. Therefore, developing governance structures which provide clear roles and responsibilities between governance levels and institutions offer an opportunity to improve and enhance DRR strategies.

At the same time, management approaches such as ICZM often correspond with national DRR implementation at local levels. As ICZM focuses on the participation of multiple stakeholders for the management of coastal zones, this suggests that participatory approaches built around local learning and action alliances between institutional actors and local societies can enable national objectives to be realized at local levels.

The use of ecosystem-based measures, potentially combined with engineered solutions, can provide win-win solutions to meet risk management objectives as well as climate adaptation and nature conservation goals. However, the implementation of ecosystem-based solutions is limited due to a lack of interaction between DRR management and nature conservation efforts on the use and application of these options.

The assessment showed that risk perception and in turn DRR responses are influenced by socio-economic, cultural, historical and political realities as well as geomorphological characteristics and physical impacts. Thus, targeting local values and adapting national DRR strategies to local priorities through multi-level communication and stakeholder inclusion leads to greater adoption and more effective implementation.

The EU is in a unique position to support and coordinate Member State efforts to develop DRR strategies. EU policies offer the legal framework to address coastal risk, for instance through the European Flood Risk Management Directive (2007) which requires Member States to prepare flood risk management plans (EC 2014d). Yet, due to the site specific nature of flooding, much flexibility on objectives and measures are rightly left to the Member States. Research affirms that local problems are best dealt with by local and regional authorities and experts, and best solved using a common scientific and technological evidence base and need to be grounded in the specific historical and socio-cultural realities in order to be sustainable and accepted (Martinez et al 2014).

RISC-KIT and PEARL are working to support EU efforts to improve DRR management at the EU, national and regional levels. These efforts seek to provide coordinated research results for a more robust and flexible management and policy framework by providing knowledge, tools, concepts, stakeholder alliances and collaborative environments to improve DRR planning across multiple coastal regions in Europe.

ADDITIONAL INFORMATION

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Website
More information about RISC-KIT can be found at:
http://www.risckit.eu/np4/home.html

More information about PEARL can be found at:
http://www.pearl-fp7.eu/about-pearl

REFERENCES

Ciavola, P., O. Ferreira, P. Haerens, M. Van Koningsveld, C. Armaroli and Q. Lequeux, (2011a). Storm impacts along European coastlines. Part 1: The joint effort of the MICORE and ConHaz Projects. Environmental Science & Policy 14 (7): 912-923.

Ciavola, P., O. Ferreira, P. Haerens, M. Van Koningsveld and C. Armaroli (2011b). Storm impacts along European coastlines. Part 2: Lessons learned from the MICORE Project. Environmental Science & Policy 14 (7): 924-933.

De Vriend, H. and M. van Koningsveld (2012). Building with Nature: Thinking, Acting and Interacting Differently. EcoShape, Dordrecht, the Netherlands.

European Commission (2010). Commission Staff Working Paper, Risk Assessment and Mapping Guidelines for Disaster Management. SEC(2010) 1626 Final. Accessed online 29 September 2014 at: http://ec.europa.eu/echo/files/about/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf

European Commission (2014a).The Challenge of Climate Change to the European Coastal Areas: State of Coasts in the Context of Global Climate Change. Accessed online 27 June 2014 at: http://ec.europa.eu/environment/iczm/state_coast.htm

European Commission (2014b). Climate Action. Accessed online 27 June 2014 at: http://ec.europa.eu/clima/policies/adaptation/what/index_en.htm

European Commission (2014c). Commission Staff Working Document, Climate Change Adaptation, Coastal and Marine Issues. Communication from The Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of the Regions. An EU Strategy on adaptation to climate change. Acessed online 29 September 2014 at: http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_133_en.pdf

European Commission (2014d). A New EU Floods Directive. Accessed online 27 June 2014 at: http://ec.europa.eu/environment/water/flood_risk/

European Commission (2014e). Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions, The Post 2015 Hyogo Framework for Action: Managing risks to achieve resilience. COM(2014) 216 Final, 08.04.2014. Accessed online 01 October 2014 at: http://ec.europa.eu/echo/files/news/post_hyogo_managing_risks_en.pdf

IPCC Fourth Assessment Report (2007). Climate Change 2007: Synthesis Report. An Assessment of the Intergovernmental Panel on Climate Change. Accessed online 9 September 2014 at: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

Marchand, M. (2009). Modelling Coastal Vulnerability. Ph.D thesis, TU Delft, 247 pp. IOS press.

Makropoulos, C., Tsoukala, V., Lykou, A., Chodros, M., Manojlovic, N. and Vojinovic, Z. (2014). Improving resilience against extreme and rare events in coastal regions: an initial methodological proposal - The case study of the city of Rethymno. International Conference ADAPTtoCLIMATE, 27-28 March 2014, Nicosia, Cyprus.

Martinez, G., Fröhle, P., Meier, H.-J., (eds), Social Dimension in Adaptation to a Changing Climate in Coastal Regions, oekom publishing house, 2014 b.

Martinez, G., Andreeva N., Armaroli, C., Gael, A., Xavier, B., Bolle, A., Boteler, B., Ciavola, P., Costa, C., Costas, S., Fakhruddin, S.M.H., Ferreira, Ó, Harley, M., imenez, J., Johannessen, A., Kiresiewa, Z., McCall, R. , McGlade, K., McIvor, A., Mollaert, J., Morando, M., Plomaritis, T., Reid, A., Rosello, L., Sanuy, M., Segnestam, L., Seiß, G., Smets, S., Spencer, T., Stelljes, N., Trasforini, E., Uddin, M.M., Valchev, N., Dongeren, A.v. (2014 b). RISC-KIT Deliverable No: D.1.2, Synthesis of data collection consultation organised at local level, unpublished.

Rohrmann, B. (2008). Risk Perception, Risk Attitude, Risk Communication, Risk Management: A Conceptual Appraisal (Keynote). In: 15th International Emergency Management Society (TIEMS) Annual Conference, Prague. http://tiems.info/dmdocuments/events/TIEMS_2008_Bernd_Rohrmann_Keynote.pdf

Ten Brinke, W.B.M., G.E.M. Saeijs, I. Helsloot and J. van Alphen (2008). Safety Chain Approach in Flood Risk Management, Proceedings of the ICE – Municipal Engineer 161: 93–102.

UNISDR (2013a).Towards a Post-2015 Framework for Disaster Risk Reduction: Building the Resilience of Nations and Communities to Disasters. Accessed online 27 June 2014 at: http://www.preventionweb.net/posthfa/.

UNISDR (2013b). Terminology. Accessed online 9 September 2014 at: http://www.unisdr.org/we/inform/terminology.

UNISDR (2014). Suggested Elements for the Post-2015 Framework for Disaster Risk Reduction. Accessed online 10 July 2014 at: http://www.preventionweb.net/files/37865_06elementswithdisclaimer.pdf

Veraart, J. and M. Bakker (2009). Climate-proofing. In: Kabat, Pavel, Fulco Ludwig, Michael van der Valk and Henk van Schaik (eds.). Climate change adaptation in the water sector. pp.109-122 Earthscan, London.