

The Need for Coastal Hazard Prevention and its Valuation Methodologies in Europe

Gonzalo Malvárez^{†*}, Fatima Navas^{†*}, Dennis J. Parker[§], and Edmund Penning-Rowell[§]

[†] Area of Physical Geography, Universidad Pablo de Olavide Sevilla, Spain.

^{*} Coastal Environments Research Group (RNM911). Research and Technological Development Groups of Andalusia, PAIDI, Spain.

[§] Flood Hazard Research Centre, Middlesex University London, UK



www.cerf-jcr.org



www.JCRonline.org

ABSTRACT

Malvárez, G.; Navas, F.; Parker, D.J., and Penning-Rowell, E., 2018. The Need for Coastal Hazard Prevention and its Valuation Methodologies in Europe. *In*: Shim, J.-S.; Chun, I., and Lim, H.S. (eds.), *Proceedings from the International Coastal Symposium (ICS) 2018* (Busan, Republic of Korea). *Journal of Coastal Research*, Special Issue No. 85, pp. 926–930. Coconut Creek (Florida), ISSN 0749-0208.

The artificialisation of the coast has significantly increased the potential for hazard affecting greater populations and still methodologies for valuation of coastal protection are lacking a multidimensional approach taking into account both hydrometeorological as well as human induced risks in a way that swift decision making can be achieved. Environmental and economic appraisal is needed for managing coastal erosion and inundation as well as oil spills. In depth analyses from the UK, Poland, Italy, Greece and Spain legislative and planning frameworks show that methodologies vary significantly and that the agreed principles of implementation of benefit-cost and/or multicriteria analyses for decision making in the context of EU directives directly involved in coastal hazards (such as the Floods Directive (2007/60/EC)) are not as yet carried out for a variety of reasons. Key findings, indicates that the range of approaches implemented in European Union member states are reduced to three models: (i) based on strong Spatial and Land Planning instruments; the main tool for decision making related to coastal hazards is ultimately mediated by urban planning. Even though specific legislation is in place for the management of coastal areas, the planning instruments are a major condition that forces actual coastal hazard alleviation; (ii) based on economic appraisal, with cost benefit analysis as a key methodology in the process to distribute resources among the various institutions involved. In those instances, allocation of resources coincides with the protection of socio-economic assets in a context of indicative planning tools; and (iii) emergency response-type approaches, which affect most countries in relation to oil spills but that also is very strong in instances where storm damage and other hydrometeorological process damages strategic resources for the economy such as beaches in Mediterranean countries. Expenses in those cases are not commonly confronted with other methods but an overriding public interest.

ADDITIONAL INDEX WORDS: *coastal erosion and inundation, oil spills.*

INTRODUCTION

Preventing all floods is not possible, but they can be managed to reduce the hazard to lives and property by the most cost-effective measures (Williams, 1994). Traditional economic analysis of flood/erosion risk management measures inevitably leave behind some variables and factors. The strategy to be adopted in the appraisal process should describe factors in as much detail as possible, so that those making the decision can take into consideration what they know and also what is ignored. Also, many intangible effects can be taken into consideration using complex methods such as a multi-criteria analyses. Other factors are even more difficult to quantify, such as the disruption, inconvenience and noise created during construction of major engineering works. Certain environmental aspects of flooding and erosion are also difficult to quantify in economic terms, and they have to be left with detailed descriptions.

As the world coasts get artificialised and global change effects are more noticeable, the response from coastal management instruments do not appear to be up to the increasing challenges. Along the coasts of Europe ecosystems and human-made structures are under greater pressure than ever. Activities such as tourism are encroaching in sensitive coastal zones. As identified by the European Environmental Agency, there is an urgent need to find more sustainable forms of tourism on the coast. This activity has a very high spatial and seasonal impact and its flows affect the whole of Europe. Thus, urgent action should promote the understanding of economic tools to compensate for major externalities and enhance solidarity amongst European regions (EEA, 2006). Such externalities are, for instance, the effects of flooding and other hazards caused by both natural phenomena as well as socio-economic activities in coastal and marine areas. However, methodologies for valuation of coastal protection are lacking a multidimensional approach taking into account both hydrometeorological as well as human induced risks in a way that swift decision making can be achieved efficiently.

The European Commission defines floods as “The temporary covering by water of land not normally covered by

DOI: 10.2112/SI85-186.1 received 30 November 2017; accepted in revision 10 February 2018.

*Corresponding author: gmalgar@upo.es

©Coastal Education and Research Foundation, Inc. 2018

water". This definition from the "Floods Directive", the European Directive on the assessment and management of floods (Directive 2007/60/EC), assumes flood risk context as a function of the probability of this temporary inundation times the consequences in terms of its impacts. It suggests that it is applicable in cases where fluvial and/or coastal waters cover temporarily land and thus it is a definition and concept that can be implemented in coastal as well as fluvial context. In coastal areas, additionally, inundation caused by storm action may infer severe erosion (retreat) of the shoreline and this in turn generates long term trends that is commonly remediated using coastal protection measures.

To deal with decision making in the management context approaches suggested within the regulatory framework can vary significantly from country to country. They reflect trends which may be based on traditional use of Spatial and Land Planning instruments by which the main tool for decision making related to coastal hazards is ultimately mediated by urban planning. Additionally, some countries tend to couple this approach on one based on economic appraisal, with Cost/Benefit (C/B) as a key methodology in the process to distribute resources among the various institutions involved. In those instances, allocation of resources coincides with the protection of socio-economic assets in a context of indicative planning tools. Finally, a further approach observed in various countries of the European realm are emergency response-type approaches, which affect most countries in relation to oil spills but that also is very distinct in instances where storm damage and other hydrometeorological process damages strategic resources for the economy such as beaches in Mediterranean countries. All of these views on coastal and marine hazard management need not be incompatible but an integrated approach seems to be, to date, lacking.

In this paper, a revision of existing practices as a reaction to the implementation of European wide regulation are presented specifically in relation to the management of hydrometeorological as well as oil spill related hazards. Examples from UK, Poland, Italy, Greece and Spain illustrate the various practices which are then grouped, for the purpose of clarity, in three types of action.

METHODS

A revision of existing data bases and knowledge platforms developed during the course of recent European Union funded research projects provided the starting point to establish a common framework. The review and analysis of existing methodologies and tools was built on the foundations of the accumulated knowledge developed by the authors in the context of previous European Civil Protection projects such as FLOOD-CBA (EC, 2015a), FLINKMAN (EC, 2012), CIVILARCH (EC, 2010) and specially ECOSHAZ (EC, 2015b) as well as other EU research projects dedicated to the assessment and management of coastal and marine resources (e.g. INTERREG funded COASTANCE, FP7 PEGASO or FP7 MEDINA). Some of the results are extracted from a deliverable from the Report on Stakeholder's views and needs of the ECOSHAZ Project (EC, 2015b) achieved by implementing a questionnaire. The questionnaire targeted knowledge on economic appraisal tools as well as common practice on hazard management in relevant institutions dealing

with coastal, marine and flood management in the countries represented in the project (Greece, UK, Spain, Poland and Italy).

RESULTS

Countries presented different degrees of development of frameworks supporting economic or territorial appraisal methodologies to gauge coastal hazards prevention measures. Some countries already have laws or regulations that deal with the economic valuation of coastal hazards management measures and a uniform application of C/B. Others, present a more fragmented situation. From the collection of background information three main types of legal and organizational differences can be highlighted. First, in Greece, Italy and Spain, there are no general laws or regulations that specifically deal with the economic valuation of coastal hazards management measures. Second, whilst in UK and Poland the competence of the subject is attributed to main national agencies, in the other countries this is fragmented in regional authorities (Italy) or is attributed case by case (Greece and Spain). Finally, in Italy, Poland and UK, C/B is applied uniformly, contrary to Greece and Spain. In view of the potential of results to be grouped in three main types these are presented for countries where *Spatial Planning* is most common, those where *Economic appraisal* is applied and finally, those where action is organised mainly as *Emergency response* measures.

Spatial and Land Planning

In some countries in Europe the tradition of spatial and land planning is more consolidated than in others. Such is the case of Spain, Germany and to some extent Italy where territorial planning (used here as synonymous to spatial planning) has been taken to a level by which all sectorial policies are linked to a spatial or territorial dimension. In the case studies revised in this article, the development of territorial planning has clearly dominated sectorial view on risk management. There is a consistent lack of implementation of economic appraisal focusing on specific flood and coastal erosion hazard and planning takes over using a Sub-regional scale. Whilst the spatial planning approach is comprehensive and thus environmentally sound, there are some aspects that tend to dominate and allow for little leverage when hazards are addressed. For instance, the most developed instruments based on urban planning tend to get a dominant role in the control of decision making processes when it comes to erosion and flooding hazard planning. Along the coasts of Spain, a Coastal Act is in force (Ley de Costas, 2013) which is an intricate regulatory framework among whose mandates is to protect the coastal public land. This interface of land and sea is taken from central administration to be regulated in terms of use and access rights. Erosion and other hazards are just one more of the competences under the umbrella of coastal protection, heavily dominated by an engineering approach to shoreline management. This is also quite complex and linked to urban planning views. For instance, the heavily regulated zoning proposed by the Ley de Costas is affected by urban plan (*Plan General de Ordenación Urbana*) in such a way that the buffer zones defined to regulate development varies as a function of the classification used for the land. This is exemplified by the fact that on rural and natural land the protection zone is extended to 500 metres from the sea influence zone, whilst on urban land this zone is reduced to 20

metres). Obviously, the attention is drawn to urban areas and the remedial works taken at a scale that, although ideal for cost and benefit analyses, are carried out in the context of urban development needs and hence the intersectorial view only complicates things. Local and National Government Agencies

interact in a complex way here, including funding schemes that in the issue of erosion quickly gets diluted in nationwide strategies where local issues may or may not be of interest (particularly if the coastal stretch bears tourism industry infrastructure).

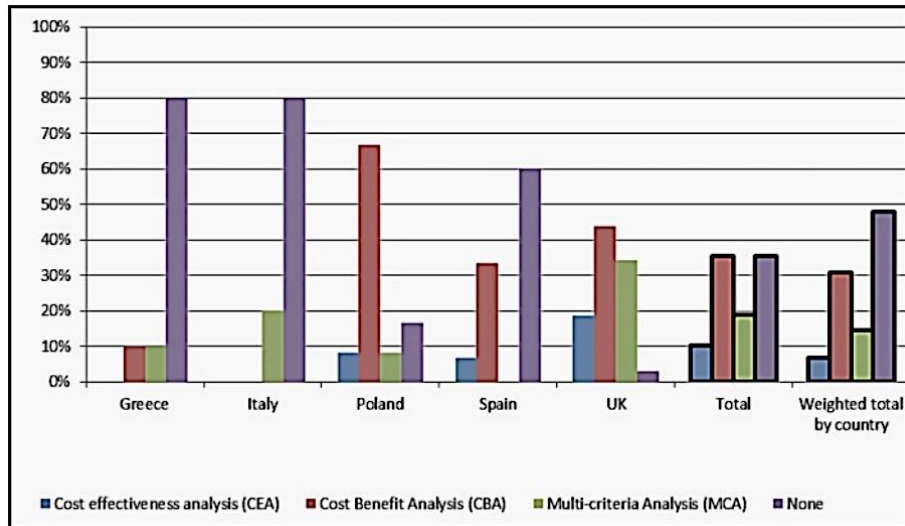


Figure 1. Application of economic tools for allocation of resources for hazards protection. From ECOSHAZ Project (EC, 2015)

Economic Appraisal

In those countries where economic appraisal (and economic planning) is dominant, the main reason that C/B is considered a useful tool is that it is a procedure that allows the selection of the most efficient option. Other positive aspects are its consistency and transparency, the inclusion of non-market impacts and the evaluation of benefits and costs over time. However, some data illustrates that stakeholders dislike this methodology, particularly questioning the central role of the discount rate, and the relevance of the procedure in the decision-making process. Albeit the considerable progress that has been made over the past few decades in the fields of hazards analysis and modelling, successful delivery of (C/B) assessment still remains very challenging and sparsely represented in decision making in relation to coastal erosion, flood management and oil spill management.

There is a considerable range of methodological approaches and terminology in use complicates the assumption of robust and comparable C/B figures. Besides the methodological differences, the lack of reliable publicly available cost assessment data is a major obstacle for process development. Initiatives such as the Inspire Directive (EU, 2007) are helping in re-directing this reality but implementation still remains heavily dominated by mapping and purely environmental management agencies. Existing cost databases are rather scarce, containing usually heterogeneous data or figures defined at an aggregate level. Moreover, many parameters related to the coastal hazards impacts are hardly reflected resulting in considerable uncertainties during the evaluation process of the appropriate mitigation measures.

The needs of stakeholders represents a perspective on the different visions in the countries selected for this study. Similar to the economic methodologies applied to coastal management, authorities actively involved in coastal risk management have a modest or no experience in C/B or other economic tools. However, the level of application of economic tools differs greatly between countries (Figure 1).

Emergency Response

When hazards are not considered in the framework of creeping or low probability hazards the trend is that civil protection as well as planning instruments in general adopt an emergency response measures position. Although spatial planning normally caters for emergency response as an integrated concept when dealing with hazards, the reality is that economic appraisal is lacking when planning phases are considering emergencies. Most cases of hydrometeorological and certainly oil spill related emergencies are attended driven by public pressure on the Administration to respond with mitigating measures. In those situation costs are not the main concern and for both decision makers and citizens at large timing is of paramount importance.

In terms of coastal erosion response, for instance, emergency response may be the main mechanism when Government agencies initiate large scale beach nourishment programs after winter storm deplete sand resources from key beaches in high demand coastal destinations in the Mediterranean. Costs and benefits are in those situations merely a technical part of the implementation plan and the public interest and the common goal of storm repairs on beaches the priority. As an example, during 2008 alone, the Region

of Andalusia in southern Spain dedicated 32.183.065€ to coastal works related to mitigate erosion problems. This annual expenditure is commonly repeated.

But perhaps this approach based on reactive actions to respond to emergencies is most visible when dealing with hazards related to oil spills and others derived from socio-economic activities. Vessel oil spills are very serious natural hazards that have affected coasts worldwide for many decades. Although oil spills from tankers are highly publicized, very little is known about the role played by the incentives and the regulatory instruments in place to prevent them.

Clearly in the topic of oil spills response has focused more in the development of funds for compensation to losses than it has on

mapping risks or economic appraisal of planning or design structures for prevention of accidents. Thus, the methodologies found dealing with these types of hazards focusses on correcting the large gap between damage and compensation scenarios. Some authors emphasize the need to strengthen compensation funds, while carrying out more comprehensive assessment studies which apply valuation methods comparable with those proposed by green capital initiatives for marine ecosystem services, and which could be used successfully during the litigation process (Alló and Loureiro, 2013).

Ratios differed greatly according to designation status. Figure 2 shows that of the 254 designated beaches, 6 and 24% met the requirements for lifeboats and rescue boats, respectively.

	Existing Legal Framework	Official Guidance	Responsible Institutions	Uniformity in the application of CBA
Greece	NO	EU Guide to Cost-Benefit Analysis of Investment Projects.	Organization that is responsible for the contingent, case by case, investment.	NO
Italy	NO	NO	Regional Public Administration Unit of Valuation	YES (under specific requirements)
Poland	YES	In existing regulation	The Chief Inspectorate of Environmental Protection-GIOS Ministry of Infrastructure and Development National Water Management Authority	YES
Spain	NO	NO at national level	No	NO
UK	YES	In existing regulation	Environment Agency Department for Environment, Food and Rural Affairs	YES

Figure 2. Regulatory framework and application of C/B approach in the representative countries used in this study. From ECOSHAZ Project (EC, 2015)

DISCUSSION

A report on the state of the coast of the European Environment Agency (EEA, 2006) on the legislative policies for the reform of the cohesion policy 2007-2013, emphasizes environmental views on the Structural Funds of the EU and the Cohesion Fund. This should help ensure compliance with the standards set out in the relevant directives. By directing structural assistance to projects that reduce coastal risks, natural hazards can be integrated and spatial planning promoted. Whilst this official approach can help strengthening spatial planning, the estimation of environmental costs and benefits should be more accurate in all countries. In the countries studied for this article most institutions are of the opinion that the presentation of the results of the C/B should be simpler and strongly recommend the introduction of physical environmental impact. The need to increase participation methods is a matter of controversy among countries.

Several limitations in the use of the C/B are identified by the respondents. The lack of funding and internal experts, and the

possibility that C/B increases conflicts among stakeholders are the main reasons that explain its limited use in decision-making processes. Additional limitations were that the C/B requires specific knowledge about types of data and needs procedures to ensure its maintenance. In several countries a previously approved methodology is still absent.

Although the C/B is considered a useful tool that helps in the decisions to select the most efficient option, the respondents show a slight preference for Multicriteria Analyses. This result may be related to the opinion expressed by the respondents that the estimates of environmental costs and benefits should be improved and that the physical environmental impacts of the option should be introduced in the C/B.

The hazard/risk assessment should be the cornerstone of any plan, as it defines the nature of the problem in terms of extent and severity, usually in the form of a risk map. Such a risk assessment can be undertaken at a large scale, in order to identify "hotspots", but the plan will be more valuable if these areas are then identified in detail, and assessed for differential

hazard/risk in different parts of each area, and the selection of different scheme options chosen accordingly. Without a proper risk assessment, no coastal hazard and risk management plan can be viable. All coastal hazard and risk management plans should include some degree of prioritisation of action, in particular to emphasise areas which need to be studied in more detail and areas where it is likely that protection and mitigation measures will be necessary. This prioritisation can be based on benefit-cost analysis, or something simpler at an exploratory stage. Without prioritisation, no coastal hazard and risk management plan can be viable in guiding future decisions. Any coastal hazard and risk management plan should attempt to identify preventative measures which can halt the rise in risk. There is a danger, without these measures, that coastal hazard and risk management plans will become simply a catalogue of engineering works and ship design measures designed to protect particular communities or coastlines at risk. This should be avoided: a thorough-going coastal hazard and risk management plan should identify the full range of measures for coastal hazard and risk reduction, and identify areas (at least at an exploratory stage) where each type of measure should be investigated and implemented.

All coastal hazard and risk management plans should identify areas for investment. This then provides a programme of capital spending, stretching many years into the future, and forms the basis of a bid to central government or other interested parties such as ship-owners for the necessary funds to carry this out. Again, prioritisation will be an essential part of this cataloguing of possible investment needs. But coastal hazard and risk management is also about preparedness for damaging events which exceed the design standards of known flood defence works and the ship designs aimed at reducing oil spill risks, and the residual risk that this entails.

The plan should encompass preparedness strategies, to be implemented locally, within a knowledge framework that serves to accurately predict hazard and risk and the communities and coastlines liable to be vulnerable. Finally, it will be sensible to include in any coastal hazard and risk management plan a strategy for developing knowledge and research suggestions. This will again form some sort of bid to those who fund research in the countries concerned, which will be all the more credible if it is based on a plan for managing coastal risks stretching many years into the future. This is because there will be opportunities within the program of risk management for new research to influence both the direction of travel and the efficiency of implementation.

CONCLUSIONS

As risk assessment, coastal hazard and risk management face increasing needs for comprehensive planning instruments, countries in Europe appear to be facing challenges in various ways. Though specific legislation is in place for the management of coastal areas planning tools focus in urban development seems excessive. Other countries base their decision making solely on economic appraisal. In those instances, allocation of resources coincides with the protection of socio-economic assets. Finally, emergency response-type approaches focus on narrow strategic resources for the economy such as beach erosion and oil spill mitigation.

ACKNOWLEDGMENTS

The authors thank the ECOSHAZ Project consortia (project supported by the European Union within EU Civil Protection Financial Instrument. Ref. ECHO/SUB/2014/693711).

LITERATURE CITED

- Alló, M. and Loureiro, M., 2013. Estimating a meta-damage regression model for large accidental oil spills *Ecological Economics* 86, 167-175
- European Commission, 2010. *Civil Protection Against Chemical Releases In Rivers CIVILARCH*. Directorate General for Humanitarian Aid and Civil Protection of the European Union.
- European Commission, 2012. *A Stakeholders' Linking Framework for Flood Management FLINKMAN*. Final Report. Directorate General for Humanitarian Aid and Civil Protection of the European Union.
- European Commission, 2015a: *Knowledge Platform for Assessing the Costs and Benefits of Flood Prevention Measures. FLOOD CBA Final Report*. Directorate General for Humanitarian Aid and Civil Protection of the European Union.
- European Commission, 2015b. *EcosHaz project. Economics of Prevention Measures Addressing Coastal Hazards Final Report*. Directorate General for Humanitarian Aid and Civil Protection of the European Union.
- European Environmental Agency, 2006. *The changing faces of Europe's coastal areas*. Office for Official Publications of the European Communities, ISBN 92-9167-842-2
- European Union, 2007. *Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)*. Official Journal of the European Union.
- European Union, 2007. *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*.
- Ley de Costas, 2013. *Ley 2/2013, de 29 de mayo, de protección y uso sostenible del litoral y de modificación de la Ley 22/1988, de 28 de julio, de Costas*. Boletín Oficial del Estado. 129, de 30 de mayo de 2013, pp 40691 to 40736
- Penning-Rowsell, E.C., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J. and Owen, D., 2013. *Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal*, London and New York, Routledge.
- William, P.B., 1994. Flood control vs. flood management. *Civil Engineering, ASCE*, Vol. 64, No. 5, pp 51-54.

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.