Guideline for socio-economic valuation of the shoreline

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As a part of the Interreg Messina project, socio-economic analyses have been performed. A guideline has been developed as a tool for the integration of costs and benefits in decision-making on investments in coastal zones. The guideline gives an overview on why, when and how socio-economic valuations of coastal areas, affected by erosion, can be made. The guideline could be used to prioritise areas that need attention due to threatened shorelines and to decide which preventive measures are the most efficient from a socio-economic point of view. The paper also describes a case study which was performed to demonstrate the practical application of socio-economic analysis and valuation in coastal management.

Introduction

People have always wanted to live close to waterways, in the past mostly for the convenient transportation possibilities but today also for recreation. However, human activities in the coastal area affect the natural coastal processes, which are also sometimes subject to severe damages by erosion and flooding. These hazards are even more potential as we talk about global climate change and the foreseen sea level rise.

Assessment of activities for prevention of coastal hazards should be used to maximise the benefits of measures or investments in the coastal zone. Attention should be given to the integration of coastal erosion into the decision making process, particularly into the strategy for sustainable coastal management. It is also important that different human activities are socially and economically evaluated.

This paper describes a guideline for evaluating shorelines, including recommendations for the need of socio-economic analyses in the decision-making process of coastal management and how such analyses can be made. The guideline is based on the experience of the Interreg-project “Management European Shoreline and Sharing Information on Nearshore Areas” (Messina). The guideline is based on case studies from France, the Netherlands, Poland and Sweden and one of the cases is presented in this paper.

Guide for valuation of shorelines

The guideline “Valuing the shoreline. Guideline for socio-economic analyses” [1] gives an overview of the importance of economic information in different phases of the decision-making process, and how to make socio-economic valuations of coastal areas affected by erosion and flooding risks. The use of such an analysis gives valuable information and insight into the function, needs, effects and costs for handling - or not handling - the erosion problems.

This guideline is meant for people working at county administrations, municipalities, governmental authorities, private landowners, etc., dealing with or affected by coastal erosion issues. The guideline can also be used when procuring consulting services.

The guideline is intended for those who are not experts in the field of coastal erosion or in the use of socio-economic analyses. The main purpose is to increase the knowledge on how to evaluate the shorelines and establish a sustainable coastal management.

The guideline could be used in order to make priorities between areas that need attention due to threatened shorelines, and/or which actions would be most efficient and effective to apply.

Why do we need economic analyses?

Directly or indirectly, coastal erosion affects societal values, such as safe areas for living or recreational possibilities. Therefore, public authorities take the responsibility to combat or alleviate negative impacts. Assessment of activities for prevention of coastal erosion should be used to maximise the benefits of future measures or investments in the coastal zone. From this point or view, it is important to give more attention to better integration of "erosion" into the decision making process and particularly into the strategy for sustainable coastal management.

Some basic statements were made in the Eurosion study [2]:

- **Internalize coastal erosion costs and risks in planning and investment decisions**
  "The impact, cost and risk of human induced coastal erosion should be controlled through a better internalisation of coastal erosion concerns in planning and investment decisions. Public responsibility for coastal erosion risk should be limited and an appropriate part of the risk should be transferred to direct beneficiaries and investors. Environmental assessment instruments should be applied to achieve this. Risk should be monitored and mapped, evaluated and incorporated into planning and investment policies".

- **Make responses to coastal erosion accountable**
  "Coastal erosion management should move away from piecemeal solutions to a planned approach based upon accountability principles by optimising investment costs against values at risk, increasing social acceptability of actions and keeping options open for the future. This move should be driven by the need to restore the coastal resilience and meet the conditions of favourable sediment status as developed in previous recommendations. It should be supported by the elaboration and implementation of Coastal Sediment Management Plans (CSMP)".

The public authorities represent all groups in society. They have the responsibility to base decisions on an integrated assessment of the consequences of alternative coastal protection schemes. Accountability of investments has to do with transparency of decision-making, based on clear criteria. The guideline describes valuation methods that can enhance accountability of decision-making by making costs and effects of measures explicit. As such these methods are supportive to decision-making.

Coastal policy options

Depending on the problem, different strategies for coastal management can be adopted. If the investigated threatened area is rural, one alternative is to let nature take its course. If the problem exists in an urban area, one reasonable option may be to maintain the present coastline since moving houses, infrastructure, or industry would be very costly. The goal of the foreseen intervention should be agreed upon, and should align with applicable policies and plans at higher levels.

A project definition describes the goals and activities required as well as the limitations of space and time. It should also consider resources required, which disciplines need to be involved for an integrated assessment and who assesses which impacts. Another crucial input is knowledge about the historical coastal erosion process, present situation and prognosis of future development in the coastal zone.

The alternatives developed can follow any of the five generic policy options as defined by the Eurosion project [2] given in Figure 1.

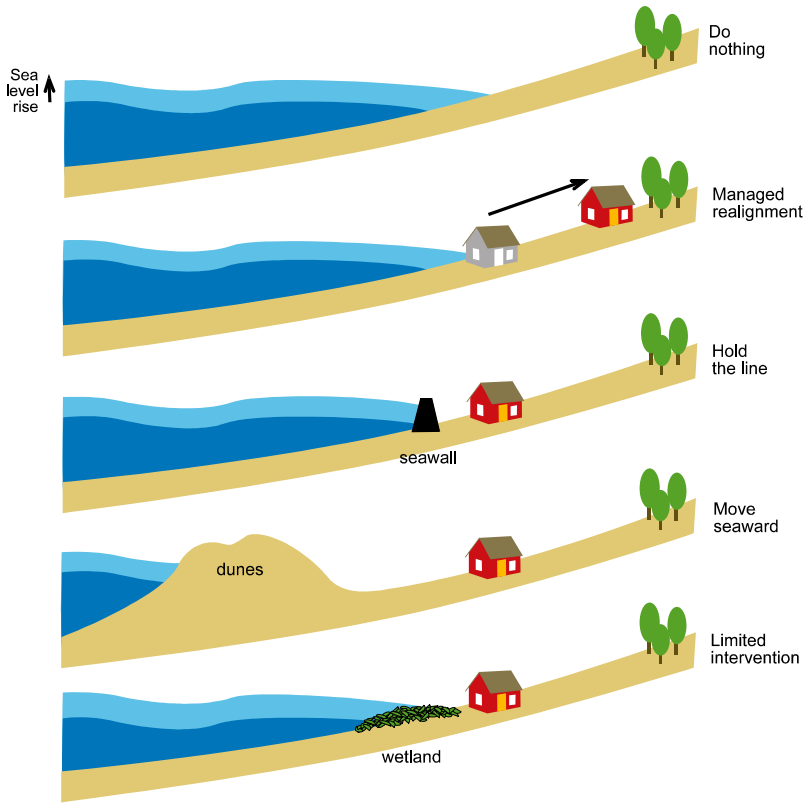

Figure 1. Generic policy options for coastal management [2].

- *Do nothing*
  There are no investments made in coastal defence assets or operations, i.e. no shoreline management activity.
- *Managed realignment*
  Identifying a new line of defence and, where appropriate, constructing new defences landward of the original defences.
- *Hold the line*
  Hold the existing defence line by maintaining or changing the standard of protection.
- *Move seaward*
  Advance the existing defence line by constructing new defences seaward of the original defences.
- *Limited intervention*
  Working with natural processes to reduce risks while allowing natural coastal change. This may range from measures that attempt to slow down rather than stop coastal erosion and

cliff recessions (e.g. nourishment), to measures that address public safety issues (e.g. flood warning systems, dune and forest maintenance, building restriction in coastal strip).

To identify the policy option to be selected, it is recommended to choose among a wide range of possible alternatives covering different protective measures, different probabilities of failure, and different time horizons. However, it is typically not feasible to fully analyse all possible alternatives. Selection of alternatives can be done in a brainstorming manner where a reasonable number of alternatives are selected for the analysis.

When should an economic analysis be made?

Three levels of decisions to combat coastal erosion and its negative impacts on society can be distinguished where project assessment is required.

- ***The planning or policy level***, which includes the different policy options "Hold the line", "Move seaward", "Managed realignment", "Limited intervention" and "Do nothing".
- ***The engineering or project level***, which cover a range of hard and soft mitigation measures. Hard techniques include breakwaters, gabions, geo textiles, groin fields, revetments and sea walls. Soft techniques include beach nourishment and re-profiling, dune and marsh regeneration and vegetation planting, beach and cliff drainage.
- ***The financial level*** includes measures and incentives, for example to control excess coastal urbanisation and tourism (development and land-use taxes, user charges), to promote restoration and cultivation (e.g. through subsidies), to accommodate the resettlement of coastal population at risk (financial compensation) and to internalise costs of risk and events (insurance fees, property rights).

An economic analysis can be applied to evaluate alternative responses on a policy or project level. The guideline doesn't explicitly describe financial measures and incentives to control potential damage as a result of erosion. In any project appraisal, the project goals, advantages and disadvantages, costs and benefits have to be identified, measured and evaluated. Human activities and interventions combined with natural coastal zone processes, produce an array of direct and indirect effects, of which only some can be directly valued in monetary terms.

Socio-economic analyses can be made in different phases and for a number of purposes, such as studies in an early phase within the land use planning. It could also be useful when protective measures have to be performed for a certain location of the shoreline.

How to make economic assessments?

The normal sequence of steps in an economic analysis for a project assessment is shown below in Figure 2. Initially, someone (e.g. landowner, municipality, regional or national authority) identifies that there is a risk that coastal erosion and flooding will damage values worth saving.

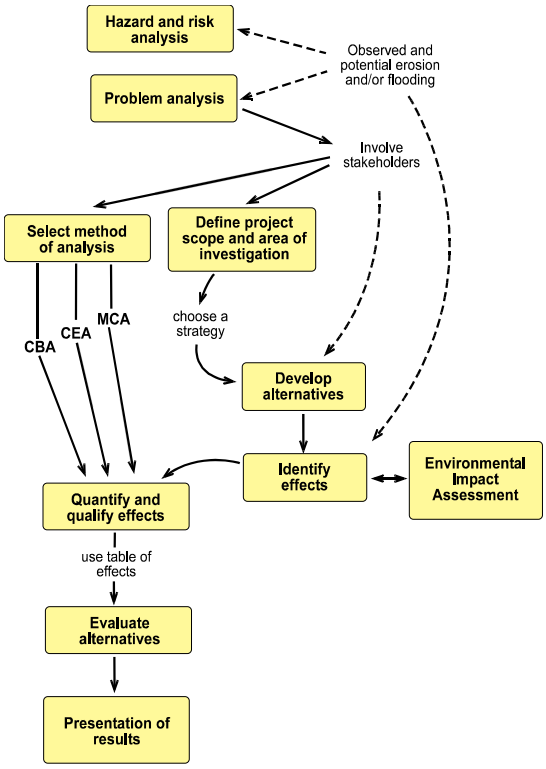

Figure 2. Steps in impact assessment and project appraisal of coastal erosion projects. [1].

This forms the basis to perform a problem analysis leading to the definition of a project to address the hazards of erosion and flooding. When the scope of the project is established and resources are allocated to conduct the investigation, different alternative options to cope with the hazards are analysed. The effects of the different options are identified, quantified, qualified, and compared using a socio-economic valuation method. Identification and quantification of effects is also the main task of Environmental Impact Analysis (EIA) and close co-operation between these parallel processes is essential.

By comparing the alternative options, the preferred alternative can be selected. This assists in giving transparency to the decision when public funding is used and it shows which economic, societal and ecological factors are included in the analysis.

Selection of valuation method

A parallel process to defining the project scope and development of alternatives is the selection of valuation method. The selection of valuation method depends on a number of factors such as

- Scope of the project and function of the valuation – what *phase* is relevant for the project in and what are the *objectives* and *goals* of the project.
- Resources available to conduct the valuation – *timescale* for the valuation, *expertise* and *funding* available, availability of *input data and information*.
- Rules and requirements of the investigating organisation – requirements on *output documentation for decision making* and *communication* with stakeholders and the public.

Several methods can be used for the assessment and valuation. The most commonly used are Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA). All methods can be used at different levels depending on who is the initiator of the valuation. (The methods are described in more detail in the guideline [1] and in the Messina State of the Art on socio-economic analyses [3].)

When public money is spent, a socio-perspective is normally used, which includes environmental, health and security aspects. For private stakeholders, a more financial/business perspective of the valuation is used.

In a social CBA, the decision criterion is the ratio between benefits and costs. If benefits exceed costs (= welfare increase) the project is worth doing from a societal point of view. For a CEA, the least cost alternative such as the cost per protected meter of shoreline is calculated for a desired effect. In a MCA, all effects are assigned scores and the effects are given different importance (weights); the option with the best total score is selected.

The main difference between the methods is that a MCA can incorporate more subjective qualitative data as it can use valuation through ranking score and assigning weights to effects/factors. In CBA and CEA on the other hand, the valuation is made by using monetary values. For that reason, it is difficult to include ecological and social-cultural effects. In the case of CEA, benefits and effects on society are not included in the valuation. Furthermore, it can be costly to establish a monetary value in a CBA, for example regarding employment effects. This is much easier to be valued in a MCA where a score is discussed and assigned.

Identification of effects

The effects of all alternatives, including the “Do nothing” alternative, need to be identified, quantified and qualified. Through adjustments in design or compensation schemes, and considering as many effects as possible of an intervention expected negative impacts can be identified in an early phase of the project development,. The most obvious problem resulting from erosion is loss of land, either privately owned (housing, agricultural land) or publicly owned (nature reserves, infrastructure). The benefit from coastal protection measures is a temporary extension of the use of a land area.

Stakeholder groups should preferably be involved in the identification of effects (through workshops or questionnaires). This is also desirable from the perspective of creating acceptance of the outcome of the analysis.

The effects are presented in a “Table of effects” where the effects are sorted under different categories, such as effects on the local economy and effects on nature.

Quantifying and qualifying effects

When the relevant effects are identified they should be described and ***quantified*** as far as possible for all alternatives, including the “Do nothing” alternative. For example, if coastal erosion and flooding endangers a residential area, the hectares, number of houses, their average market value and number of citizens need to be defined. It is of high relevance to have good information/research on effects, and as much as possible quantified. Co-operation with other disciplines is essential in order to agree on what effects should be analysed, which criteria are used to express the effects (hectares, biotope lost, numbers of species lost, number of houses damaged, number of tourists affected etc.).

Qualifying means ranking each effect. The values can be monetary or non-monetary. Monetary values represent, among others, investment costs, production losses, and costs of restoring damage. Non-monetary values include classification and ranking scales that describe the effects of alternatives such as loss of biodiversity, wildlife habitats and cultural values. Certain methods can be used to assess monetary values for these non-monetary values.

To conduct a total assessment, including all factors affecting the project under assessment will demand huge resources. It is recommended that the effects are preliminary valuated and ordered after importance. Valuation starts with the most important effects and ends with only minor influence from the included effects. The selection of effects to be included in the valuation is done by the project initiator, experts and key stakeholders involved to ensure a relevant outcome.

Comparing alternatives and basis for decision-making

The result of the socio-economic analysis should be presented with its supporting background data to form a basis in the decision making process and to communicate the results and alternatives of action to stakeholders, end-users and the public. This can e.g. be done through reports, information activities. The results must be presented in such a form that the alternatives can be understood by end-users, which normally don't include economic experts.

Case studies

The guideline is based on the experience of socio-economic studies made within five cases. Coastal erosion issues in four European countries have been studied and lessons learned from different types of economic analyses. In the Netherlands, CBA has been performed for one area of coastal extension in South Holland and also for protection of a coastal city [4,5]. Coastal erosion protection of a beach in Ystad, in southern Sweden, has been analysed by a CBA [6]. MCA has been used to study the problems of a narrow land area in the Lido of Sète in France and this method has also been used for the ruin of the old church in Trzeacz in Poland [7,8].

The experiences from these case studies are summarised in the guideline.

Valuation of the shoreline – Ystad Sandskog case

Ystad Sandskog is situated east of the city of Ystad, close to the Baltic Sea in the southern part of Sweden. The 5 km^2coastline of Ystad Sandskog consists of sandy beaches and the area adjacent to the shore is frequently visited for different kind of recreation activities. In the last 50 – 100 years the shoreline has retreated about 50 meters due to coastal erosion. Some areas at Ystad Sandskog are currently protected from erosion and possible flooding at high water levels by seawall with foot-paths that needs constant maintenance. Other measures taken to reduce the effects of coastal erosion are revetments, groins, draining pipes and vegetation stabilisation. .

Failure of the existing wall and other protective measures will at extreme weather situations lead to flooding of the protected area, progressive erosion is estimated to lead to loss of the beach area with some 415 000 m^2 in the coming 100 years.

For that reason, a Cost-Benefit Analysis (CBA) was carried out to give guidance in deciding on strategies for the coastal management and selecting among alternatives.

Active processes and future development

Predictions based on evaluation of historical data show that the coastal retreat by erosion in Ystad Sandskog will be about 0.5 meters per year if no action will be taken. Since different types of erosion protection already exist the present erosion act both on the shoreline and on underwater areas. Underwater erosion thereby undermines the ground and this erosion is therefore just as important as the more visible one. To maintain the present coastal situation and prevent further erosion, protective measures must be undertaken.

Values at Ystad Sandskog

There are a number of values that have to be taken into account when deciding the strategy and measurers to protect the coastal area at Ystad Sandskog. The most important values are related to buildings, (houses, hotel, summer cottages), infrastructure (roads and railway, pipes for water, electricity etc.) and recreational and tourism activities (camping site, bathing, restaurants etc.).

Furthermore, the area at Ystad Sandskog contains many different types of biotopes including rare plants, herbs and animals, many of these protected by Natura 2000-areas.

Impact assessment and project appraisal

The process of impact assessment and project appraisal followed the steps indicated in Figure 2 above. The hazard and risk analysis at Ystad Sandskog together with problem analysis and technical assessment of the future situation were based on available maps from Ystad municipality and some technical reports from the area. An assumption of sea level rise by 0.5 m within the next 100 years, will lead to 50 m of coastal erosion. Historical data indicates erosion rate of 0.3-0.7 m per year during the last 100 years.

The strategy of the municipality

The present strategy of Ystad municipality is to “Hold the line” with ”Limited intervention” to preserve the present position of the coastline. There is a yearly budget for maintaining the present erosion protection constructions and for testing new methods. The municipality is also the main landowner of the coast in Ystad Sandskog.

Alternatives of coastal protection

Several alternatives, that can be considered in order to mitigate the coastal erosion, have been evaluated. The “Do nothing” alternative (no project option) implies that land, properties, roads and utilities are successively lost to the sea. The protecting sand dunes will probably not move landward but erode and give space for flooding in times of high water levels. This is not really a desired option for the municipality. Measures have to be done to prevent damages on buildings, infrastructure etc. This option is used in the analysis to demonstrate what values are at stake. A “Managed realignment” of the coastline would mean that the facilities, hotel, the foot-path/bike road etc should be moved landwards as erosion and sea level rise evolves. This alternative is not analyzed. The “Move seaward” is really not one of the discussed options. However not many would mind if there was an accumulation of sand along the coast.
Finally, two options were analysed, based on the “Hold the line” and ”Limited intervention” strategies.

Option 1 – Maintain existing seawall and groins and new breakwaters

The municipality is currently maintaining the shore protecting structures (seawall and groins) at place. New submerged breakwaters should be installed and will protect the coastal bike road and a building situated just 50 meters from the present shoreline.

Option 2 - Beach nourishment

The municipality has made a study on a beach nourishment alternative. At present a permission is given to deposit 20 000 m^3 along the shores of Ystad Sandskog. The municipality will also apply for a permission to extract sand from the sea floor about 5 km south of the

coast. This option also includes limited maintenance of existing erosion protection constructions.

Evaluation model

In order to evaluate these options a Cost-Benefit Analysis (CBA) was chosen. The CBA was carried out using a modified version of spreadsheets developed by the British authority Defra [9]. The modification concerns only layout of the spreadsheets that have been adjusted to suit this particular case study. Formulas and calculations were original.

The basic way of working with the CBA model is to start with estimating the total damage and loss of the "Do Nothing"-alternative (No Project). This value is later used as the benefit (or avoided damage) for the investigated options of preventive actions. Next step is to estimate the schedule and cost of implementing the options. Finally there is still risk of damages for the investigated options; the cost of this is calculated.

Valuation of effects

The estimated development of the shoreline if nothing was done and the effect of the two alternatives were calculated. Properties at danger were house, villas, summer cottages, a hotel, a couple of restaurants, rent cabins and cottages. A road of local and regional importance, railroad and parking areas, a system of smaller roads that leads to the summerhouses is also at risk. Furthermore, sport facilities such as a municipality athletic stadium are at risk but there are no industry plants in the area. Other values affected are tourism, recreation and nature life. The municipality owns approximately 90 % of the land in the area. The effects are summarized in Table 1.

Table 1. Table of effects for the Ystad Sandskog case

	Alternatives		
	Do nothing	**Option 1 Maintenance and new breaktwaters**	**Option 2 Beach nourishment**
Direct effects			
Investment costs	0	Yes	Yes
Maintenance costs	0	Yes	Yes
Direct/indirect effects			
Damage to property and infrastructure	Yes	Some	Some
Agriculture	0	0	0
Recreation/Tourism	Yes	0	0
Other damages	Yes	0	0

The data used for quantity and cost data come was delivered by the municipality of Ystad, based on analogous estimate and historical data. The quantity data was based on the technical assessment and prognosis of future erosion risk. Cost data was estimated from historical data and past experience.

Results and discussion

All calculations and a summary of results is presented in the case study report [6]. For a CBA the selection criterion is that if the ratio between benefits and costs is greater than 1 (benefits divided by costs >1) the option is worth doing. The option with highest benefit cost ratio gives "Best value for money". In this case study both option 1 and option 2 were worth

doing as they both had a cost benefit ratio (b/c) greater than 1. Option 2, Beach nourishment, had the highest b/c ratio of 3.6 as shown in Table 2.

Table 2. Summary table of Ystad sandskog case study evaluation. ((PV=Present Value)

Costs and benefits of options (MSEK)				
	No Project	Option 1	Option 2	
PV costs from estimates	0	38	31	
Optimism bias adjustment		23	19	
Total PV Costs for appraisal PVc		60	50	
PV damage PVd	235	53	56	
PV damage avoided		182	180	
PV assets PVa				
PV asset protection benefits		0	0	
Total PV benefits PVb		182	180	
Net Present Value NPV		122	130	
Average benefit/cost ratio		3,0	3,6	
Incremental benefit/cost ratio			0.24	
		-	Highest b/c	
Brief description of options:				
Option 1	Maintain existing seawall and groins, new breakwaters			
Option 2	Beach nourishment			

The analysis shows that the present value of investment was about 6 M€ for option 1 and 5 M€ for option 2. The value of avoided damage if the options are implemented was 18.2 and 18 M€ respectively. This means for option 1 that if 1 M€ extra would be invested, compared to option 2, 0.2 M€ will be avoided

A decision maker can use the b/c ratio to select the best alternative. One possible way of reacting to this is to ask for better alternatives. Can we accept the predicted damage level of the case study? Is there an option that reduces predicted damages even better?

Conclusions

An economic analysis is necessary as a decision basis in coastal management. By a CBA, a long-term perspective is generated and the influence over time of natural change and manmade intervention will be demonstrated.

In a case like Ystad Sandskog where land is lost to the sea it is of direct interest for the landowner to evaluate future possibilities. The adjacent coastal areas are reasonably stable and do not influence on the part of the beach, which has been studied.

A CBA adopted on regional or national levels may help prioritising different planned projects and the different alternatives can be analysed using the same methods to estimate quantities and to establish cost data. In the case of single project analysis, over- or underestimating may be more systematic and may not pose a big problem as long as the options are treated equal.

Technical evaluation and models for evaluating shoreline development and impact of manmade activities on erosion and the shoreline are fundamental for a reliable analysis.

Final remarks

Socio-economic analyses are necessary when decisions have to be made in coastal management. Such an analysis could be performed either in an early land use planning phase or

when protection measures must be taken. That would offer possibilities to maximise the benefits of future measures or investments in the coastal zone.

In the Messina guideline for socio-economic analyses of shorelines practical recommendations are given to be used by county administrations, municipalities, governmental authorities, private landowners, etc., dealing with or affected by coastal erosion issues.

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