



Protection by hard defence structures or relocation of assets exposed to coastal risks: Contributions and drawbacks of cost-benefit analysis for long-term adaptation choices to climate change



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ABSTRACT

Adapting to sea-level rise due to climate change involves new public policies that aim to relocate those assets most at risk from coastline erosion or flooding. It is no longer solely a question of studying the merits of a defence infrastructure project designed to prevent risks but of looking instead into a broader and longer-term project implying a whole new logic of land-use management for the areas concerned. In this context, the aim of the present article is to compare different adaptation scenarios and to show the need for evolving economic assessment and decision-making tools to include multidimensional and long-term aspects of adaptation policies. It is important to show the limitations of traditional Cost-Benefit Analysis (CBA) by integrating economic impact and non-market factors which are currently only assessed in multi-criteria approaches. Such assessments enable comparison of the Net Present Value (NPV) of a protection scenario using hard defence structures with various relocation scenarios, depending on whether the CBA includes only the direct damages avoided (classic CBA) or integrates the long-term tourist economy and environmental impacts (enhanced CBA). As costs of property purchasing are high, CBA may initially favour the protection scenario over relocations despite unfavourable tourist and environmental consequences. However, if one takes into consideration innovative land-purchase mechanisms which enable reduced investment costs in relocation scenarios, the latter measures may have a positive NPV. We therefore conclude that, in the long term, taking into account the local tourist economy and environmental benefits, the likely fall in prices of real estate at risk and the implementation of anticipatory schemes could enable relocation policies to become economically viable.

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1. Introduction

According to the Intergovernmental Panel on Climate Change (IPCC, 2014), sea-level rise resulting from climate change will exacerbate the effects of storms and coastal flooding in coastline areas. These areas, often highly urbanized, are very vulnerable in terms of damage to infrastructure, property and human safety. Until now, coastal management doctrines have emphasized measures that attempt to stabilize the coastline, to protect it from erosion and coastal flooding. Faced with the prospect of increased

risks, the current recommendations are for policies that 1) reduce sensitivity to risks through mitigation, and/or 2) reduce exposure to risks by relocation of assets (MEDDTL/DGALN, 2012). Even when policies adapt to the local situation by associating several kinds of measures, the costs and respective advantages of each may be called into question, especially for protection measures that involve hard defence structures such as riprap structures or seawalls, and recently recommended relocation policies whose political and social acceptability is problematical.

Cost-Benefit Analysis (CBA) is the emblematic decision-making tool for this type of public choice. It is used to rule upon the pertinence of a project or to arbitrate between several management strategies. However, in the field of river (or coastal) flood prevention, CBA is generally limited to the investment and maintenance

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costs of hard defence structures and to direct damages avoided (the latter being assessed through damage functions) (André et al., 2013). In the case of adapting to climate change, it seems useful to adopt a more global understanding and also include certain indirect avoided costs and long-term impacts such as repercussions upon the tourist economy and non-market effects upon the environment, which are not integrated into “classic” CBA. The aim of this article is to suggest ways to address these limitations. This leads us to envisage the CBA of a territorial project of urban development of a much broader scope than that of a project dedicated solely to risk prevention, and therefore one that is more attuned to the spirit of adaptation to climate change and to the urban and social transformations involved in relocation policies.

In this article, a CBA was carried out on the basis of five scenarios: (i) a reference scenario corresponding to minimal action against coastal risks, in line with present-day management (referred to as “reference situation”), (ii) a scenario corresponding to the construction of hard defence structures (known as “protection”), (iii) an initial relocation scenario using existing schemes (known as “standard relocation”) and finally (iv and v) two relocation scenarios which integrate innovative compensation procedures which reduce the costs of asset repurchasing and facilitate social and political acceptance of the operation (Lambert, 2013; André et al., 2015). These are referred to as “relocation with division of ownership” and “relocation with buy and leaseback”.

Our approach is intended to be both instructive and comparative so as to weigh up the various factors involved and the differences in results according to the scenario and the type of approach. To free ourselves from specific conditions, we have thus chosen to build our assessment upon a fictional site that constitutes an archetypal example of a seaside community of the French Mediterranean coastline. The use of such an archetypal reference site helps strengthen the instructive nature of our evaluation to local decision-makers. The site is representative of a dense urban area, located on a low, sandy coastline, faced with a considerable risk of erosion and coastal flooding. This is a very common situation in France and especially on Mediterranean coastal territories.

The aim of this study is to emphasize that decision-makers, facing to climate change, will have to rethink their overall planning by integrating numerous factors, including environmental, economic and tourism features, the latter being often the main source of income for Mediterranean territories. It is therefore important to identify the factors that enhance the interest of the relocation policies, such as the maintenance of beaches, as these are both a natural infrastructure of protection and an asset to the tourism sector. For this purpose, the use of a simplified case study facilitates a comprehensive approach, to compare the different protection and relocation scenarios, showing the interest of the division of ownership and the buy and leaseback procedures, which are the innovative elements introduced by the article. This fictional case study is a decision support for local decision-makers, who are today helpless with regards to those long-term horizon projects, with many uncertainties on both coastal natural hazards and evolution of economic market. Of course, in reality, the range of risk management actions is wider, the choice depending on local characteristics, which most often leads to combine several types of measures, which can be qualified of “hard” (defence structures like seawalls or breakwaters) or “soft” (dune management, beach nourishment, etc.). Our approach focuses on the study of the conditions of the economic feasibility of relocation policies, specifically for urban coastal areas where humans, urban assets and tourism issues are particularly significant.

The intention is not to provide accurate valuations but to enable sensitivity analyses which can grade results according to orders of magnitude. Unlike the usual practice in France of carrying out CBA

assessments at a national scale, and thereby excluding effects that may balance each other out in spatial terms (in the transfer, for example, of tourist attractiveness between towns), our approach is deliberately focused on a local scale, the one at which adaptation projects are carried out after public consultation. Decisions taken at this level should take into account the whole range of relevant effects.

After examining in the second part to what extent climate change and associated adaptation policies involve methodological adjustments in relation to classic CBA, we present in the third part the details of our approach. The results are presented in the fourth part which compares the scenarios of classic and enhanced approaches. The fifth part is given over to discussion of the results and a sensitivity analysis for the main factors of specific impacts.

2. Renewing assessment tools to guide long-term decisions

2.1. Practices and limitations of traditional methods

Without wishing to open up an epistemological debate about the usefulness and relevance of economic or management science to decision-making, it is important to ask how adaptation to climate change implies a necessary development of its tools and above all of its procedures, given long-term prospects and the progressive nature of the logic which should characterize adaptation policy.

Sequential (Treich, 2000) or adaptive (Holling, 1978) approaches are appropriate for progressive action by what are known as “no-regrets” policies, i.e. ones that have positive impact during the phase of adaptation and are designed to avoid irreversible effects. These are policies of “act and see”, creating pathways of adaptation that, in the continuously progressive spirit of sustainable development, allow action to be taken from a position of anticipation, adjusting it all the while as further knowledge becomes available, and giving priority to avoided costs. These are the sequential policies put forward by Treich (2000) for whom it is important not only to seek the “social acceptability of a level of risk or the choice of a reasonable investment to prevent the risk” but also to define “strategies of intermediate management that offer high degrees of flexibility for future generations”. The transformations of the decision-making process towards greater flexibility should be accompanied, according to Treich (2000), by profound changes in laws and forms of governance. These changes also mean reconsidering the discount rate, whose single nature has been called into question and whose level in France has recently been reduced to increase long-term benefits, especially environmental ones (Quinet, 2013).

These debates also occur at a time of budget restrictions when CBA, bolstered by the principles of “new public management” (Bezes et al., 2011), has become increasingly used to rationalize and legitimize public action (Roy and Damart, 2002). It can be considered as the cornerstone for traditional economic calculations and decision-making practices, especially for valuing projects. In the last few decades, the implementation of more complex and interdisciplinary projects and policies, in the field of sustainable development for example, has affected the methods for assisting decision-making and valuations. This evolution concerns both metrics, with the surge of indicators and multi-criteria methods, and practices too, with the development of participatory evaluation (Plottu, 2005; Baslé, 2008; Rey-Valette and Mathé, 2012). However, CBA is actually used quite seldom in Europe (Laurans et al., 2013), especially in France where the culture of valuation is not widespread (Varone and Jacob, 2004; Banos and Rulleau, 2014).

Traditionally used for infrastructure projects (transport in particular), CBA has come to be employed more and more in natural hazard management. In the area of flood prevention, the

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