Coastal Engineering 87 (2014) 169–182

Contents lists available at ScienceDirect

Coastal Engineering

journal homepage: www.elsevier.com/locate/coastaleng

Review

The consequences of doing nothing: The effects of seawater flooding on coastal zones

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ARTICLE INFO

Article history:
Received 2 August 2013
Received in revised form 29 November 2013
Accepted 3 December 2013
Available online 18 January 2014

Keywords:
Climate change
Flooding
Ecosystem services
Coastal areas
Biodiversity
Business disruption

ABSTRACT

Sea level rise and an increased frequency and severity of storm surge events due to climate change are likely to increase the susceptibility of low lying coastal areas to seawater flooding. An integral part of any coastal management strategy throughout European countries is the "do nothing" scenario; this is the benchmark against which putative intervention strategies are evaluated. While the prime concern of a flood defense scheme appraisal often focuses on the sustained financial "benefits" of an intervention, intrinsic to a complete multicriteria analysis is a comprehensive evaluation of the ecological and social consequences of coastal flooding, reflecting the needs of end users and satisfying relevant national and international policies.

An ecological perspective may be usefully employed to examine the impact of the do nothing option on coastal environments (e.g. estuaries, sand dunes and grasslands) and businesses. Although at first sight coastal environmental and business systems appear quite different, they have similarities in that both are vulnerable and susceptible to flood damage or loss and both may be analyzed by employing ecological, adaptive, resilience frameworks. From an ecological perspective many coastal environments are of international conservation importance and provide important ecosystem services including coastal protection, nutrient cycling, carbon sequestration, food production and recreation. Nonetheless, despite their potential vulnerability to coastal flooding, our understanding of the effects of salinity on the biological response of many coastal plants and animals is extremely limited. We show here how plant physiology and patterns of plant and invertebrate distribution are impacted by sea water flooding. We also present responses of model plants to sea water inundation based on the Intergovernmental Panel on Climate Change (IPCC) (2007) predictions of sea level rise and storm surge events. Results showed that coastal habitats surveyed are relatively resilient to flooding due to their species rich nature and their ability to adapt to flooding. However specific groups of plants such as grasses are more affected by flooding and less able to recover.

The socio-economic dimensions of doing nothing are addressed in relation to the impacts of coastal flooding specifically on business activity, which has received little attention to date. Here the focus is on the presence or absence of business disruption and recovery plans as a means of increasing a business's adaptation and resilience to flooding. Results show that some businesses, particularly small ones, are more likely to fail to recover from flooding due to lack of forward planning. Therefore from an ecological perspective business recovery post flooding is likely to be dependent upon ability to adapt, which itself depends upon the construction of resilient business environments.

Contents

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http://dx.doi.org/10.1016/j.coastaleng.2013.12.001

1. Introduction

Europe's shoreline faces an unprecedented level of risk from flooding and erosion as a consequence of sea-level rise and extreme weather events (Intergovernmental Panel on Climate Change, IPCC, 2007; Nicholls and Cazenave, 2010; Weisse et al., 2013). One of the over-arching objectives of the THESEUS project (http://www.theseusproject.eu) was to assess the key risks faced by the European coastline and provide a coherent, integrated strategy to mitigate the socio-economic and ecological impacts of flooding on the coastal environment. A model for this approach already operates in the UK where coastal management policy is centered on Shoreline Management Plans (SMPs) that describe how coastal areas should be managed to combat flooding and erosion. Originally drawn up in the 1990s these have now been updated into the second generation plans which integrate coasts and estuaries, focusing on short- (0–20 yrs), medium- (20–50 yrs) and long-term (50–100) predictions of the behavior of coastal processes and threats of flooding and erosion taking due consideration of climate change and sea level rise. Having divided sections of coast into 'management units', SMPs are based on one of four different management policies ascribed to each section as follows (Environment Agency, 2013):

1: Hold the (existing defense) line—Build or maintain artificial defenses so that the position of the shoreline remains.
2: Managed realignment—Allow the shoreline to move naturally, but managing the process to direct it in certain areas.
3: Advance the line—New defenses are built or new habitat created on the seaward side of the existing shore.
4: No active intervention—There is no planned investment for defense against flooding or erosion. Flooding will not be actively prevented or directed, i.e. the "do nothing scenario".

Option 1 tends to be the most widely practiced throughout Europe and a combination of so-called 'hard' (see Mendoza et al., 2013) and 'soft' (see Hanley et al., 2013a) engineering solutions are at the forefront of methods used to 'hold the line'. However, an integral part of coastal management and planning is option 4 —the no active intervention (Defra, 2006) or "do nothing" scenario. Rather than being seen as the default position for coastal planning, this more commonly represents the benchmark scenario against which all putative managed interventions must show sufficient benefit to be viable. The Benefit Cost Ratio (BCR) of a proposed scheme should be "robustly in excess of 1" (Sugden, 2004) in order to be passed forward for consideration for funding.

The expected cumulative economic cost of a proposed scheme is estimated over a suitable planning horizon, through assuming either minimal or no on-going maintenance of any existing defenses. In the UK the planning horizon is 100 years. The "cost" of the "do nothing" scenario is calculated over the short-, medium- and long-term epochs using a range of flood maps. These are drawn up according to an acceptable risk level or Standard of Protection (SoP), by considering meteomarine events of "return periods" equivalent to the specified SoP, combined with the anticipated land subsidence and global sea level changes appropriate to each epoch. From the details of the flood maps, damage costs to land, building and infrastructure can be derived, which may also be combined with (loss of) "life costs".

At the same time socio-economic and environmental considerations and other factors identified during end user consultation are evaluated. These may later be incorporated into a multicriteria analysis used to appraise possible flood risk reduction interventions informed by end user and legislative priorities (Zanuttigh et al., 2013). In some situations the BCR will be such that either the economic benefits of defending a piece of coastline are not sustainable over the management timeframe, or are so marginal that there are always other schemes of greater priority and urgency that are apportioned the available funding. In these cases it is important for coastal managers to understand and appreciate the ecological and socio-economic consequences of doing nothing which is the focus of this paper. In some cases this may lead to a decision to defend a stretch of coastline on a basis beyond the economics of the damages expected, as in the case of a site of historical or cultural importance. In other cases the consequences may actually prove beneficial as in the case of managed realignment and habitat creation/compensation.

Thus, in deciding to adopt the 'do nothing' option, coastal managers and policy makers must be able to weigh up the ecological impacts of seawater flooding on coastal environments and coastal businesses, including with the latter the socio-economic implications. The latter have been widely studied (Penning-Rowsell et al., 1992, 2005), yet