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Depolderisation policy against coastal flooding and social acceptability on the French Atlantic coast: The case of the Arcachon Bay

Lydie Goeldner-Gianella [a, c, *], Frédéric Bertrand [b, d], Annaig Oiry [a, c], Delphine Grancher [c]

[a] University Paris 1 Panthéon-Sorbonne, Institute of Geography, 191 rue Saint-Jacques, F - 75005 Paris, France
[b] University Paris-Sorbonne, Institute of Geography, 191 rue Saint-Jacques, F - 75005 Paris, France
[c] Laboratory of Physical Geography UMR 8591, 1 place Aristide Briand, F - 92195 Meudon, France
[d] Laboratory PRODIG, 2 rue Valette, F - 75005 Paris, France

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ABSTRACT

This article details the results of a social survey concerning "depolderisation", conducted in the Arcachon Bay on the south-western French Atlantic coast. Depolderisation consists of reopening polders to the sea via tidal gates, creating breaches in the dikes or dismantling them altogether. Although this technique has rarely been used in France, in comparison with the UK or the USA, it has begun to arouse interest, especially in the wake of storm Xynthia which in 2010 heavily damaged the French Atlantic reclaimed coast. In the Arcachon Bay, researchers have demonstrated that managing flooding risk through depolderisation leads to ecosystemic benefits, such as a more flexible sea defence through the restoration of saltmarshes, biodiversity enhancement and nature-based recreation. They have also investigated the social acceptability of depolderisation – the main topic of this article. Several methods were used to analyse this acceptability: thorough interviews, a questionnaire survey answered by 675 polder users and inhabitants and a survey on their willingness to pay. The results show that the local people and some of the stakeholders are largely opposed to depolderisation, preferring the reinforcement of sea dikes. This refusal is not linked to a fear of the sea but to a deep attachment to local polders and their uses, and to the slow pace of national policy development on coastal risk management. The fact that similar results have been obtained in other European countries confirms some of these results. This article is a contribution to the debate initiated in developed countries on more flexible or natural ways of managing coastal risks and adaptation to climate change, and on the social obstacles that hinder renewed and sustainable coastal policies.

1. Introduction

Xynthia was a windstorm that hit the French Atlantic coast on 27 and 28 February 2010. It caused 47 deaths and nearly €1 billion of damage, bringing about a sudden awareness of France's exposure to the hazards of sea flooding (Chadenas et al., 2013). Even though projections of storm and storm surge changes likely to affect Europe are highly uncertain (EEA, 2013; Kovats et al., 2014; MEDDTL, 2012), a series of violent storms since 1999, in conjunction with the increasing numbers of people living on or near the coast, have propelled the hazard of sea flooding up the local and national agenda (Ciscar et al., 2011). Coastal zones in Europe are usually centres of population and economic activity. Prior to Xynthia, risk management techniques for sea flooding consisted primarily of large-scale defences involving the raising or reinforcement of dikes that protect polders (either by widening them or by adding riprap). There is, however another, and more flexible means of flood risk management, namely "depolderisation" – i.e. creating tidal gates or breaches in the dikes, or even dismantling them altogether, so as to open up polders to the sea once again. This approach has rapid ecological impacts, with the return of tidal marshes able to attenuate the energy of the swell prior to its reaching the dike, and thus partially reducing the risk of flooding. This attention to wetlands increased after a series of recent natural disasters such as the Indian Ocean tsunami in 2004, which proved the protective role of mangrove, or the hurricane Katrina in 2005, which highlighted the role of saltmarshes in coastal protection.

In both North America and Europe natural environments are increasingly being used as a form of natural infrastructure to provide sea defences and help adapt to climate change. Increasing

* Corresponding author. University Paris 1 Panthéon-Sorbonne, Institute of Geography, 191 rue Saint-Jacques, F - 75005 Paris, France.
E-mail addresses: Lydie.Goeldner-Gianella@univ-paris1.fr (L. Goeldner-Gianella), frederic.bertrand@paris-sorbonne.fr (F. Bertrand), annaig.oiry@gmail.com (A. Oiry), Delphine.GRANCHER@lgp.cnrs.fr (D. Grancher).

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attention is thus being paid to the role played by tidal marshes in sea defence, and a positive correlation has been shown between their width and plant density and the attenuation of the energy of the swell and height of the waves, as well as the stabilisation of the coastline (Shepard et al., 2011). With sufficiently wide tidal marshes it would thus be possible to limit the extent to which the dikes behind them need to be raised, which would be of great economic benefit within the context of climate change. Hence the large-scale policy of depolderisation in the UK – where it is called "managed realignment" – to recreate tidal marshes (Pethick, 2002), particularly in the South-East. In 2000 60% of the depolderised sites in North-Western Europe were in the UK. Whilst certain scientific studies have looked into the way people perceive managed realignment (Ledoux et al., 2005; Goeldner-Gianella, 2007a; Vega-Leinert et al., 2012), physical studies show that the protective role of tidal marshes only functions within specific geomorphological and biogeographical contexts, both within the depolderised sites and outside them (French, 2006; Wolters et al., 2005; Bertrand and Goeldner-Gianella, 2014), and that this role needs to be better attested during storm periods (Niemeyer and Kaiser, 2001). In the United States, where more than half of saltmarshes have been lost due to human impacts (Shepard et al., 2011), scientists have primarily examined the ecological impacts of depolderisation and ways of restoring sea marshes (Weinstein and Kreeger, 2000; Williams and Orr, 2002; Teal and Peterson, 2005).

In France this innovative form of management has been comparatively little-used (Goeldner-Gianella, 2007b). A group of researchers therefore teamed up with a landowner and environment managers in Arcachon Bay (Fig. 1) – a lagoon near the city of Bordeaux on the Atlantic coast in the Aquitaine region – to examine the idea of using depolderisation as a means of risk management. Indeed coastal land around the Bay was once again flooded in February 2010, as had been the case before, most notably during the storms of 1999, 2008 and 2009. The reclaimed land on the eastern coast of Arcachon Bay together with their inhabited fringes clearly face a risk of flooding, firstly because they are sensitive to storm surge (Anselme et al., 2008; Goeldner-Gianella and Bertrand, 2014a) and secondly because of the vulnerability of part of the coastal population which already numbers 140,000 inhabitants in the Bay – a figure which is destined to increase due to urban sprawl around Bordeaux and the general process of population shift towards the coast: local development plans anticipate an average growth rate of 1.84% per year between 2008 and 2030 for the north shore of the Arcachon Bay (Goeldner-Gianella et al., 2013). Consequently sea flooding – modelled at 4.69 m in 2050 – could affect several hectares of coastal land at Audenge and Biganos at a value of several tens of millions of euros (Fig. 1) (Bertrand and Goeldner-Gianella, 2013). Given that it is an outstanding natural environment (taking in a vast wetland, the Dune du Pyla, and the Landes forest) where nature-based tourism developed early on, it seems an instructive place in which to study perceptions of a flexible means of sea defence. This article presents the results of this survey and the resultant recommendations for local decision-makers.

2. Methods and objectives

2.1. Context of the survey and sites under study

In the 18th and 19th century the inland areas of Arcachon Bay were polderised (Fig. 1). At first these polders were used for salt production, but this rapidly gave way to fish farming. The productivity of these fisheries declined after the Second World War due to increases in the cost of labour and polder maintenance. As fish farming disappeared on the Certes and Malprat polders they gradually turned into shrubland, but no houses were built there. Between 1984 and 2002 the French Coastal Conservation Agency *(Conservatoire du Littoral)* – a public body that buys up land to help protect the coast – acquired the polders of Certes, Fleury, Graveyron, and Malprat (Fig. 1) and opened them to the public as a place for walking and admiring the natural environment, in addition to other farming activities. These activities remain very extensive through cattle grazing and fish farming. Only two tenant farmers use the land on behalf of the Conservatoire du Littoral, with a target more focused on the maintenance of the polder land than on for-profit exploitation. Because the Agency owns 40 square kilometres of formerly inhabited polder farmland in France that it has converted into opened nature sites, it now faces very high dike repair and maintenance costs (Clus-Auby et al., 2006). This situation will only get worse locally with rising sea level and increasingly frequent flooding, leading to several degrees of flooding exposure of the polders and their surrounding land (Goeldner-Gianella and Bertrand, 2014a). For instance the cost of repairing flood and storm damage in 1999, 2009, and 2010 to the Conservatoire du Littoral polders in Arcachon Bay alone stood at over €700,000 (Bertrand and Goeldner-Gianella, 2013). The Conservatoire du Littoral is therefore considering halting maintenance on certain dikes and even returning entire polders to the sea. For instance it has recently decided to return the foreland of the Graveyron and Malprat polders to the sea where breaches have been accidentally created during recent storms (Fig. 1). Our survey relates specifically to the three polders which have been partially depolderised or where this policy is likely to be extended (Graveyron, Malprat, Certes).

It was within this context that a scientific programme was set up, enquiring into the advantages and disadvantages of depolderisation in comparison to various other forms of management used in the Bay (raising dikes, reinforcing with riprap or wooden stakes, and so on). The purpose of the study was to show that managing flood risk by depolderisation would make it possible to counter the negative impacts of this risk whilst offering a greater variety of functions and services (a flexible means of sea defence by restoring saltmarshes, conserving biodiversity, diversifying the landscapes, and encouraging nature-based tourism and leisure activities). This article relates in particular to the reactions to depolderisation of inhabitants, users and visitors of the polders.

2.2. Several different types of opinion survey

In order to analyse perceptions of the risk of sea flooding and of various forms of risk management – including depolderisation – the geographers and economists used a varied range of techniques for their surveys (Hénaff and Philippe, 2014), which they carried out in 2010 and 2011 (Bertrand and Goeldner-Gianella, 2013). Here we will analyse only a twenty-minute questionnaire survey of 675 polder users or residents in the surrounding villages and a second survey of 173 users and residents concerning people's willingness to pay. Both these surveys were based on the same diagram (Fig. 2) showing all the possible ways of managing flood risk, ranging from hard defences based on maintaining the dikes (scenario A) or reinforcing the dikes (scenarios B, C, and D) to varying degrees of depolderisation by opening the polders to the sea (E and F) or else eliminating the dikes completely (G). Using a diagram made it easier to question interviewees about management methods with which they were not necessarily familiar (E, F, and G), which were not easily visible in the field when the survey was being carried out (E and F), or else which had not yet been implemented for the polders under study (B and G).

2.3. Content and statistical analysis of the questionnaire

The questionnaire survey comprised 39 questions, most of which were closed. The first part of the questionnaire related to the