



Research article

Landowner's perception of flood risk and preventive actions in estuarine environment: An empirical investigation



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ABSTRACT

Within Europe, flood and coastal risk management is undergoing a major paradigm shift as it moves from an approach dominated by investment in flood defence and control infrastructure to another one in which non-structural measures are favoured. One research challenge consists in developing a better understanding of local population risk perception and its effects on prevention and preparedness actions in order to improve social acceptability of adaptive flood risk management. Landowners' involvement in wetland management offer benefits beyond the line of their property. Accordingly, the purpose of this study is to achieve an empirical understanding of risk perception and self-protective behaviour among the landowners of the riparian marshes in the Gironde Estuary, in France. Application of the psychometric approach reveals that flood risk perception among landowners can be characterised by three synthetic variables that indicate on the degree of exposure, the sense of control and knowledge of the risk. Examining the relationships between these perceived risk dimensions and landowners' participation in water structures management provides three profiles of self-protective behaviour distinguishing "vulnerable", "autonomous", and "passive" individuals. Finally, implications of our findings for the management of flood risk in estuarine environment which is often drained areas are discussed.

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1. Introduction

Because of changes in climate conditions – rising sea levels and more frequent extreme weather events –, estuarine areas are increasingly exposed to natural hazards, and in this case to flood risks. This growing vulnerability to climate change therefore indicates that a serious escalation in ecological damage (Barendregt and Swarth, 2013) and economic damage (Brouwer and Hassan, 2013) can be expected if adaptive management strategies are not implemented. The traditional approach to flood defence through the construction of dykes and levees has altered balances in estuary and coastal areas and has contributed to the disappearance of some of their ecological functions (Ducrottoy, 2010). From an economic efficiency standpoint, such flood defence system has also been questioned, given the recurrent problems of public safety, despite its high investment and maintenance costs.

Within Europe, new flood management strategies are actually designed with the aim to attain an appropriate balance between

structural and non-structural measures (Hansson et al., 2008). Among non-structural measures are land-use controls, extension of flood-prone areas, improved risk information and communication. Non-structural measures are shared by scientific and experts of being more flexible and environment-friendly. They help to restore habitats for endangered species and some of the ecological functions of wetlands (Cox et al., 2006). In this way, the socio-economic benefits (including flood protection benefits, changes in natural recreation opportunities, and improvement in water quality) may also outweigh the associated costs of these alternative flood control policies (Brouwer and van Ek, 2004).

However, the socio-economic and institutional conditions for deploying new models of flood risk management at the local level still raise a number of questions (Næss et al., 2005). A main reason for this is that the "full control approach" that has prevailed for flood defence and control these last decades has reduced the public awareness of the possibility of flooding as much as dykes and other protective measures were in place (Wolinsk, 2010). In view of this, the appropriation of non-engineering actions that could be compatible with adaptation to climate change, by local populations cannot be dissociated from changes in their risk perception (Lujala et al., 2015). Thus, the evaluation and understanding of risk

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perception by the different local stakeholders (land-users/resident population) should become an integral part of knowledge issues enabling improvements in the governance of flood risk management.

The concept of risk perception refers to the construct of risk by a layman, as opposed to an expert. This perception is influenced by a number of factors: affect and emotions produced by events (Finucane et al., 2000; Loewenstein et al., 2001); familiarity with the events in question (Weinstein et al., 2000); control over the consequences of these events (Rogers, 1983); or fear (Grothmann and Reusswig, 2006; Raaijmakers et al., 2008). Moreover, it cannot be removed from the cultural context of individuals, their social background, or the commonly held beliefs that affect the degree of awareness people have of risks (Douglas and Wildavsky, 1982; Dake, 1991; Fishbein and Stasson, 1990; Weber and Hsee, 1998, 1999). Quantitative evaluation of risk perception therefore proves complex and remains subject to debate (Siegrist et al., 2005; Sjöberg, 2003).

A recent review of Bubeck et al. (2012) shows that there is a large body of research which focuses on individual households' perception of flood risk and their protective behaviour. However, flood risk does not only concern residential populations. It should be noted that in Europe, flood-prone areas are covered by networks of hydraulic structures, whose effective management for agricultural purposes can contribute to the production and maintenance of a certain number of wetland ecological functions, and also to flood defences (Goldman et al., 2007). Flood risk perception among the key managers and users of drained areas has a considerable impact on the effectiveness of new climate change adaptation strategies (Becker et al., 2013). It indicates the motives for the individual measures taken by farmers or landowners to protect themselves on the one hand, and to help to secure an area for ecological and social benefits on the other. By the same token, any management strategy that impacts the level of risk incurred for property, people and nature should be put into perspective in relation to risk perception among direct managers and users of these areas in order to anticipate their behaviour (Becker et al., 2013; Miceli et al., 2008).

To our knowledge, no study has yet been made of flood risk perception and self-protective behaviour among landowners and farmers, who are the direct managers and users of estuarine and wetlands areas. Our study attempts to fill this gap with methodological and practical challenges. We build our empirical investigation of self-protective behaviour of landowners who manage the riparian marshes of the Gironde estuary, in France, by applying a psychometric approach (Slovic, 1987). Thus, we use our understanding of factors that explain landholders' protective behaviours in this area, to discuss incentive measures aimed at providing relevant improvements in wetland management to meet community safety and ecosystem resource preservation.

2. The study case

2.1. The study area

Our empirical investigation relies on data collected from a survey designed to inform the management of the estuarine–wetland systems of the Gironde River located in the southwest of France. The Gironde estuary is the largest estuary in Europe (75 km long, 12 km wide, with an area of 635 km²) and considered as one of the most preserved in Europe. The riparian marshes of this estuary are an integral part of the estuary ecosystem. It is made up of marshes, permanent pastures and cultivated areas, and currently covers a total area of 44,572 ha. These estuarine wetland areas play a role comparable to that of wetlands in the floodplains of major rivers.

They provide hydrological functions as flood control and protection for the Bordeaux urban region. They are also a key component of the overall functioning of the “hydro-system”, making a significant contribution to the biological productivity of the estuarine ecosystem and to its functional diversity. These areas are currently home for the largest and most varied population of migratory fish in Europe (eleven species in total).

With the construction of polders in order to drain land for agricultural activities (production of cereal and to some extent the renowned Bordeaux vineyards), the riparian island and riverbank habitats have become cut off from the river by the creation of dykes and channel to prevent the intrusion of salt water at high tide and during exceptional events such as storms and floods. At present, only the management and maintenance of protective dykes and hydraulic structures by landowner associations and their members enable, through the regulation of water exchanges between the wetland areas and the river, the reconciliation of different uses (agricultural, residential, recreational), the preservation of the natural capital of this estuarine ecosystem, and finally protection against rising river levels and flood risks to people and property.

The riparian marshes of the Gironde Estuary are managed by the 53 landowner associations and their members. In 2010, we were able to access the member lists for 25 of the 53 ASPs that currently manage the marshes on both sides of the estuary. During the years 2010 and 2011, a postal survey was sent to 2574 marsh landowners. Some 344 landowners returned the questionnaire, giving a response rate of 13%. This rate is clearly low, but fairly typical of postal surveys of this kind. Representativeness is respected for each ASP in the sample, but it is nevertheless regrettable that the smallest of these associations are only represented by a handful of landowners.

2.2. Participants

The sample of landowners who respond to the survey is mostly men (77%) with an average age of 60 years. The average level of education is a vocational school certificate. The sample includes a high proportion of retired people (49.4%). Some 37% of landowners use their land for agricultural purposes, and 17.4% of respondents are farmers. Around a third of properties are used for recreational purposes (hunting, fishing, outdoor pursuits, etc.) and 16% are in a state of neglect. Agricultural plots have an average area of 72.7 ha, compared to an average of 30 ha for recreational properties and 3.8 ha for neglected properties. A third of properties are registered Natura 2000 sites. The majority of landowners have not suffered any flooding since 1999 (33% of properties have been flooded since then). Moreover, only 16.6% of properties are officially in flood zones (covered by a PPRI, *Plan de Prévention du Risque Inondation*, or flood risk prevention plan). Almost a quarter of properties have dykes on them (22.7%), and more than half of all properties (55.8%) have at least one hydraulic structure on them (canals, locks, sluices, floodgates).

2.3. Landowner's perception of wetland management priorities

We questioned landowners about their opinions on the objective given to wetland management (Fig. 1). For the majority of landowners (51.7% of the sample), the preservation of the wetland as a whole is chiefly aimed at protecting themselves against flooding, followed by maintaining leisure activities (50%) and preserving natural habitats (45.6%). As shown in Fig. 2, they believe that flood risk in the estuary area is increased by the poor state of repair of dykes and other protective structures (79.4% of the sample), followed by climate change (54.4%) and erosion and sedimentation processes (48.5%).

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