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Storm surge risk perception and resilience: A pilot study in the German North Sea coast

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ABSTRACT

Resilience is defined as the capacity of a community to organise itself before, during and after a dangerous/hazardous event in order to minimise the impacts. A conceptual framework is proposed to assess the resilience of a community by understanding and integrating the institutional, legal and social capacities to cope and recover from a natural hazardous event in order to minimize the impacts in the short-term and to adapt to the risk in the long-term. A survey-based method and a specific resilience questionnaire is proposed to explore the perception of stakeholders regarding the risk and emergency management processes as well as psychological and social factors conditioning individual and community preparedness. The method is applied in a pilot area (the Dithmarschen district in the German North Sea Coast) for its validation before applying it to the entire Wadden Sea region, the pilot results being presented in this work. Although some questions may need some type of adaptation to fit adequately to other study sites, the conceptual and methodological framework could be applied worldwide. The study area and its population are characterized by their continuous interaction with the ocean, with the continuous transformation and reclamation of land for agricultural and other purposes, the constant reshaping of the coastline and frequent coastal inundation by storm surge flooding. The assessment allows identifying the main characteristics of the study area in terms of stakeholders' risk perception, intention to prepare, individual and societal behavioural patterns, as well as their opinion regarding authorities' decision-making on emergency and risk management. It also addresses potential improvement in emergency and risk management in terms of multi-sector partnerships and additional adaptation measures for the area. The deficiencies and incoherencies between society's and administration's answers detected in the analysis point towards the challenges to deal with, in order to foster an adequate community preparedness and adaptation to storm surge risk. Some of the results that the proposed method permitted to obtain in the study area show (i) the need for a better information strategy to enhance society's awareness and preparedness; (ii) the respondents' current proactive behaviour and preference on participatory risk management options, despite fully participatory schemes are not yet set by the authorities; (iii) the need for awareness campaigns regarding the relevance and benefits of the integrated approach in potential partnerships, and (iv) the need for tailored and site-specific adaptation instruments and measures due to the current society's disagreement with some of the options currently provided. The results are useful to improve risk reduction initiatives by means of including society's opinions from the beginning of the management process.

1. Introduction

Resilience is defined as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions (UN/ISDR, 2009). Cutter et al. (2008) defines resilience as the degree to which the community has the necessary resources and is capable of absorbing disturbance and reorganising into a fully functioning system. This refers to the capacity of a community to organise itself before, during and after the

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event in order to minimise the impacts (González-Riancho et al., 2014), and is directly linked to risk reduction, understood as the development and implementation of activities aimed at mitigation, preparedness, response and recovery (Mileti, 1999). The ability of a system, community or society, implies the recognition of both institutional and social/individual abilities. Resilience assessments focus on the changeable collective conditions improvable through learning and experience, such as risk preparedness within the communities, in contrast to the unchangeable conditions such as the age of the population (González-Riancho et al., 2014).

Accordingly, a resilient society is aware of the hazard, is prepared for its impacts and is able to recover. These capacities are referring to both institutional and social spheres of the community. In the field of resilience, some authors have focused on the institutional performance and preparedness (US/IOTWS, 2007; Birkmann et al., 2013; González-Riancho et al., 2014), while others focus on the preparedness and protective behaviour of the individuals (Fishbein and Ajzen, 1975; Rogers, 1983; Schwarzer, 1992; Paton, 2003, 2005, 2010; Becker et al., 2011, 2013; Lindell and Perry, 2012) or on how factors like risk perception may influence the behavioural adjustment and preparedness (Douglas and Wildawsky, 1982; Renn, 2008; Solberg et al., 2010; Birkmann et al., 2012a, 2012b). Table 1 presents a summary on the behavioural factors studied by several authors to predict preparedness and/or measure resilience. These factors had their origin in theories from health and social psychology, being applied and adapted afterwards to the natural hazards discipline.

The objective of this work is to propose a conceptual framework to assess the resilience of a community by understanding and integrating the institutional, legal and social capacities to cope and recover from a natural hazardous event in order to minimize the impacts in the short-term and to adapt to the risk in the long-term. By means of a proposed survey-based method we explore the perception of stakeholders regarding the risk and emergency management processes as well as psychological and social factors conditioning individual and community preparedness.

The proposed conceptual framework and method are applied for their validation in a small area (Dithmarschen district, Schleswig–Holstein) exposed to storm surge hazard on the German North Sea coast, the results of this pilot study being presented in this paper. From the methodological point of view, the validation of the newly developed framework is considered successful, so the survey will be further replicated along the whole trilateral Wadden Sea region, including the Netherlands and Denmark, in the framework of the ongoing FP7 ENHANCE Project (Enhancing risk management partnerships for catastrophic natural disasters in Europe, www.enhanceproject.eu). The project is aimed at developing and analysing new ways to enhance society's resilience to catastrophic natural hazard impacts, by providing new scenarios for selected hazard cases in close collaboration with stakeholders, and contribute to the development of new Multi-Sector Partnerships (MSPs) to reduce or redistribute risk.

2. Storm surge resilience assessment

This section describes a conceptual framework to understand the factors affecting the resilience of a community exposed to risks from natural hazards. The conceptual and methodological framework could be applied worldwide, although some questions may need some adaptation to fit adequately to other risks and study sites. The application to storm surge risks at the Dithmarschen district in the German North Sea Coast is presented here. Moreover, the proposed methodology allows analyzing each of the relevant factors to enhance disaster risk management and adaptation policies.

2.1. A framework for assessing resilience

A conceptual framework is proposed to assess the resilience of a community by understanding its short-term coping capacity and long-term adaptive capacity, the former referring to the emergency/disaster management cycle, i.e. preparedness, response and recovery phases, while the latter refers to the adjustments in the human-natural system needed to respond properly to the existing threat. Fig. 1 conceptualizes and summarizes all the aspects considered in the storm surge resilience assessment presented here and that will be explained in this section.

Preparedness is defined as the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent or current hazard events or conditions (UN/ISDR, 2009). The performance in this phase will determine the success in the subsequent emergency and recovery phases. Therefore, it must be based on a sound risk analysis as well as supported by formal institutional, legal and budgetary capacities. Accordingly, to better understand the organizational capacity of a community, institutional, social and legal dimensions should be considered since a failure or a shortage/deficit of a specific ability in one of them could turn the risk management and/or the emergency process partially ineffective or invalid for the worst case.

The institutional adaptation to the storm surge risk implies the improvement of every task included in the disaster management cycle (US/IOTWS, 2007; González-Riancho et al., 2014), such as flood protection measures, vertical and horizontal coordination, public information and awareness, early warning system, evacuation planning, emergency protocols, contingency planning, etc., as well as a range of recovery options. Most of the tasks of the institutional adaptation are requirements defined in obligatory documents (which are included in the legal dimension in this framework). The institutional awareness and knowledge regarding the storm surge risk as well as the existing mandatory conditions to manage it will affect the level of implementation of each step.

The social adaptation, however, is voluntary and more complex to understand due to existing society's values, risk cultures, perceptions and dynamics. The voluntarism associated to a society's behaviour make necessary to analyze its potential adaptation to the storm surge risk in terms of “intentions”, which are understood as the cognitive representation of a person's readiness to perform a given behaviour, and considered to be the immediate antecedent of behaviour (Ajzen, 1991). Besides the individual protective behaviour as predictor of preparedness, developing community participation to achieve community goals is considered essential for effective disaster management (Perry and Lindell, 2003; Wisner et al., 2003; UN/ISDR, 2005; Paton, 2006; US/IOTWS, 2007; Basolo et al., 2009; Solberg et al., 2010). It is therefore important to understand the capacity of the society to work in a collaborative way and if this networking and the results obtained from it are supported by coordination and empowerment mechanisms promoted by the authorities (Becker et al., 2011). The intention to prepare at both individual and collective levels is determined here through the analysis of the behavioural conditioning factors presented in the conceptual framework (orange boxes), which are inspired by the work carried out by Paton (2003, 2005, 2010), Becker et al. (2011, 2013) and Birkmann et al. (2012a).

The fulfilment of both social and institutional requirements is essential to enhance society's resilience to catastrophic storm surge events. The close collaboration between governmental authorities, sectoral stakeholders and the community, for example through new MSPs to reduce or redistribute risk, is proposed in this framework to be a needed step towards improved risk