EDITED BY
E. CARINA H. KESKITALO

Climate Change and Flood Risk Management

Adaptation and Extreme Events at the Local Level

Climate Change and Flood Risk Management

Adaptation and Extreme Events at the Local Level

Edited by

E. Carina H. Keskitalo

Professor of Political Science, Department of Geography and Economic History, Umeå University, Sweden

Edward Elgar

Cheltenham, UK • Northampton, MA, USA

Published by
Edward Elgar Publishing Limited
The Lypiatts
15 Lansdown Road
Cheltenham
Glos GL50 2JA
UK

Edward Elgar Publishing, Inc.
William Pratt House
9 Dewey Court
Northampton
Massachusetts 01060
USA

A catalogue record for this book
is available from the British Library

Library of Congress Control Number: 2013942227

This book is available electronically in the ElgarOnline.com Economics Subject Collection, E-ISBN 978 1 78100 667 2

FSC www.fsc.org MIX Paper from responsible sources FSC® C013056

ISBN 978 1 78100 666 5

Typeset by Columns Design XML Ltd, Reading
Printed and bound in Great Britain by T.J. International Ltd, Padstow

Climate Change and Flood Risk Management

Contributors

Jenny Åkermark, Department of Geography and Economic History, Umeå University, Umeå, Sweden.

E. Carina H. Keskitalo, Department of Geography and Economic History, Umeå University, Umeå, Sweden.

Merle Massie, Department of Geography and Planning, University of Saskatchewan, Saskatoon, Canada.

Maureen G. Reed, Department of Geography and Planning, University of Saskatchewan, Saskatoon, Canada.

Peter Scholten, Department of Geography and Economic History, Umeå University, Umeå, Sweden.

Dan Shrubsole, Department of Geography, University of Western Ontario, Ontario, Canada.

Minna Turunen, University of Lapland, Rovaniemi, Finland.

Gregor Vulturius, Department of Geography and Economic History, Umeå University, Umeå, Sweden.

Terhi Vuojala-Magga, University of Lapland, Rovaniemi, Finland.

Joonas Vola, University of Lapland, Rovaniemi, Finland.

Acknowledgements

We are most grateful to all the interviewees who took time to participate in this work, as well as to all the reviewers who took time to read and comment on the chapters. Special thanks go to Nigel Watson, Alan Diduck, Franz Krause, Theresia Petrow, Mark S. Reed, Johanna Wandel and Olle Stjernström. We are grateful to the Swedish Foundation for Strategic Environmental Research MISTRA Arctic Futures programme for funding for the project 'Preparing for and Responding to Disturbance. Arctic Lessons for Sweden'. We are also grateful to the Swedish Research Council project 'Organizing adaptation to climate change in Europe: can models and premises for increased adaptive capacity be identified?', for funding for Gregor Vulturius' work, and to the Department of Geography and Economic History, Umeå University for funding for Peter Scholten's work. Dan Shrubsole extends his gratitude to the International Journal of Emergency Management for revision and updating of his 2007 piece in the journal for this book.

Contents

1. Introduction. Local organisation to address flood risks: possibilities for adaptation to climate change?

E. Carina H. Keskitalo

> 'Climate change adaptation and disaster risk management (especially disaster risk reduction) are critical elements of long-term sustainability for economies, societies, and environments at all scales.'
>
> (IPCC 2012: 444)

INTRODUCTION AND AIM

Adaptation to climate change has recently arisen as a major issue for local planning and organisation. While mitigation – the reduction of greenhouse gas emissions – is necessary to limit risks, present assessments suggest that even at existing emission levels we need to develop adaptations or ways of managing the effects of climate change. Water resources are among the components of the environment most seriously affected by climate change, and water-related hazards make up 90 per cent of all natural hazards (Sadoff and Muller 2009; Connor and Stoddard 2012; cf. IPCC 2012). In the European Union (EU), over 40 billion euros per year are currently spent on flood mitigation, and recovery and compensation for flood damage, most of this sum in urban areas. Between 2000 and 2009, Europe 'witnessed some of the largest flooding events in its history' (van Ree et al. 2011: 874). While much of the rise in losses from natural disasters is a result of increased assets in risk areas, it signals higher potential risk in the context of climate change (Connor and Stoddard 2012). Built environments, which are prevalent in flood risk areas due to the concentration of population in coastal and river areas, affect and are affected by floods, and make the costs of infrastructure damage particularly large (Wheather and Evans 2009; EEA 2012). Some of the potential consequences of climate change include increased costs for the infrastructure of inhabited areas, including roads, storm water drainage and flood protection (Muller 2009).[1] In addition, critical urban infrastructure, such as water, electricity and transport, are today often interdependent, resulting in substantial risks in the case of extreme events (van Ree et al. 2011).

This situation makes it relevant to not only cope with the relatively high incidence of extreme events – evidenced during the last few years – but also to adapt to the increased risk of floods in the future, anticipated rises in sea level and the predicted higher frequency of extreme weather events (Sadoff and Muller 2009; Birkmann and von Teichman 2010; Quevauvillier 2011). These consequences will impact both small and large population centres, which may have very different strategies for dealing with flooding. Even systems that work well today will need to reassess responses, as they may face flow regimes that vary beyond recorded limits due to the effects of climate change. The development of policy to adapt to climate change at the local, regional, state or even higher levels may support the extension of disaster management to extreme events and long-term trends, provided that the policy frameworks are integrated. Relevant frameworks include those for existent emergency and disaster management, flood management and more recently developed adaptation policies (Krysanova et al. 2010: 4122).

The chapters in this book focus on possibilities to integrate emergency preparedness, flood response and recovery measures with adaptation to climate change; the principal interest is in planning in order to improve responses to events. With a focus mainly on the local level, the chapters concentrate on institutional factors more so than the technical availability of resources, modelling methods or construction techniques. Broader governance and more specialised sectoral management or operational procedures (cf. Reed and Bruyneel 2010) are seen as constituting part of the framework that needs to be understood in order to conceive of the multiple contexts that affect responses to water-related risk. However, in reviewing how current systems deal with challenges that are among those likely to increase with climate change, in particular the risk of floods, we are not assuming that any events viewed so far are necessarily the result of climate change. Rather, we note that an understanding of the measures and capacities developed to deal with these is likely to help understand potential coping and adaptation during future events and may furnish a basis from which increased adaptive capacity may need to progress.

This book thus also asks to what extent adaptation to climate change is actually developed in practice to support long-term flood response strategies, and to what extent it is being mainstreamed, that is, integrated with existing approaches. With adaptation to climate change only recently recognised as a relevant long-term issue, how can it be identified in flood management in different cases? Indeed, is a focus on adaptation necessary for current activities in flood management in order to support adaptation or longer-term adaptive capacity? In examining these issues, the book seeks to problematise adaptation and place the focus on the multiple forces and contexts that may determine how flood management is developed in a future-oriented context.

The book draws attention to a number of different cases. They have been selected within federal states (Canada and Germany) and unitary states (the Netherlands, Sweden and Finland), which exhibit very different flood preparedness, incidences of extreme events, adaptation policies and forms of local organisation. The cases have also been chosen to include both rural and urban population centres in order to elucidate the differing capacities among municipalities to deal with flood risks. The rural areas studied feature winter snow and snowmelt floods, supplementing the focus on flash floods often seen in Continental Europe. The federal states Canada and Germany have both experienced major flood events – in the case of Saxony, Germany, one that even contributed to the final shape of the EU Floods Directive – but have developed adaptation polices to very different extents and with very different orientations. There is a risk that the federal system in both countries results in highly varied responses among different states and local communities. In the unitary states – the Netherlands, Sweden and Finland – flood response systems also vary considerably. The Netherlands, much of which lies below sea level, has had to learn to live with water management risks and has, to a large extent, naturalised flood response in administration and by encouraging local networks, among other means. Sweden and Finland, while comparatively less focused on water management, grant local government relatively extensive opportunities for self-determination in planning, whereby there may be extensive variation responses locally. However, in both countries, the risk of floods has thus far been comparatively less pronounced and involved comparatively few societal actors. Taken together, these varying cases may – rather than providing a unified picture – illustrate the diversity in how different rural and urban contexts experiencing varying events and working under different governance structures are able to deal with floods today and may respond to them in the future.

Serving as an introduction and broad theoretical context to the book, this chapter reviews adaptation as an issue for the local level within different state structures and how this problem is addressed in different contexts. The chapter discusses planning for present and future circumstances with reference to integration between emergency management, water management and adaptation frameworks, as well as the responses on the local, regional, national and international levels. The concluding section provides an overview of the component contributions to the volume.

DEFINITIONS AND SETTING THE STAGE

In line with the IPCC (2012), for instance, this book treats events in terms of hazardous physical events. The cases discussed include extreme events, defined as those where measurements rise above threshold values near the upper end of observed values of the variable, and less severe cases of flooding, that is, overflowing of the normal channel of a river (cf. IPCC 2012). The concepts of disaster, emergency and hazard are used largely in line with the literature and seen as related to local and other preconditions. The risk associated with events may include both perceptions of risk that may affect responses and more calculable facets of the risk of a disaster. Risk ultimately depends on the likelihood of severe alterations 'determined by examining the probability of occurrence of the event, along with measuring asset inventory and liable resources' (Haque and Burton 2005: 344). A hazard is defined as being 'generated and determined by the potential for damage, both tangible and intangible', by an extreme environmental event. Thus, it is preconditioned by the 'presence of the human domain' (Haque and Burton 2005: 343). Similarly, a disaster is defined as 'severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions' (IPCC 2012: 31).

Events are thus not always associated with disasters or hazards; whether they are may depend to a large extent on available response frameworks and adaptive capacity and, more broadly, the institutional context. Accordingly, a well-managed flood may not result in a disaster, whereas even small floods, if poorly managed, may have significant impacts. As the book primarily concerns itself with response and broader adaptation frameworks, the focus is on institutional rather than natural conditions. This also makes discussions of responses to non-extreme events and to gradual change relevant, as these may be used to indicate preparedness. From an institutional viewpoint, events are important here mainly as drivers of policy and responses to flood; they may also serve to indicate a level of capacity for dealing with future events. Terms such as 'flood management' are used to cover a number of available frameworks that may support responses – in the areas of water and disaster management as well as in potential adaptation contexts – in order to cover the breadth of actions in different fields that have an influence on water disaster-related risks.[2] While insurance plays a substantial role in the management of catastrophic events, it falls outside the scope of the present research, as the focus is mainly on the public sector and public-sector responses (but see, for example, Keskitalo et al., 2012b).

With regard to potential changes in risks in the future, uncertainty on a very specific level, as well as variation down to individual localities, in how climate change may affect flood regimes makes exact assessments difficult. However, agreement exists that climate change may increase the variability and intensity of precipitation; this, in turn, may increase the risk of rain-generated floods, for instance, in many areas (Sadoff and Muller 2009; see also IPCC 2012). In addition, the melting of the polar ice due to climate change and thermal expansion causes a rise in sea levels that affects coastal areas and cities. In areas with snow cover during winter, glacial lake outburst floods and impacts related to precipitation stored in snow, such as snowmelt and meltwater floods, will impact flood regimes (van Ree et al. 2011; IPCC 2012). Such changes will place requirements on planning not only for present levels of risk, but also for how risk may increase or decrease in relation to certain events or during specific seasons as a result of climate change (IPCC 2012) (see Box 1.1).

These differential impacts, as well as numerous flood risk patterns in different countries, result in varying types of flood risks in the present and the future where infrastructure development and changes in natural conditions are concerned. In Continental Europe, flash floods were responsible for 40 per cent of the flood-related casualties between 1950 and 2006 (EEA 2012), and may become more frequent with an increase in high precipitation events, in particular as denser infrastructure development may hinder percolation. Well-known examples of flash floods include the event in Saxony in 2002 (EEA 2012) examined in this volume (Chapter 2). In areas with snow cover during winter, floods are closely connected to the snowmelt period and may increase with higher precipitation during winter or quicker snowmelt. Today, about 40 per cent of flood disasters in Canada occur during the spring thaw in southern Canada (April–May) (Shrubsole et al. 2003).

BOX 1.1 EXAMPLES OF FACTORS CONTRIBUTING TO FLOOD RISKS

The European Environment Agency (EEA) lists the types of flooding affecting cities as river floods, flash floods, coastal floods, urban drainage flooding and groundwater flooding. River floods can be triggered by heavy rainfall, upstream snowmelt or downstream tidal influence that saturates the ground and results in overflow. Flash floods result from events causing rapid release of water – often upstream from higher elevations.

Events causing this range from extreme rainfall to landslides or dyke/flood protection failure. Coastal floods result from storm surges, but may take a long time to drain from the affected area. Urban drainage flooding may occur if the capacity of drainage systems cannot accommodate rainfall. Groundwater flooding may raise the water table, for example, as a result of excessive rainfall over long periods (EEA 2012).

Causes of flooding in northern areas include snowmelt runoff floods, rain-on-snow floods and ice jam floods (Shrubsole et al. 2003). Snowmelt runoff floods may have considerable impacts, especially where a thick snow cover melts rapidly when temperatures rise above freezing. Rain-on-snow floods combine the features of high rainfall with those of snowmelt runoff floods, resulting in very rapid increases in runoff. Ice jam floods can occur from ice build-up in river channels that blocks upstream water; this can take place both during freeze-up and break-up periods. Once the ice jam breaks up, the resulting water surge may cause flooding downstream. Ice jams can develop during snowmelt and the two forms of flooding may occur simultaneously, worsening impacts (Shrubsole et al. 2003).

Table 1.1 List of factors contributing to flooding

Meteorological factors	Hydrological factors	Human factors aggravating natural flood hazards
Rainfall Storm surges Temperature Snowfall and snowmelt	Soil moisture level Groundwater level prior to storm Presence of impervious cover Channel cross-sectional shape and irregularity Topography, slope, basin geometry Presence or absence of over bank flow, channel network Synchronisation of runoff from various parts of watershed High tide impeding drainage	Land-use changes (for example, surface sealing due to urbanisation, deforestation) increase runoff and may cause sedimentation Inefficiency or non-maintenance of sewage system and clearing of river banks Excessively efficient drainage of upstream areas increases flood peaks Climate change affects magnitude and frequency of precipitation and floods Urban microclimate may exacerbate precipitation events Building in flood-prone areas Reducing/cutting off flood plains

Source: modified from EEA 2012 (44).

ORGANISING IN RESPONSE TO FLOOD RISKS

Organising in response to flood risks is necessarily related to policies and practices among a range of actors at the local, national and supranational levels. To understand response structures in relation to events such as disasters, it is thus crucial to understand existing water, disaster and emergency management frameworks and any developing adaptation policies designed to accommodate future risks in responses. One relevant framework is emergency or disaster management at large, which is regularly organised through a number of local and national actors and is designed to cover a number of different emergencies. A second important context consists of the water and flood management frameworks that govern regular water management – not that for extraordinary or crisis situations – and that may include a number of water management actors, such as water authorities or other parties who regularly influence the planning system. A third framework, the most recent to start taking shape, is the adaptation framework, which is often determined at national as well as regional and local levels but at present differs in development and implementation (see, for example, Keskitalo 2010) (see Figure 1.1). Key strategies across all of these contexts may encompass combinations of a number of different structural and non-structural strategies, such as flood warnings and awareness raising, land-use control and management to limit risky development, homeowner adaptation and improved emergency management (Johnson et al. 2007).

Of these, adaptation constitutes a future-oriented as well as conceptually broad framework that can be used to contextualize water and emergency management. Policy development on adaptation to climate change in advanced industrial states has received relatively limited attention in literature to date (Gagnon-Lebrun and Agrawala 2008; Keskitalo 2010a; Ford and Berrang-Ford 2011).[3] This may be a result of the novelty of adaptation as a subject area and its necessary linkage to other issue areas as well as the complexity of the issues. Adaptation is generally defined as actions to respond to the impacts of climate change (Smit and Wandel 2006). The concept can be subdivided into planned adaptations – managed responses explicitly conditioned through policy and management systems – and autonomous or reactive adaptations, which are undertaken as events occur as an extension to or in the absence of formal management frameworks. It is today an accepted perspective in social vulnerability research that climate change, as a stress, needs to be understood in the broader perspective of how people develop and prioritise adaptations in relation to the full scope of stresses to which

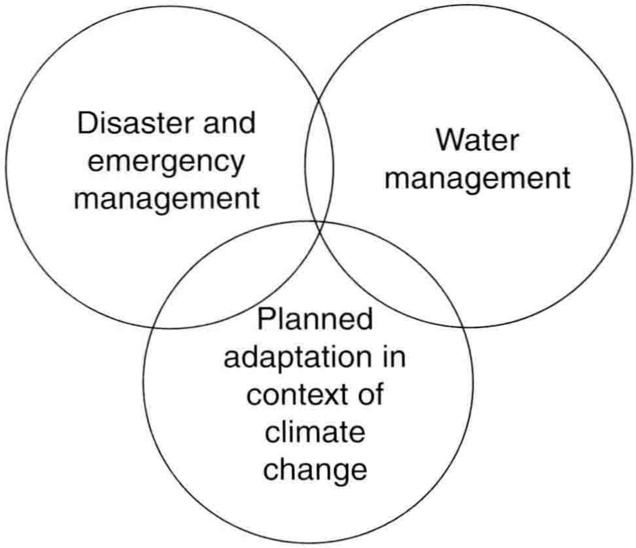

Figure 1.1 The intersecting management requirements for flood risks including the impacts of climate change

they need to respond, with these including economic and political changes (for example: O'Brien and Leichenko 2000; Dixit 2003; Haque and Burton 2010). While the term 'adaptation' is generally designed to cover specific responses to climate change stress, it is recognised that these will often draw upon and develop from coping responses, which are defined as more short-term responses to a stress, such as increased flooding, that are developed based on present behavioural patterns (cf. Keskitalo 2010b). The dividing line between adaptation and coping responses may thus not be clear-cut: indeed, it may be expected that rather than developing entirely new responses to extreme events – flooding, for example – in order to deal with future climate change, society will highlight and extend present coping responses (cf. IPCC 2012). Further limitations to adaptation also lie in the fact that not all adaptations are necessarily beneficial. While they may be undertaken to respond to a specific stress, adaptations may result in maladaptation if they are developed without adequately analysing the effects on different actors or, for instance, on sectors other than the one for they which were designed. This makes it necessary to examine 'who is adapting to what' (Smit et al. 2000).

Factors that may determine even longer-term, strategic actions on flood response to a rather large extent may thus not necessarily relate explicitly to climate change adaptation as such even though they may influence responses to climate change; rather, the possibility to efficiently adapt to future stress is fundamentally dependent on present organisational systems and assumptions. This extensive context dependence has led to an increasing focus in the literature on adaptive capacity (Smit and Wandel 2006).[4] Adaptive capacity is defined as the capacity of a societal, organisational or other unit to adapt to any impact (such as flooding or climate change at large) and is determined by institutional, economic and technological factors (among others) as well as by infrastructure, knowledge/information access and structures (Smit and Pilifosova 2001; Keskitalo et al. 2012a).[5] A focus on adaptive capacity thus underlines the social vulnerability perspective whereby one should start with understanding the societal preconditions that form the basis for any development of adaptation. However, among other sources, the IPCC (2012: 74) points out that 'capacity to respond is not sufficient to reduce risk', as not all capacities may be tapped in interventions or as interventions may be targeted incorrectly. Van Ree et al. note that major bottlenecks that hamper adaptation may include '(i) lack of understanding of current and future risks, (ii) lack of long-term planning, poorly integrated and comprehensive planning, (iii) lack of understanding of the effectiveness of these technologies, and (iv) inadequate controlling guides of local and regional authorities, and lack of formal guidance and policies for adaptation' (van Ree et al. 2011: 875).

The adaptation and adaptive capacities literature thus to a large extent highlights the capacities and potential actions for responding to climate change. However, although the literature on adaptation is mainly centred on adaptation to climate change (see, for example, Smit and Wandel 2006 for an overview), it is recognised that adaptations can be reactive or may to a large extent be developed from existing coping responses. As a result, even if adaptations are conceived of more as longer-term actions designed specifically in relation to climate change, the specific actions involved may not in all cases operationally differ from existing ones other than in their being suitable also in the context of climate change stress. For this book, this prompts a focus on problematising adaptation as well as on exploring the potential for development or inclusion of adaptation concerns in existing management systems. Even if adaptations to climate change specifically are not yet developed in a particular case, resources such as developed long-term plans or existing administration and long-term approaches to flood management may make it more likely that strategic, planned adaptations – which relate to future risks and not