



# Local Environment

The International Journal of Justice and Sustainability

ISSN: 1354-9839 (Print) 1469-6711 (Online) Journal homepage: <https://www.tandfonline.com/loi/cloe20>

## Project coordinators' views on climate adaptation costs and benefits – justice implications

Therese Asplund & Mattias Hjerpe

To cite this article: Therese Asplund & Mattias Hjerpe (2020) Project coordinators' views on climate adaptation costs and benefits – justice implications, *Local Environment*, 25:2, 114-129, DOI: [10.1080/13549839.2020.1712340](https://doi.org/10.1080/13549839.2020.1712340)

To link to this article: <https://doi.org/10.1080/13549839.2020.1712340>



© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 14 Jan 2020.



Submit your article to this journal [↗](#)



Article views: 203



View related articles [↗](#)



View Crossmark data [↗](#)

# Project coordinators' views on climate adaptation costs and benefits – justice implications

Therese Asplund  and Mattias Hjerpe 

Department of Thematic Studies - Environmental Change and Centre for Climate and Policy Research, Linköping University, Linköping, Sweden

## ABSTRACT

As local climate adaptation activity increases, so does the number of questions about costs, benefits, financing and the role that economic considerations play in adaptation-related decision-making and policy. Through five cases, covering a range of climate risks and types of adaptation measures, this paper critically examines Swedish project coordinators' perceptions of costs and benefits in already-implemented climate adaptation measures. Our study finds that project coordinators make use of different system boundaries – on temporal, geographical and administrative scales – in their cost/benefit evaluations, making the practice of determining adaptation costs arbitrary and hard to compare. We further demonstrate that the project coordinators interpret costs and benefits in a manner that downplays the intangible environmental and social costs and benefits arising from the adaptation measures, despite their own experience of how such measures negatively impact upon social value. The exclusion of social and environmental costs and benefits has severe implications for justice, as it can bias decisions against people and ecosystems that are affected negatively. Based on the findings, we propose three tentative social justice dilemmas in local climate adaptation planning and implementation: 1. Cost and benefit distribution across scales; 2. The identification and valuation of non-market effects; and 3. The equitable allocation of costs and benefits.

## ARTICLE HISTORY

Received 25 June 2018

Accepted 2 December 2019

## KEYWORDS

Climate adaptation;  
economic aspects; justice  
implications; co-benefits;  
maladaptation

## Introduction

Climate adaptation activity is on the rise globally, posing questions about costs, benefits, financing and the role that economic considerations play in adaptation decision-making and policy. Economics research has established, from a theoretical perspective, how economic aspects should and could be included in decision-making. Working Group II of the IPCC concluded in its fifth assessment report there is agreement that economic evaluations of local climate adaptations should consider non-monetary measures, such as the social and environmental costs and benefits stemming from them (Chambwera et al. 2014). As adaptation measures can both positively and negatively affect non-market factors such as water quality, ecosystem function, human health, social organisation and cultural practices, a broad definition and application of costs and benefits will not only provide a more systematic understanding of the adaptation measure under consideration but may also incentivise the appraisal of gains in climate-related welfare that occur following an adaptation action. Moreover, a broad definition and application of costs and benefits will more explicitly address justice

**CONTACT** Therese Asplund  [therese.asplund@liu.se](mailto:therese.asplund@liu.se)  Linköping University, Department of Thematic Studies, 581 83 Linköping, Sweden

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group  
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

implications, as it becomes more transparent who will be the winners and losers in the context of climate adaptation measures (O'Brien and Leichenko 2003; Eriksen et al. 2011).

However, putting these theoretical advances into practice by those involved in the planning of climate-change adaptation measures is difficult and empirical studies – i.e. how economics is practised – are rare (Chambwera et al. 2014). A few studies show that the costing of adaptation measures has primarily focused on estimating the direct costs rather than considering the indirect costs, life-time costs or costs associated with social and environmental values (Bouwer et al. 2014; Fankhauser 2010; Neumann and Strzepek 2014; Sussman et al. 2014). As for the benefits, studies on how the climate benefits of local climate responses are viewed by local public actors in the Nordic countries describe them as direct, local and reactive (Storbjörk 2007; Aall 2012; Lund et al. 2012), reflecting that benefits are understood in terms of risk reduction rather than as incorporating non-monetary values, as the conceptual literature advocates. Taking its starting point in a framework of costs and benefits that captures non-monetary effects, this study aims to critically examine Swedish project coordinators' perceptions of costs and benefits in already-implemented climate adaptation measures. The measures were realised by local public-sector agencies as stand-alone physical and technological projects (cf. IPCC 2014; Li, Mullan, and Helgeson 2014) covering a range of climate-risk measures. Specifically, we examine the following research questions:

- What categories of costs and benefits do project coordinators of implemented climate adaptation measures consider in their evaluations of local adaptation costs and benefits? To what extent do they consider non-market and human health effects?
- What are the project coordinators' views on funding options and strategies?
- What implications are there in following a broad or narrow framework for evaluating climate adaptation costs and benefits?

Based on the study's findings, as well as empirical and conceptual literature on climate adaptation costs and benefits, we identify three tentative social justice dilemmas in the planning and implementation of physical climate-change adaptation measures.

## Costs, benefits and social justice of climate adaptation measures

In order to critically examine what costs and benefits the project coordinators include in their economic appraisals, our study utilises categories of costs and benefits identified in previous economic studies of climate-change adaptation, including distributional aspects and justice implications.

Overall, the IPCC (2014, 948) contends that: "Economic thinking on adaptation has evolved from a focus on cost–benefit analysis and identification of 'best economic' adaptations to the development of multi-metric evaluations including the risk and uncertainty dimensions". Such a risk perspective primarily frames the costs and benefits of adaptation as an investment in risk reduction (OECD 2015). This explicitly recognises the residual risks that will remain even after implementation of the climate adaptation measure (Watkiss 2015).

In terms of methodology, advances have resulted in situating economic analysis in a wider societal and ecological context. The IPCC (2014, 948) acknowledges that the consequences of adaptation decisions:

cannot be expressed comprehensively through standard economic accounting of costs and revenues. Adaptation decisions can also affect other items such as income distribution and poverty, the regional distribution of economic activity, including employment; non-market factors such as water quality, ecosystem function, and human health; and social organization and cultural practices.

While there are now methods available that can capture non-monetary effects, distributional impacts and ethical considerations, these rest heavily on the controversial issue of the valuation of non-market costs and benefits. However, leaving non-monetary effects aside is not unproblematic,

particularly from a justice perspective, as contended by the IPCC: “A narrow focus on quantifiable costs and benefits can bias decisions against the poor and against ecosystems and those in the future whose values can be excluded or are understated” (IPCC 2014, 948). Studies on social justice in climate adaptation suggest that new vulnerabilities can emerge as a result of redefined power relations and differential access to resources (Hoang and Pulliat 2019). However, the acknowledgement that differing values and interests affect adaptation outcomes can – if local knowledge is integrated – contribute to social justice and environmental integrity (Eriksen et al. 2011). Also, Nursey-Bray (2017) argues that conflicts have transformative potential and can be incorporated into management in ways that harness their capacity to drive innovation and lead to more robust and just adaptive governance. Similarly, social capital and climate justice characteristics combined with local proactive planning and policy measures may reduce disaster losses and enhance community resilience (Bennett 2018; Kim, Marcouiller, and Woosnam 2018). Other findings suggest that the social justice aspects of climate adaptation need to not only engage the policy sector but also develop new social practices and encourage a broader cultural shift (Wamsler 2018), including the engagement of civil society actors (Chu, Anguelovski, and Carmin 2016), particularly women (Enarson 2013), to enhance equitable planning processes and just adaptation outcomes. Recently, Oberlack (2017) voiced concerns about who should take part/be consulted in planning and decision-making on climate adaptation. The OECD (2015, 47) also notes that the inclusion of stakeholders is particularly relevant for climate adaptation because: “in many cases adaptation is a response to a cross-sectoral risk ... thus there is the potential for co-ordinated responses to share costs, generate co-benefits and address potential benefits”.

### Conceptualising the costs and benefits of climate adaptation measures

Based on existing characterisations of the social and environmental costs of a climate-related *event* (Messner et al. 2007; MSB 2013), and guidelines for common cost and benefit categories (Li, Mullan, and Helgeson 2014), we developed a framework for the characterisation of costs and benefits that

**Table 1.** Examples of different categories of costs and benefits of climate adaptation measures derived from the framework that distinguishes between costs (upper table) and benefits (lower table) of climate change adaptation measures and whether these are direct, indirect, non-market or human health.

<i>Costs</i>	
<i>Direct</i>	<ul style="list-style-type: none"> <li>• Investment, including labour and materials</li> <li>• Institutional and administrative costs</li> <li>• Costs in other parts of the system</li> </ul>
<i>Indirect</i>	<ul style="list-style-type: none"> <li>• Monitoring, maintenance and management</li> <li>• Maladaptive practices</li> </ul>
<i>Non-market</i>	<ul style="list-style-type: none"> <li>• Landscape modified/changed</li> <li>• Negative effects on ecosystems and non-human species</li> </ul>
<i>Human health</i>	<ul style="list-style-type: none"> <li>• Negative health effects</li> </ul>
<i>Benefits</i>	
<i>Direct</i>	<ul style="list-style-type: none"> <li>• Reduced property and infrastructure damage</li> <li>• Reduced service interruption and/or improved quality of service</li> </ul>
<i>Indirect</i>	<ul style="list-style-type: none"> <li>• Improved business opportunities</li> <li>• Increased perception of safety</li> </ul>
<i>Non-market</i>	<ul style="list-style-type: none"> <li>• Positive effects on ecological services and non-human species, such as improved biological diversity</li> <li>• Improved recreation value, i.e. a co-benefit</li> <li>• Improved aesthetic value</li> </ul>
<i>Human health</i>	<ul style="list-style-type: none"> <li>• Positive health effects such as reduced morbidity, improved air quality or increased well-being</li> </ul>

could be associated with a climate adaptation *measure* (see Table 1). Alongside costs and benefits, the framework also distinguishes whether these are direct, indirect, non-market or human health impacts. We will use it as a schematic structure for analysing what project coordinators consider to be costs and benefits associated with a given climate adaptation measure (see Table 1).

*Direct costs* of a climate adaptation measure cover expenses related to the immediate investment in physical or administrative measures. Direct costs include investments in adaptation measures; for example, a water purification system and urban retention basins. *Indirect costs* of a climate adaptation measure are expenses that are consequential to the investment, and reflect extra costs for monitoring, maintenance and management. Loss of production in companies affected by the measure and the induced production losses of their suppliers and customers would also qualify as indirect costs. While direct and indirect costs refer to what can be specified in monetary terms, impacts such as casualties, health effects or damages to ecological goods are often referred to as non-market goods and services. *Non-market costs* typically cover negative impacts on social and ecological values, e.g. negative health effects or negative effects on ecosystem services (Li, Mullan, and Helgeson 2014). In a recent study on the indirect effects of climate adaptation – maladaptation – Juhola et al. (2016) distinguish between three types of maladaptation: (1) where the implementing/targeted actor(s) are directly affected by the measure; (2) where an identified external actor is directly affected by the measure; and (3) where common-pool resources (such as the atmosphere) are affected by the measure, resulting in indirect effects for all or several actors.

Benefits may also, at least analytically, be characterised into direct, indirect, non-market and human health impacts (see Table 1). *Direct benefits* of adaptation measures are perhaps self-evident and cover reduction in the damage caused by the climate risk, such as waterborne disease outbreaks, and flooded assets including buildings and infrastructure. *Indirect benefits* of a climate adaptation measure represent positive effects that stem from its realisation, such as increased business opportunities. While tangible benefits refer to positive effects that can be easily monetarised, as with costs there are also *non-market benefits* representing positive effects that are difficult to assess in monetary terms. Such non-market benefits may follow directly as a result of the realised adaptation measure, such as improved perceptions of safety or higher recreation value, or, more indirectly, improved well-being or increased biological diversity.

While our study is not an analysis of costs and benefits of climate adaptation measures, we use such framework to guide the interviews and to structure the analysis on Swedish local practitioners' perceptions on costs and benefits of climate adaptation measures.

### **Categories of costs and benefits of climate adaptation measures**

Costing, the process of calculating, evidently has a central place in economics research on climate adaptation. Ideally, costs should include investment costs as well as the resources expended to develop, implement, and maintain the adaptation action. Costs should also be identified from “the broadest possible market and non-market scope” (IPCC 2014, 948). While conceptual guidelines specify common cost categories, such as direct, indirect, non-market and human health impact costs (Li, Mullan, and Helgeson 2014), in practice, however, studies have demonstrated that the estimated adaptation costs are often almost exclusively focused on estimating direct costs (Bouwer et al. 2014; Sussman et al. 2014), possibly leading to a bias towards structural measures and a neglect of critical “soft” measures, such as better planning, (OECD 2008). In their assessment of adaptation costs and benefits in climate sensitive sectors, OECD (2008) concludes that information about adaptation costs are available although it is unevenly distributed among sectors. In the case of coastal zones and agriculture, they conclude, there is a fairly comprehensive coverage, while information on direct adaptation costs is much more limited for the water resources, energy, infrastructure, tourism and public health sectors. Similarly, Neumann and Strzepek (2014) highlights gaps in the lack of comprehensive sectoral coverage and conclude that critical cross- and multi-sectoral effects remain poorly understood. Moreover, if the adaptation actions of one economic unit

negatively affect the damages of another unit, this indicates a large potential for externalities and maladaptation (Juhola et al. 2016). Studies also suggest that the transaction costs associated with planning, investigating and making adaptation measures more politically viable are downplayed. For instance, Fankhauser (2010) contends that institutional and administrative costs, including the costs of building planning capacity, are often omitted. Moreover, most cost estimates only consider investment costs, rather than the lifetime costs of adaptation measures, which include operating costs and perhaps decommissioning costs, which could be substantially higher (Fankhauser 2010). Also Sussman et al. (2014) address the more “hidden” social and institutional costs of adaptation – those that may involve training, new forms of behaviour, or interaction with technical systems, and interacting with insurance companies, developing emergency management response plans, and other administrative and management activities. Sussman et al. (2014) conclude that as studies rarely consider the costs of these types of adaptive responses, the current state of knowledge on adaptation costs is to a large extent based on narrow cost analyses in which only direct categories of cost are included.

In terms of financing climate-change adaptation measures, it is widely recognised that even institutions in advanced countries face funding constraints (e.g. Amundsen, Berglund, and Westskog 2010; Baker et al. 2012; Moser and Ekstrom 2012; Dupuis and Knoepfel 2013; IPCC 2014). Furthermore, specific combinations of factors, such as lack of funding from central government, limited access to financial resources, few institutions that facilitate the financing of climate adaptation, all limit financing (Adger et al. 2007; OECD 2008). Local climate adaptation studies have identified that a lack of funding was constraining municipal climate action in, inter alia, Australia (Baker et al. 2012), Norway (Amundsen, Berglund, and Westskog 2010; Dannevig, Rauken, and Hovelsrud 2012), Sweden (Storbjörk 2007), the Netherlands (Uittenbroek, Janssen-Jansen, and Runhaar 2013; Root, van der Krabben, and Spit 2015) and Switzerland (Dupuis and Knoepfel 2013). In contrast, national grants (Aall 2012; Nilsson, Gerger Swartling, and Eckerberg 2012) and earmarked resources (Anguelowski and Carmin 2011) have been demonstrated to incentivise local climate adaptation. Studies have also pointed to the importance of habit and ability to finance non-mandatory tasks within local governmental administration (Dannevig, Rauken, and Hovelsrud 2012; Juhola, Haanpää, and Peltonen 2012). Moreover, financing also concerns the issue of who pays for adaptation and how much they should contribute (Füssel, Hallegatte, and Reder 2012). The distribution of responsibilities for financing climate adaptation has been fiercely debated (IPCC 2014). Here, Hjerpe and Glaas (2012) found that the general ability to finance investments differed significantly across local governmental departments, which impeded the ability to fund climate-change adaptation measures that benefited several municipal sectors.

The benefits of climate adaptation are commonly defined as “the reduction in damages plus any gains in climate-related welfare that occur following an adaptation action” (IPCC 2014, 952). There is widespread recognition that so-called co-benefits should be factored into adaptation decision-making (IPCC 2014; Viguie and Hallegatte 2012; Li, Mullan, and Helgeson 2014; Neumann and Strzepek 2014). Hence, similar categories as for costs also apply to benefits; i.e. direct, indirect, non-market and human health impact benefits (Li, Mullan, and Helgeson 2014). As with costs, there are methods available for evaluating non-market benefits, and the same criticisms apply. In practice, studies of local climate responses in northern Europe suggest that climate adaptation is framed narrowly; as direct (Lund et al. 2012), local (Aall 2012), and reactive (Storbjörk 2007) benefits. This may be a consequence of politicians perceiving climate adaptation as having low urgency (Granberg and Elander 2007; Storbjörk 2007; Biesbroek et al. 2013; Hjerpe, Storbjörk, and Alberth 2015) and low political costs (Naess et al. 2005). Similarly, in their review of economic impacts of climate change in the U.S., Neumann and Strzepek (2014) found a broad class of indirect effects to be largely ignored, for example business interruption and long-term capital losses. Yet, studies have found politicians eager to relate climate adaptation to other social benefits, such as employment and welfare (Glaas et al. 2010), or other benefits falling within their ministerial portfolio (Van Bommel and Kuindersma 2009). Hence, benefits arising from climate adaptation measures targeting such indirect climate-

related effects would potentially result in more complete incorporation of adaptation opportunities in impact assessment as well as increased political interest.

## Method

To harness new empirical findings on local project coordinators' perceptions of costs and benefits of implemented climate adaptation measures, the methodological design of our study included three steps; firstly, the identification of implemented adaptation measures that reflect different climate risks and different sizes of target groups; secondly, identifying and conducting interviews with project coordinators; and, thirdly, a thematic analysis of what these project coordinators regarded as adaptation costs and benefits, as well as their views on adaptation financing. Following calls for more empirically-driven research on the economic aspects of climate adaptation (Chambwera et al. 2014), the methodological design included only ongoing or already-implemented climate adaptation measures (see Table 2). In total, the material covers project coordinators involved in five cases of climate adaptation that together reflect different climate risks and different sizes of target groups. Altogether, the heterogeneity of the cases create opportunities for expressing a variety of perspectives and views to examine perceptions of costs, benefits and funding. The five cases of climate adaptation measures were carried out in different geographical parts of Sweden, were targeted towards various climate risks, e.g. flooding and torrential rain, and the measures' target groups ranging from about a dozen home owners to about 500 000 inhabitants of Sweden's second most populated city (see Table 2). Furthermore, the climate adaptation cases concern direct capital investments in public infrastructure: a water purification system, an urban retention basin, dams and the securing of buildings.

We conducted semi-structured interviews with project coordinators who were responsible for planning and realising the climate adaptation measures. To improve dialogue, the interviews took place at their local offices. Interviewees were recruited by email and phone, and snowball recruiting was employed, in which respondents recommended us to interview a colleague to get complementary information. Case-specific circumstances, such as the involvement of several project leaders, different responsibilities and the need for a general overview yet detailed knowledge resulted in a different number of interviews for each case. In total, we conducted nine interviews conducted: one in Göteborg (improved water treatment in a major city), three in Växjö (an urban retention basin in a residential area), three in Arvika (a levee to protect a town), one in Örnköldsvik (geotechnical measures to secure a ferry berth/quay) and one in Sollefteå (geotechnical measures to protect a few single-family homes). Our interview guide consisted of introductory case-specific questions, including target groups, followed by questions about direct costs, financing, social and environmental costs and, finally, social and environmental benefits. The interviewer always started with open questions, enabling an analysis of interviewees' immediate responses, and then followed up with more in-depth questions. Particularly for questions on indirect costs, three types of maladaptive outcomes guided the questions on increased vulnerability (Juhola et al. 2016), and for questions on financing: Who pays? How much? What criteria? (Füssel, Hallegatte, and Reder 2012).

**Table 2.** Overview of the five cases of implemented climate adaptation measures that were used to analyse how project coordinators view the costs and benefits of climate adaptation measures.

Geographical area	Main climate risk	Climate adaptation measure	Target Group
Göteborg	Waterborne disease outbreaks	Water purification system using ultrafiltration	Affects ~500 000 people
Växjö	Flooding	Storing water during intensive rainfall in a retention basin	Affects ~ one dozen homeowners
Arvika	Flooding	Build levees to protect the city of Arvika	Affects ~ 14 000 inhabitants
Örnköldsvik	Landslides	Secure buildings and a berth area by anchoring in bedrock	Tourism in a popular archipelago
Sollefteå	Landslides	Secure buildings by re-profiling slope	Affects ~ 20 properties



The interviews were recorded and transcribed verbatim. We performed a qualitative thematic analysis on the transcripts, focusing on trends and patterns across the nine interviews. We treated the transcripts as one text, examining recurring themes in the entire material, rather than seeking similarities and differences between the cases (Rausch 1998). Such an approach allows for the identification of common issues across interviews and cases. By analysing the interviews as one set of material, our study reflects different climate risks and the different sizes of target groups, offering an analytical generalisation of climate adaptation costs and benefits.

## Results

Our analysis of Swedish project coordinators' perceptions of climate adaptation costs and benefits was conducted in relation to a framework conceptualising costs and benefits as direct, indirect, non-market impacts, as well as human health impacts, so we will present and discuss the key results will be presented accordingly. Table 3, below, schematically summarises the analysis of how project coordinators perceived direct and indirect costs and benefits.

### *What types of adaptation costs and benefits do project coordinators consider?*

We found that project coordinators approached costs as shaped by geographical, temporal and administrative scales. They also acknowledged non-market environmental and human health costs as important but overlooked in sustainability planning processes, while viewing non-market environmental and human health benefits as uncountable and politically insignificant.

**Table 3.** Categories of costs and benefits as they are viewed by climate adaptation project coordinators.

Costs		Viewed by project coordinators
<i>Direct</i>	<ul style="list-style-type: none"><li>Investment, including labour and materials</li><li>Institutional and administrative costs</li><li>Costs in other parts of the system</li></ul>	Included in all five cases. Labour costs partly included. Planning and administrative costs are not included or only partly included. Investments needed in other parts of the system are not included (three cases).
<i>Indirect</i>	<ul style="list-style-type: none"><li>Monitoring, maintenance and management</li><li>Maladaptive practices</li></ul>	Included partly in all cases. Social conflicts in three cases. <i>In other cases project coordinators could not find any.</i>
<i>Non-market</i>	<ul style="list-style-type: none"><li>Landscape modified/changed</li><li>Negative effects on ecosystems and non-human species</li></ul>	Changed landscape included qualitatively in the levee case. <i>Project coordinators could not find any.</i>
<i>Human health</i>	<ul style="list-style-type: none"><li>Negative health effects</li></ul>	<i>Project coordinators could not find any.</i>
<i>Benefits</i>		
<i>Direct</i>	<ul style="list-style-type: none"><li>Reduced property and infrastructure damage</li><li>Reduced service interruption and/or improved quality of service</li></ul>	Damage reduction or reduced waterborne diseases included in four cases.
<i>Indirect</i>	<ul style="list-style-type: none"><li>Improved business opportunities</li><li>Increased perception of safety</li></ul>	Maintained business opportunities included in two cases. Included in all cases.
<i>Non-market</i>	<ul style="list-style-type: none"><li>Positive effects on ecological services and non-human species e.g. improved biological diversity</li><li>Improved recreation value, i.e. a co-benefit</li><li>Improved aesthetic value</li></ul>	<i>Project coordinators could not find any.</i> Included in the retention basin case. <i>Project coordinators could not find any.</i>
<i>Human health</i>	<ul style="list-style-type: none"><li>Positive health effects, such as reduced morbidity, improved air quality or increased well-being</li></ul>	Improved working environment in two cases. Improved school playground in one case.

Note: Displayed according to the same logic as in Table 1, i.e. costs (upper table) and benefits (lower table) of climate change adaptation measures and whether these are considered as direct, indirect, non-market or human health.



### *Costs: the blurred line between direct and indirect costs*

Even though costs can be categorised as direct as or indirect, based on previous studies (Bouwer et al. 2014; Fankhauser 2010), we anticipated that respondents would primarily report direct costs. When asked about the cost of their implemented climate adaptation measure, all the project coordinators referred to its direct investment costs. However, we found that the respondents included institutional and administrative costs, e.g. planning and operating costs, to differing degrees in their appraisals. For instance, one project coordinator in the retention basin case stated that “The cost was 1.2 million. I found it in the cost estimate”, while another project coordinator working with the same adaptation measure stated:

It [1.2 million] feels low ... Well, if we say 1.2 million crowns then it is just the design of the surface, so to speak; the football field itself. No investigation costs are included. No drainage pipes further up in the system that we've built. This is just that tiny square ... it doesn't provide any benefits without being connected to a system, so I had to build an entirely new stormwater system. (Retention basin case, respondent 2)

These two excerpts show that project coordinators view costs differently, by as much as a factor of two when referring to the same adaptation measure. In the second excerpt, the interviewee elaborates on costs associated with timescales – “investigation costs” – and geographical scales – “drainage pipes further up in the system”.

Like the retention basin case, the project coordinator of the ultrafiltration case included direct investment costs in the cost estimation while excluding the costs of the new water pipes required to handle the increased flow. Hence, the examples from these two cases illustrate that geographical system boundaries seem to determine what the project coordinators perceive as climate adaptation costs. These examples also suggest that determining adaptation costs is challenging, with justice implications, because cost estimates may indicate very different values and all may be viewed as equally correct or incorrect, but costs always depend on “who includes what”.

Moreover, we found that different approaches to the weighing of costs associated with past, present and future timescales also shaped the project coordinators' evaluations of climate adaptation costs. The planning processes for these five cases covered very different timescales, having lasted from days to decades. Project coordinators included such institutional and administrative costs associated with timescales to different degrees. While the project coordinator in the ultrafiltration case partly included costs for planning in the overall cost estimation, the project coordinator in the slope re-profiling case stated:

No, our own time is not reported anywhere in any way at all. What our staff did and how much and so on. The invoice is just from the external consultancy ... One has certainly worked 100 h. Maybe that is not enough ... It is probably a couple of hundred surely. (Bedrock anchoring case)

In this excerpt, the project coordinator proposes figures regarding their own staff's working hours, concluding that these are not included in the cost estimate. In the retention-basin case, planning and design costs amounting to about 10% of the total cost were omitted from the cost estimate. In the levee case, the costs associated with fifteen years of investigations were not included, totalling about 7 million SEK, 7% of the total cost. Conversely, in the slope re-profiling case, the project coordinator reported that external investigation costs are included because these costs “can be verified by invoices”. These examples demonstrate that project coordinators approach the costs associated with planning, investigation and other preparatory activities differently. Some include them, some do not. The project coordinators also approached the future indirect costs associated with the adaptation measure very differently:

No, it [maintenance] does not go in there. The investment is separate. Then the operational costs must be retrieved because it's ongoing all the time. It's like forever. (Retention basin case, respondent 1).

This excerpt illustrates a recurring pattern in the material as project coordinators in all cases excluded costs related to any activity after the initial investment.

To sum up, when asked about the cost of their climate adaptation measure, all project coordinators reported the measure's direct investment costs. In some cases, institutional and administrative costs, such as planning, and indirect costs related to monitoring and maintenance, were included in the cost estimates. Hence, our study confirms that adaptation costs often reflect costs at the time of the investment but rarely those incurred before or after the initial investment is made (Bouwer et al. 2014; Fankhauser 2010; Neumann and Strzepek 2014; Sussman et al. 2014).

***Financing through traditional funding schemes, or Puzzle-solving.*** Based on the interviews, we found investments in adaptation measures to either be funded by traditional funding schemes, for instance, through local water and sanitation taxes (retention basin case) and local government taxes (slope re-profiling case) or subject to new arrangements, such as a mixture of green bonds (ultrafiltration case), EU funding (levee case), or funding from national government agencies and municipal departments (levee and bedrock anchoring cases) and an insurance company (bedrock anchoring case). Project coordinators voiced concerns over the prominence of a funding-by-tradition approach, because this may lead to ethical dilemmas between collective and private funding and the associated benefits. One project coordinator exemplified this ethical dilemma by asking about the lower limit, the smallest possible number of houses that should be protected by local government taxes. Hence, while climate adaptation financing concerns the issue of who pays and how much (Füssel, Hallegatte, and Reder 2012), our study shows that local project coordinators perceive that the ethical and justice aspects underpinning climate adaptation will require new solutions and funding schemes.

#### ***Non-Market environmental and human health costs as peripheral externalities***

Adaptation measures can impact negatively upon social and ecological assets, and this is captured by the concept of maladaptation (Juhola et al. 2016). We found that none of the project coordinators considered non-market or negative human health impact aspects in their cost estimates. They were even surprised by the question, and at times did not understand it, as illustrated by the three following quotes from three different cases:

I have the wrong structure in my brain to think of anything. (Ultrafiltration case)

I don't know what it [social and environmental costs] would be / ... / I've never reflected much and it's really nothing we have ever investigated deeply either. (Slope re-profiling case)

We don't initiate anything or look at anything like that [protected species]. No. (Retention basin case, respondent 2)

Project coordinators in all five cases struggled to identify any social or environmental costs of the implemented adaptation measure. We found that all the measures were primarily associated with the positive values of risk-reduction and that potential negative aspects were unintentionally neglected. These excerpts illustrate that the project coordinators' interpretive frameworks may perhaps limit the adaptation options considered, because any non-market environmental and/or human health costs are not even included qualitatively in their cost estimates. We conclude that the unintentional exclusion of such costs constitutes a cognitive barrier that may aggravate the risk of unintentional social and environmental injustice.

Even though the project coordinators stated that they had not reflected upon external effects, almost all of them had experienced conflict during the planning and implementation of the adaptation measure. Based on the cost/benefit framework, we categorise conflict in climate adaptation management as an indirect social cost indicating maladaptive practices. The respondents reported conflicts both between different local governmental departments within the same municipality, and involving the local authority and other societal actors. The most notable example of social costs stemming from a conflict was found in the levee case. Here, the municipality wanted to erect levees to protect the town against future floods, which a private landowner strongly resisted:

That property owner called me in 2002 and said: “You can rest assured, [name], I will appeal this to the highest court.” And I had no idea what that would imply. I know now. (Levee case, respondent 3)

This project coordinator referred to the numerous juridical consultations, prolonged and time-consuming legal processes and several court rulings before the levees were put in place. Further examples of similar indirect social costs stemming from conflicts concerned different views on how sludge from the drinking-water treatment process should be handled and by whom this cost should be covered, and diverging views on the prioritisation of functionality and aesthetic values in the retention basin case.

Interestingly, even though the project coordinators all initially tended to exclude any negative environmental and/or social effects of the adaptation measure, all of them had experienced negative effects associated with social conflict, as the above excerpts illustrate. Based on the finding that project coordinators excluded non-market environmental and human health costs, we anticipate that the risk of social and environmental injustice could be relatively common since potential negative effects are rarely estimated, and hence unknown. In sum, we conclude that project coordinators primarily approach adaptation costs as direct, sometimes partly including indirect costs but completely omitting non-market environmental and human health costs from their cost evaluations. Furthermore, these examples also highlight justice implications since social and environmental aspects are undervalued, and the direct costs are primarily attributed to private ownership and direct usage, while the non-market environmental and human health costs are primarily associated with public goods.

### *Benefits – more than risk reduction?*

The framework on climate adaptation costs and benefits conceptualises the benefits of climate adaptation measures as direct, indirect and covering both co-benefits that are easily monetarised and those to which it is difficult to assign a monetary value. Generally, the project coordinators associated the benefits of adaptation measures with direct risk reduction, i.e. decreasing the risk of damage caused by the climate risk (see [Table 3](#)). Our study thus strengthens previous findings on benefits as direct and local (Aall 2012; Lund et al. 2012). Besides the recognition of direct benefits, project coordinators also acknowledged intangible benefits such as a feeling of increased safety. Furthermore, while two cases (the levee and bedrock anchoring cases) exemplifies the presence of indirect benefits, such as maintaining business opportunities, several project coordinators reflected upon non-market and human health benefits, e.g. an improved working environment and an improved school playground. As illustrated by this example, the project coordinators considered that the implementation activity provided an opportunity to address other issues or improve certain social and environmental conditions at the same time. This is exemplified by a project coordinator in the bedrock anchoring case stating:

When we said, ‘What should it look like here?’ All skippers, all staff on the ferries sat down and ‘Now you have the chance. How would you like it? What is not good?’

This project coordinator subsequently concluded that the involvement of staff improved their working conditions significantly. Likewise, we identified the awareness of non-market benefits in terms of improved working conditions in the ultrafiltration case, in terms of an improved school playground in the slope re-profiling case, and in a public football and sports pitch in the retention basin case. These excerpts demonstrate that co-benefits are unsystematically and opportunistically seized upon during implementation, and are not the results of intentional planning as recommended by the literature on climate adaptation and social justice (e.g. Bennett 2018; Kim, Marcouiller, and Woosnam 2018).

While project coordinators reported that they often take climate adaptation benefits into account, these were seldom explicit in the cost–benefit estimates, but rather something that was being done in parallel:

When you're there and about to put a measure in place anyway, surely you look just outside the concrete measure. Is there anything else that we can do? As in this case, we could build more and establish a reasonable school playground ... A landscape architect drew how you could make use of the school playground then ... And it was in dialogue with the school leaders. (Slope re-profiling case)

This excerpt suggests that the project coordinator noticed benefits related to human health in the process of securing buildings but then continued to describe them as politically insignificant. This example provides one, of possibly many other, reasons, why co-benefits are not monetarised and, thus, not really accounted for in current decision-making on climate adaptation. To conclude, project coordinators described benefits in qualitative terms, viewed them as being of low significance for decision-making, and only accounted for co-benefits in the implementation process – rather than during planning processes. Based on how these project coordinators approached non-market environmental and human health benefits, we suggest that greater attention to the benefits and opportunities provided by an adaptation measure would create space for the inclusive processes needed in the movement towards social and environmental justice in the economics of adaptation. In this way, the benefits of climate adaptation measures could be multifunctional, targeting multiple actors as well as both social and environmental goals.

### **Discussion: views of adaptation costs and benefits and justice implications**

One role of economics is to develop methodologies to assess costs and benefits, including non-monetary ones, and the equity impacts of alternative actions to support decision-making (Chambwera et al. 2014; OECD 2015). Even so, the recent literature on climate adaptation costs and benefits is largely disconnected from discussions on equity impacts and social justice, while the number of implemented adaptation measures in response to the effects of climate change is constantly increasing. Based on our examination of Swedish coordinators' perspectives on the costs and benefits of implemented climate adaptation measures, we have identified the following tentative social justice dilemmas:

- (1) Distribution of costs and benefits of climate adaptation across scales.
- (2) Identification and valuation of non-market effects of climate adaptation measures.
- (3) Equitable allocation of costs and benefits of climate adaptation measures.

#### ***Distribution of costs and benefits of climate adaptation across scales***

The first dilemma refers to the distribution of climate adaptation costs and benefits to different spatial, temporal and administrative levels. Our study has shown that the costs of adaptation measures fall under different administrative levels, such as planning, investment or maintenance – with different budget allocations and, thus, the same adaptation measure may make disproportionate budget claims. Potential social justice dilemmas of cost and benefit distribution across scales also have an intergenerational perspective because the costs of today are for the benefit of future generations (cf. Cooper and McKenna 2008). As costs over time decrease when actions are taken early on, the merits of including intergenerational dimensions have been pointed out (Cooper and McKenna 2008; Stern 2006).

#### ***Identification and valuation of non-market effects of climate adaptation***

Our study found that adaptation implementation does not systematically include equity considerations in adaptation planning, but merely addresses the needs of targeted population groups “on the fly”. If considered ad hoc, the process can never guarantee a fair and just distribution of goods and services, rights and opportunities associated with the adaptation measure. Potentially, it may lead to disproportionate costs and favouritism shown to certain groups (Cooper and McKenna

2008; Martens 2006) and, as our study shows, the downplaying of environmental aspects. While the non-market impacts of climate adaptation measures are clear in principle, we have established that, in practice, project coordinators did not just undervalue them but omitted them from their cost assessments altogether. For instance, none of the project coordinators considered the negative environmental or social effects of their adaptation measures, suggesting a risk of social and environmental injustice.

While the above concerns the identification and valuation of non-market costs, our study has also identified social justice dilemmas relating to the identification and valuation of non-market *benefits*. Several project managers intentionally, yet ad hoc, included non-market benefits for particular groupings, e.g. schools or workers, in the implementation of their climate adaptation measure. While in principle it is widely recognised that co-benefits should be factored into adaptation decision-making (IPCC 2014; Viguie and Hallegatte 2012), such benefits are still conceptualised very narrowly and directly (Aall 2012; Lund et al. 2012; Storbjörk 2007) rather than a systematic assessment being made of the potential positive effects that follow more indirectly, such as improved business opportunities, recreation value or biological diversity.

While our study has pinpointed tentative ethical dilemmas concerning the identification and valuation of non-market costs and benefits, previous studies on social justice in climate adaptation have concluded that the integration of local knowledge and differing values into adaptation policy, planning and implementation can contribute to social justice and lead to a more just adaptive governance (Eriksen et al. 2011; Nursey-Bray 2017). Although local proactive planning and policy measures may reduce losses due to disasters and enhance community resilience (Bennett 2018; Kim, Marcouiller, and Woosnam 2018), the engagement of civil society actors (Chu, Anguelovski, and Carmin 2016) and, in particular, women (Enarson 2013) remains challenging but necessary in order to enhance equitable planning processes and just adaptation outcomes. Together with previous studies, our analysis suggests that a random approach may risk injustice towards certain groups, while the systematic reflection upon, identification and valuation of non-market benefits has the potential to improve social and environmental justice.

### ***Equitable allocation of costs and benefits of climate adaptation measures***

Social justice in climate adaptation costs and benefits refers to fairness in the distribution of the goods and services, rights and opportunities associated with the adaptation measure. Our study has shown how various understandings of costs and benefits imply different cost and benefit attributions, which consequently underpin financing strategies. Previous studies on the economics of climate adaptation have concluded that questions about who will pay, and how much, still remain a very challenging issue because they raise questions about justice (Füssel, Hallegatte, and Reder 2012; IPCC 2014; Barnett et al. 2015). Our study has found that traditional funding schemes often finance climate adaptation measures. The ethical dilemma of financing concerns the extent to which common resources such as taxes should be used to finance the cost of climate adaptation measures that benefit only a few, and the extent to which property owners can maximise their individual rights. In the levee case of the City of Arvika, The Supreme Court of Sweden signalled that climate adaptation measures should be judged in favour of the public good. Other studies have shown the reverse. For instance, in transport planning, Martens (2006) found that cost–benefit analysis has a built-in distributive mechanism that structurally favours transport improvements for highly mobile groups.

Project coordinators in our study challenged this funding-by-tradition approach, arguing that the ethical and justice aspects underpinning climate adaptation require new solutions and funding schemes. A broader framework on climate adaptation costs and benefits includes a consideration of the costs and benefits that follow *indirectly* from the adaptation measure. Such costs refer not only to monitoring, maintenance and management, but also, more importantly, to the inclusion of benefits beyond damage reduction. Consequently, such a broadening of climate adaptation cost and benefit frameworks in local responses to climate change means that social justice and fairness

in the distribution of goods and services, along with the rights and opportunities associated with the adaptation measure, are addressed to a greater degree. Based on our findings, such an approach would address the need for non-traditional funding schemes – potentially crossing geographical, temporal and administrative barriers. It would also entail a shift in who should contribute financially towards actors/stakeholders who can be seen as equally directly and/or indirectly affected by the climate adaptation measure, such as tourist operators, as represented in the bedrock anchoring case. A funding scheme based on the added value and multifunctional co-benefits of adaptation measures could possibly attract funding from multiple actors.

The foregoing discussion illustrates that the assessment of the costs and benefits of climate adaptation measures is both a challenging and multifaceted task. Nevertheless, reflective and transparent dialogue on costs and benefits, direct and indirect, could offer a way forward for the critical aspect of financing climate adaptation, enabling more actors to find incentives to invest in the added value of climate adaptation measures. Similarly, Bosomworth (2015) proposes that a frame-reflective practice can enable policy sectors to appreciate how their current framing directs action towards specific adaptation options, and how exploring a different frame could reveal a wider array of options than those currently considered. Also, Prior (2013) argues that such an analysis would allow the identification of potential sources of conflict, as well as identifying opportunities for constructive reframing and for agreement to be achieved more easily.

Consequently, we see a need for further research analysing the interplay and value judgements between direct, indirect, non-market and human health costs and benefits in order to comprehensively explore the potential for a coordinated response to sharing costs and generating benefits across multiple scales.

## Conclusions

This paper set out to critically examine what Swedish project coordinators consider to be costs and benefits in already-implemented climate adaptation projects. Our study found that:

- measures of non-market effects were not just undervalued but lacking altogether. None of the interviewees discussed any negative environmental or social effects of the adaptation measures, thus suggesting an increased risk of maladaptive outcomes.
- climate adaptation benefits were conceptualised mainly in terms of risk and damage reduction – hence, as direct benefits, rather than valued as carrying potential indirect positive effects, such as increased business opportunities, improved perceptions of safety, higher recreation value, improved well-being or increased biological diversity.
- respondents' perceptions of what constitute the costs and benefits of climate change adaptation differed both in terms of indirect costs (monitoring, maintenance and management) and indirect benefits (improved business opportunities), as well as in consideration of the negative and positive effects on health, ecosystems and non-human species, illustrating that the assessment of the costs and benefits of climate adaptation measures is both a challenging and multifaceted task

Based on our study's findings, as well as the empirical and conceptual literature, we identified three tentative social justice dilemmas in the costs and benefits of physical climate change adaptations: 1. Distribution of costs and benefits of climate adaptation across scales; 2. the identification and valuation of non-market effects, and 3. the equitable allocation of costs and benefits. In conclusion, to avoid biasing decisions against particular social groupings or against ecosystems, and to consider the range of multifunctional co-benefits, adaptation strategies need to employ broad-based economic tools that include both direct and indirect non-monetary values. Furthermore, by conceptualising climate adaptation benefits beyond damage reduction, local practitioners may facilitate climate adaptation processes and also enhance the transition to a sustainable society, because new multifunctional co-benefits are likely to follow from such processes.



## Acknowledgements

We would like to thank The Swedish Meteorological and Hydrological Institute and The Swedish Research Council Formas, grant number 942-2015-106 for supporting this work.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work supporting is The Swedish Meteorological and Hydrological Institute and The Swedish Research Council Formas, [Grant Number 942-2015-106].

## ORCID

Therese Asplund  <http://orcid.org/0000-0001-5549-5897>

Mattias Hjerpe  <http://orcid.org/0000-0002-5500-3300>

## References

- Aall, C. 2012. "The Early Experiences of Local Climate Change Adaptation in Norwegian Compared with That of Local Environmental Policy, Local Agenda 21 and Local Climate Change Mitigation." *Local Environment* 17 (6–7): 579–595. doi:10.1080/13549839.2011.631992.
- Adger, N., S. Agrawala, M. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit, and K. Takahashi. 2007. "Assessment of Adaptation Practices, Options, Constraints and Capacity." In *Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of WG II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M. Parry, O. Canziani, J. Palutikof, P. van der Linden, and C. Hanson, 717–743. Cambridge: Cambridge University Press.
- Amundsen, H., F. Berglund, and H. Westskog. 2010. "Overcoming Barriers to Climate Change Adaptation—A Question of Multilevel Governance?" *Environment and Planning C: Government and Policy* 28 (2): 276–289. doi:10.1068/c0941.
- Anguelowski, I., and J. A. Carmin. 2011. "Something Borrowed, Everything New: Innovation and Institutionalization in Urban Climate Governance." *Current Opinion in Environmental Sustainability* 3 (3): 169–175. doi:10.1016/j.cosust.2010.12.017.
- Baker, I., A. Peterson, G. Brown, and C. McAlpine. 2012. "Local Government Response to the Impacts of Climate Change: An Evaluation of Local Climate Adaptation Plans." *Landscape and Urban Planning* 107 (2): 127–136. doi:10.1016/j.landurbplan.2012.05.009.
- Barnett, J., L. Evans, C. Gross, A. Kiem, R. Kingsford, J. Palutikof, C. Pickering, and S. Smithers. 2015. "From Barriers to Limits to Climate Change Adaptation: Path Dependency and the Speed of Change." *Ecology and Society* 20 (3): 5. doi:10.5751/ES-07698-200305.
- Bennett, N. J. 2018. "Navigating a Just and Inclusive Path Towards Sustainable Oceans." *Marine Policy* 97: 139–146. doi:10.1016/j.marpol.2018.06.001.
- Biesbroek, R., J. Klostermann, C. Termeer, and P. Kabat. 2013. "On the Nature of Barriers to Climate Change Adaptation." *Regional Environmental Change* 13 (5): 1119–1129. doi:10.1007/s10113-013-0421-y.
- Bosomworth, K. 2015. "Climate Change Adaptation in Public Policy: Frames, Fire Management, and Frame Reflection." *Environment and Planning C: Government and Policy* 33 (6): 1450–1466. doi:10.1177/0263774X15614138.
- Bouwer, L. M., E. Papyrakis, J. Poussin, and C. Pfurtscheller. 2014. "The Costing of Measures for Natural Hazard Mitigation in Europe." *Natural Hazards Review* 15 (4): 04014010. doi:10.1061/(ASCE)NH.1527-6996.0000133.
- Chambwera, M., G. Heal, C. Dubeux, S. Hallegatte, L. Leclerc, A. Markandya, B. A. McCarl, R. Mechler, and J. E. Neumann. 2014. "Economics of Adaptation." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, edited by C. B. Field, and V. R. Barros, 945–977. Cambridge, UK: Cambridge University Press.
- Chu, E., I. Anguelovski, and J. Carmin. 2016. "Inclusive Approaches to Urban Climate Adaptation Planning and Implementation in the Global South." *Climate Policy* 16 (3): 372–392. doi:10.1080/14693062.2015.1019822.
- Cooper, J. A. G., and J. McKenna. 2008. "Social Justice in Coastal Erosion Management: The Temporal and Spatial Dimensions." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 39 (1): 294–306. doi:10.1016/j.geoforum.2007.06.007.
- Dannevig, H., T. Rauken, and G. Hovelsrud. 2012. "Implementing Adaptation to Climate Change at the Local Level." *Local Environment* 17 (6–7): 597–611. doi:10.1080/13549839.2012.678317.



- Dupuis, J., and P. Knoepfel. 2013. "The Adaptation Policy Paradox: The Implementation Deficit of Policies Framed as Climate Change Adaptation." *Ecology and Society* 18 (4): 31. doi:10.5751/ES-05965-180431.
- Enarson, E. 2013. "Two Solitudes, Many Bridges, Big Tent: Women's Leadership in Climate and Disaster Risk Reduction." In *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, edited by M. Alston and K. Whittenbury, 63–74. Dordrecht: Springer.
- Eriksen, S., P. Aldunce, C. S. Bahinipati, R. D'Almeida Martins, J. I. Molefe, C. Nhemachena, K. O'Brien, et al. 2011. "When Not Every Response to Climate Change is a Good One: Identifying Principles for Sustainable Adaptation." *Climate and Development* 3: 7–20. doi:10.3763/cdev.2010.0060.
- Fankhauser, S. 2010. "The Costs of Adaptation." *Wiley Interdisciplinary Reviews: Climate Change* 1: 23–30. doi:10.1002/wcc.014.
- Füssel, H. M., S. Hallegatte, and M. Reder. 2012. "International Adaptation Funding." In *Climate Change, Justice and Sustainability: Linking Climate and Development Policy*, edited by O. Edenhofer, J. Wallacher, H. Lotze-Campen, M. Reder, B. Knopf, and J. Müller, 311–330. Heidelberg, Germany: Springer. doi:10.1007/978-94-007-4540-7\_29.
- Glaas, E., A. Jonsson, M. Hjerpe, and Y. Andersson-Sköld. 2010. "Managing Climate Change Vulnerabilities: Formal Institutions and Knowledge Use as Determinants of Adaptive Capacity at the Local Level in Sweden." *Local Environment* 15 (6): 525–539. doi:10.1080/13549839.2010.487525.
- Granberg, M., and I. Elander. 2007. "Local Governance and Climate Change: Reflections on the Swedish Experience." *Local Environment* 12 (5): 537–548. doi:10.1080/13549830701656911.
- Hjerpe, M., and E. Glaas. 2012. "Evolving Local Climate Adaptation Strategies: Incorporating Influences of Socio-Economic Stress." *Mitigation and Adaptation Strategies for Global Change* 17 (5): 471–486. doi:10.1007/s11027-011-9337-3.
- Hjerpe, M., S. Storbjörk, and J. Alberth. 2015. "'There is Nothing Political in it': On Barriers and Triggers of Political Momentum for Local Climate Adaptation." *Local Environment* 20 (8): 855–873.
- Hoang, T., and G. Pulliat. 2019. "Green for Whom? Exploring Ecotourism as a Climate-Adaptation Strategy in Trang An, Vietnam." In *Urban Climate Resilience in Southeast Asia*, edited by A. Daniere and M. Garschagen, 179–200. The Urban Book Series. Cham: Springer.
- IPCC. 2014. "Adaptation Needs and Options." In *Climate Change 2014: Impacts, Adaptation and Vulnerability*, edited by C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, et al., 833–868. Cambridge: Cambridge University Press.
- Juhola, S., E. Glaas, B.-O. Linnér, and T. Neset. 2016. "Redefining Maladaptation." *Environmental Science & Policy* 55: 135–140. doi:10.1016/j.envsci.2015.09.014.
- Juhola, S., S. Haanpää, and L. Peltonen. 2012. "Regional Challenges of Climate Change Adaptation in Finland: Examining the Ability to Adapt in the Absence of National Level Steering." *Local Environment* 17 (6–7): 629–639. doi:10.1080/13549839.2012.665860.
- Kim, H., D. W. Marcouiller, and K. M. Woosnam. 2018. "Rescaling Social Dynamics in Climate Change: The Implications of Cumulative Exposure, Climate Justice, and Community Resilience." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 96: 129–140. doi:10.1016/j.geoforum.2018.08.006.
- Li, J., M. Mullan, and J. Helgeson. 2014. "Improving the Practice of Economic Analysis of Climate Change Adaptation." *Journal of Benefit Cost Analysis* 5 (3): 445–467. doi:10.1515/jbca-2014-9004.
- Lund, D., K. Sehested, T. Hellesen, and V. Nellesmann. 2012. "Climate Change Adaptation in Denmark: Enhancement Through Collaboration and Meta-Governance?" *Local Environment* 17 (6–7): 613–628. doi:10.1080/13549839.2012.678318.
- Martens, K. 2006. "Basing Transport Planning on Principles of Social Justice." *Berkeley Planning Journal*, Department of City and Regional Planning, UC Berkeley.
- Messner, F., E. Penning-Rowsell, C. Green, V. Meyer, S. Tunstall, and A. van der Veen. 2007. "Evaluating Flood Damages: Guidance and Recommendations on Principles and Methods. EU-funded FLOODsite Project Deliverable D9.1." [http://www.floodsite.net/html/partner\\_area/project\\_docs/T09\\_06\\_01\\_Flood\\_damage\\_guidelines\\_D9\\_1\\_v2\\_2\\_p44.pdf](http://www.floodsite.net/html/partner_area/project_docs/T09_06_01_Flood_damage_guidelines_D9_1_v2_2_p44.pdf).
- Moser, S., and J. A. Ekstrom. 2012. "Identifying and Overcoming Barriers to Climate Change Adaptation in San Francisco Bay: Results from Case Studies." *California Energy Commission*. CEC-500-2012-034. <http://www.energy.ca.gov/2012publications/CEC-500-2012-034/CEC-500-2012-034.pdf>.
- MSB, Swedish Civil Contingencies Agency. 2013. Pluviala översvämningar. Konsekvenser vid skyfall över tätorter. En kunskapsöversikt. MSB 567:13. <https://www.msb.se/RibData/Filer/pdf/26609.pdf>.
- Neumann, J., and K. Strzepek. 2014. "State of the Literature on the Economic Impacts of Climate Change in the United States." *Journal of Benefit-Cost Analysis* 5 (3): 411–443. doi:10.1515/jbca-2014-9003Xx.
- Nilsson, A., Å Gerger Swartling, and K. Eckerberg. 2012. "Knowledge for Local Climate Change Adaptation in Sweden: Challenges of Multilevel Governance." *Local Environment* 17 (6–7): 751–767. doi:10.1080/13549839.2012.678316.
- Næss, L.-O., G. Bang, S. Eriksen, and J. Vevatne. 2005. "Institutional adaptation to climate change: flood responses at the municipal level in Norway." *Global Environmental Change* 15: 125–138.
- Nurse-Bray, M. 2017. "Towards Socially Just Adaptive Climate Governance: The Transformative Potential of Conflict." *Local Environment* 22 (2): 156–171. doi:10.1080/13549839.2016.1181618.
- Oberlack, C. 2017. "Diagnosing Institutional Barriers and Opportunities for Adaptation to Climate Change." *Mitigation and Adaptation Strategies for Global Change* 22: 805–838. doi:10.1007/s11027-015-9699-z.

- O'Brien, K., and R. Leichenko. 2003. "Winners and Losers in the Context of Global Change." *Annals of the Association of American Geographers* 93: 89–103. doi:10.1111/1467-8306.93107.
- OECD. 2008. "Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments." <http://www.oecd.org/env/cc/economicaspectsofadaptationtoclimatechangecostsbenefitsandpolicyinstruments.htm>.
- OECD. 2015. "Climate Change Risks and Adaptation: Linking Policy and Economics." OECD Publishing, Paris. doi:10.1787/9789264234611-en.
- Prior, J. 2013. "Community Engagement to Resolve Climate Adaptation Conflicts: Utilising Consensus-Building, Joint Fact-Finding Strategies and Cognitive Frames Analysis." In *Climate Adaptation Futures*, edited by J. P. Palutikof, et al., 167–176. Chichester, UK: Wiley-Blackwell.
- Rausch, M. 1998. "Analyzing and Reporting Focus Group Results." In *Analyzing & Reporting Focus Group Results*, edited by R. Krueger, 94–96. The Focus Group Kit, no 6. Thousand Oaks, CA: Sage.
- Root, L., E. van der Krabben, and T. Spit. 2015. "Bridging the Financial gap in Climate Adaptation: Dutch Planning and Land Development Through a new Institutional Lens." *Journal of Environmental Planning and Management* 58 (4): 701–718. doi:10.1080/09640568.2014.885412.
- Stern, N. 2006. "Stern Review: The Economics of Climate Change." United Kingdom.
- Storbjörk, S. 2007. "Governing Climate Adaptation in the Local Arena: Challenges of Risk Management and Planning in Sweden." *Local Environment* 12 (5): 457–469. doi:10.1080/13549830701656960.
- Sussman, F., N. Krishnan, K. Maher, R. Miller, C. Mack, P. Stewart, K. Shouse, and B. Perkins. 2014. "Climate Change Adaptation Cost in the US: What do we Know?" *Climate Policy* 14 (2): 242–282. doi:10.1080/14693062.2013.777604.
- Uittenbroek, C., L. Janssen-Jansen, and H. Runhaar. 2013. "Mainstreaming Climate Adaptation Into Urban Planning: Overcoming Barriers, Seizing Opportunities and Evaluating the Results in Two Dutch Case Studies." *Regional Environmental Change* 13: 399–411. doi:10.1007/s10113-012-0348-8.
- Van Bommel, S., and W. Kuindersma. 2009. Policy Integration, Coherence and Governance in Dutch Climate Policy. A Multi-level Analysis of Mitigation and Adaptation Policy. Wageningen, Alterra, Alterra-rapport 1799.
- Viguie, V., and S. Hallegatte. 2012. "Trade-offs and Synergies in Urban Climate Policies." *Nature Climate Change* 2: 334–337. doi:10.1038/NCLIMATE1434.
- Wamsler, C. 2018. "Mind the Gap: The Role of Mindfulness in Adapting to Increasing Risk and Climate Change." *Sustainability Science* 13 (4): 1121–1135. doi:10.1007/s11625-017-0524-3.
- Watkiss, P. 2015. "A Review of the Economics of Adaptation and Climate-Resilient Development." Centre for Climate Change Economics and Policy, Working Paper 231. <http://www.vfmadaptation.com/Working-Paper-205-Watkiss.pdf>.